Program SUC 2013-2016 P-2
„Scientific information:
Access, processing and safeguarding"

White Paper

for a Swiss Information Provisioning and Processing Infrastructure 2020

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Foreword

The "White Paper for a Swiss Information Provisioning and Processing Infrastructure 2020" was compiled in the first year of the funding period as the basis for implementing SUC P2. It documents the framework conditions for the program, describes the development of an implementation strategy over several stages and finally sets out the concrete measures that are to be supported during the funding period up to 2016. The White Paper forms the basis for preparing and evaluating project applications during this period.

In January 2014, an initial version of the White Paper underwent a consultation process that received a large number of responses despite the fact that participants only had two weeks to reply. The comments revealed that there is a great deal of interest in an initiative to promote the collaborative management of scientific information at universities and that this corresponds with the aims of many participating organizations. However, they also showed that the success of the program will depend to a large extent on whether the projects supported will be accepted quickly by most of the scientific community and will contribute toward forming a market of scientific information service providers and users. We are confident that the White Paper will help us with this task.

During the consultation, the White Paper was criticized as "unwieldy" and unsuitable for communication to a wider audience. The Steering Committee therefore presented the program's strategy to the Swiss University Conference in a shorter version with less technical language. The national strategy "Combining Efforts to Manage Scientific Information" was approved by the SUC on April 3. This is designed to make scientific information a domain in which Swiss universities meet requirements together in future instead of competing with one another. Targeted funding of collaborative projects should help to strengthen the Swiss scientific community's position in the face of international competition.

The Program Management and Steering Committee would like to take this opportunity to thank everyone who participated in the compilation of the White Paper and the development of the national strategy, sometimes under extreme time pressure. We hope that we can rely on further support during the implementation of this ambitious project.

The President of the Steering Committee:
Prof. Dr. Martin Täuber

April 2014

Contents

Figures

Tables

1 Introduction

The P-2 program, endowed with CHF 45 million by the Swiss University Conference (SUC), aims at creating a service network for the Swiss higher education sector that permits the seamless provisioning, handling and processing of information. The program runs from 2013 to 2016. This White Paper defines the implementation strategy for P-2.

1.1 Background

The continuous and rapid developments in the sphere of information and communication technologies are transforming the world of research and teaching. Digitization permeates every scientific field, with the result that new discoveries and breakthroughs in the world of research invariably require easy access to data and state-of-the-art technology.

Because of this, unrestricted access on the part of all Swiss higher education institutions to sources of scientific information is vital to the competitiveness of Swiss research and science in all disciplines. At the same time, collaboration between researchers and between institutions is gaining in importance as far as scientific work is concerned. Researchers need access to data held by other institutions, access to their own data from any location and the ability to exchange data through collaborations. Besides the rapid pace of technological progress and increasingly close collaboration between researchers and institutions, the exponential growth in the volume of data presents the Swiss scientific world with a major challenge.

From a provider's point of view, data storage media, content and IT resources have now become commodities that can be accessed from almost anywhere thanks to virtualization and Internet technologies. This means that the current organizational structure – whereby each university operates its own information provision and IT – is now outdated. The informatization of the "higher education business" since the 1980s, which has been turbulent at times, needs to be consolidated for the long term.

No one can map out the structure of the Swiss scientific world's information provision in the year 2020. Since tasks and expenses rise steadily and sometimes increase dramatically, a gradual reorganization is nevertheless required to enable the parties involved to divide up work more effectively. The creation of a national domain should allow them to make services more widely available and to work with better economies of scale.

The Swiss University Conference (SUC) has therefore launched Program P-2 (2013-2016): "Scientific information: access, processing and safeguarding" [PRG_P2-A]. The Rectors' Conference of the Swiss Universities (CRUS) has been tasked with carrying out the program. As stipulated in the Program Request, an implementation strategy for P-2 was developed in this White Paper in 2013.

1.2 Vision

The P-2 program envisions a future where academic needs for information handling and processing are seamlessly supported by a Swiss information provisioning and processing infrastructure that transcends the borders of individual institutions. The program shall strengthen Switzerland's reputation as a top location for education and research and as an attractive partner in international research collaboration.

1.3 Mission

The mission of the P-2 program is to combine and further develop the currently separate efforts to provide and process scientific information. The aim is to establish a reorganized system by the year 2020 that will provide researchers, teachers and students with an extensive range of science-related digital content and the optimum tools for processing it.

These services should feature availability on a national level, stability, flexibility and competitiveness. Through targeted funding, P-2 will initiate and control the development of this range of services and ensure its sustainable operation. The program will be based on the following principles and guidelines:

- Services will cover the entire life cycle of scientific information.
- Existing services will be used wherever possible. If necessary, these services will be expanded in order to provide a national service.
- Services can be provided centrally or using a decentralized system.
- The sustainability of services is of vital importance.
- Shared services will enable cost optimization.
- Only services which meet the needs of education and research will be implemented.
- Services are guided by national and international standards and best practices.
- Services are easy, intuitive, efficient and effective to use.
- Services will be made available through defined interfaces and standards in order that organizations can use them autonomously.
- Services are listed in a Service Catalog, which is centrally managed and made available in electronic form to all academic users.
- Services will be made available to all the organizations listed in section 1.5, and can therefore be used throughout Switzerland.
- There is central governance with clearly defined interfaces and standards.
- Legal constraints will be observed. Where the appropriate bases are missing, the program must initiate their creation.

Essential to the success of Program SUC P-2 is the implementation of appropriate cost control and financing mechanisms. Reorganization must include a shared understanding of who finances what. This requires roles to be clarified and implemented by 2020.

1.4 Sustainability

The funding of research at higher education institutions and universities is in a state of flux. The Federal Act on University Funding and Cooperation in the Field of University Education [UFG] currently applies to the university sector. The UFG is expected to be replaced by the Federal Act on the Funding and Coordination of the Higher Education Sector [HFKG] in 2015. It is likely that there will be a transitional period of several years prior to the new law taking effect. Unlike the UFG, the new HFKG also applies to universities of applied sciences.

The following two excerpts from the consultation version of the HFKG show that the new legislation is likely to have a bearing on the SUC P-2 program:

Article 3: *"With regard to collaboration in the higher education sphere, the Federal Government is pursuing the following objectives in particular: […]*
h. national coordination *and division of tasks in higher education policy in particularly cost-intensive areas. [...]"*

Article 47, Paragraph 3: *"The Federal Government may provide financial aid in the form of subsidies for the shared infrastructural facilities of higher education institutions and other institutions in the higher education sphere if the infrastructural facilities fulfill tasks of national relevance. These*

subsidies will not exceed 50 percent of operating expenditure." [HFKG]1

How and to what extent the HFKG will apply to this program must be addressed during the course of the program.

It is difficult to incorporate project-related funding into an ongoing operation or an ongoing budget. Consequently, financing instruments that are intended for new developments are in fact frequently used to plug gaps. A reorganization of information provision and IT as proposed by SUC P-2 therefore requires a shift from local service providers to national ones and scope for growth. SWITCH, and to a certain extent the Consortium of Swiss Academic Libraries, are examples of service providers with a national scope.

In addition to viable service providers and the cooperation of the universities, a sustainable range of services requires a dialog with the funding policy of the State Secretariat for Education, Research and Innovation SERI (2017-2020 Dispatch, update of the "Swiss Roadmap for Research Infrastructures", [SERI_RM]), the Swiss National Science Foundation SNSF (open access, open data) and the Swiss Academies of Arts and Sciences (e.g. SAHS data and service center).

1.5 Scope

The program prioritizes and supports projects that contribute toward coordinating scientific content and the relevant university infrastructure, making it available to other participants and developing it into national services. The White Paper determines the framework and direction of the planned activities during the period 2013-2016 and beyond.

The program can commission specific foundations in a targeted manner. The current commitments of the Consortium of Swiss Academic Libraries for licenses for electronic journals, databases and e-books will form the basis for this. However, when implementing its objectives, the program will primarily build on the local parties involved. The following institutions are invited to apply:

- The ten cantonal universities
- The Swiss federal institutes of technology and the four research institutes
- The seven public universities of applied sciences
- The institutions eligible for grants under the [UFG]
- The universities of teacher education
- The institutions as per Art. 15 of the [FIFG]

Institutions that provide services to the universities in one of the program's areas of implementation (e.g. the library associations) and institutions in which universities play a leading role (e.g. SWITCH or the Consortium of Swiss Academic Libraries) are also eligible to apply. Only applications from non-commercial institutions will be considered. Businesses can be included as project partners by those institutions eligible to make applications.

The program awards project-related grants from the Swiss Confederation to be used as start-up funding. An own funding contribution of 50% from the institution itself will usually be required (matching funds). Sustainability extending beyond the duration of the program will be one of the selection criteria. Each academic organization reserves the right to decide whether to use the services created in this way.

1.6 Similar initiatives abroad

Annex A, International efforts, contains a list of selected international projects which pursue similar aims to those of Program SUC P-2.

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[1] English is not an official language of the Swiss Confederation. This is a translation provided for information purposes only.

2   Program structure

For the White Paper, the seven fields of activity of the Program Request were again compared with the universities' requirements and projects. Using a model, the implementation strategy was then developed and the fields of activity gradually brought together to form an overall strategy. In order to expand the basis for the program, as many of the program's stakeholders as possible were involved in the strategy process.

2.1   Fields of activity

The request for Program SUC P-2 defines and describes in detail seven fields of activity [PRG_P2-A]:

Figure 1: Illustrative overview of the fields of activity

The following list highlights the content of the fields of activity:
- **Identity management**: An infrastructure for identity management at national level to ensure that students, teachers and researchers not only have access to data to which their current status entitles them, but also lifelong access to their personal data (certificates, diplomas, e-portfolio, research results, etc.).
- **Working environment**: Integration of different services in personalized and ergonomic virtual environments to support the work of researchers, teachers and students.
- **e-Publishing**: Licensing for electronic documents (current publications and "back-file archives"), digitization and presentation of historical documents, implementation of an open access policy.
- **e-Learning**: The infrastructure necessary for education based on electronic means, in particular mobile platforms, personal learning environments, e-portfolio, e-assessment and open educational resources.
- **Data management**: Access to, management, exchange and storage of research data and educational material (metadata, life-cycle data, permanent archiving).
- **Cloud computing**: A shared infrastructure made available with infrastructure as a service, and with software as a service to respond in a flexible manner to the massive needs for the processing and storage of data in all scientific disciplines.
- **National organization**: This field of activity creates a robust, structured organization for the program. The operational model permits the groundwork to be laid for a coherent strategy and the transition beyond the program to be well managed. It will also create a management framework which ensures that the different projects set up contribute towards this strategy and deliver the results expected by the scientific community. The national organization will ensure that it makes full use of all possible synergies to avoid duplication, and will pay particular attention to cost control. It will ensure the dissemination and outreach of the program, so that the scientific community is made aware of what it can offer.

2.2   Stakeholders (context diagram)

The various parties involved and stakeholders with regard to scientific information can be illustrated as a context diagram.
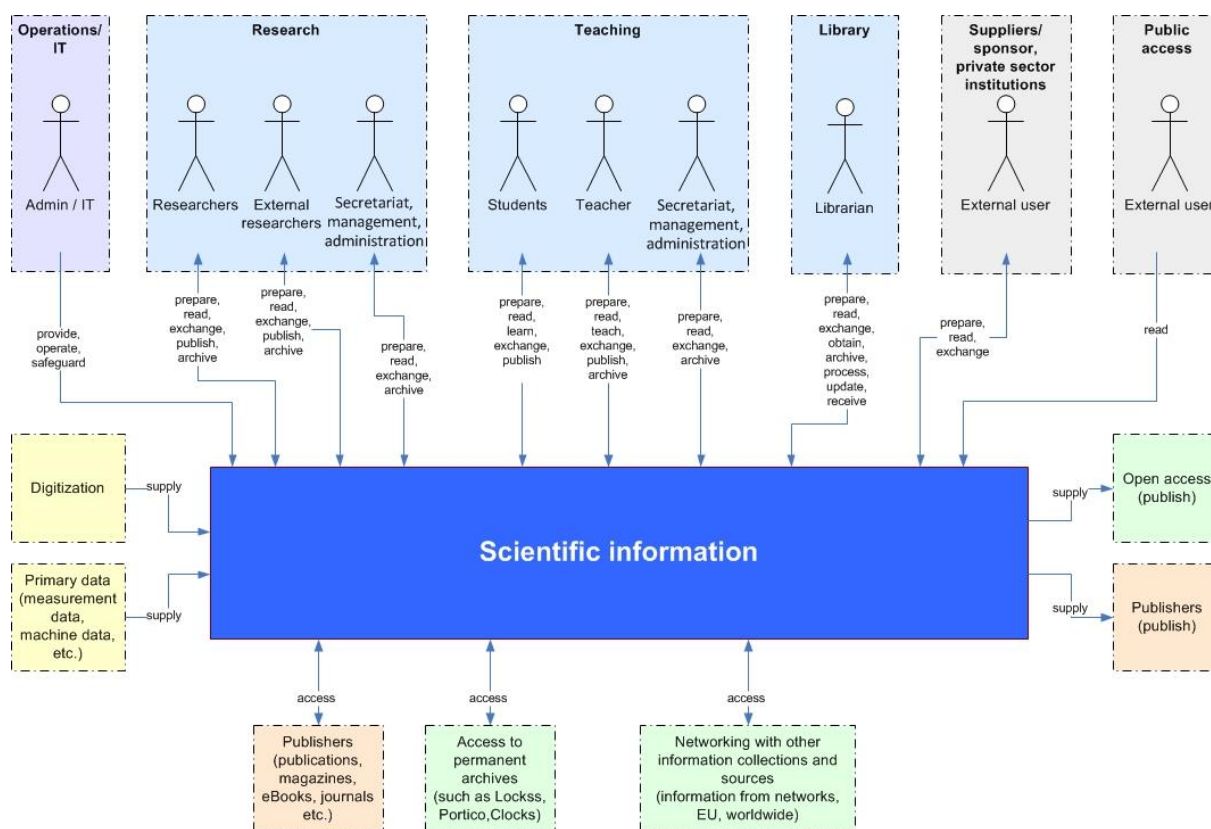
Figure 2: Stakeholders for scientific information (context diagram)

2.3   Strategy development

2.3.1   Phase 1 (Jan-Aug 2013): Requirements and solution architecture

In early 2013, the Steering Committee tasked a consulting team from IBM Schweiz AG with developing a strategy. With the help of the stakeholders, who had been identified in the program's development phase, contacts within the Swiss university network were identified for the fields of activity, with the exception of the national organization.

The contacts helped the consulting team to collate requirements from a user's perspective (use cases) and existing services with potential for development that corresponded to the intentions of SUC P-2 as specified in the Program Request. Around 159 people submitted a total of 269 use cases via the 13 people with responsibility for the fields of activity. The consulting team prepared the evaluation by July 31, 2013 in the document "Foundations for the Strategy" [PRG_P2-B].

2.3.2   Phase 2 (Aug-Dec 2013): Sub-strategies for each field of activity

To draft the White Paper, one strategy group made up of experts was appointed for each field of activity. When creating the groups, the Program Management selected the best possible balance of members on the basis of nominations by stakeholders and applications.

By October 11, 2013, each strategy group developed an implementation strategy for its own field of activity. The document "Foundations for the Strategy" served as input, in particular the architecture with function blocks and national services proposed by the consulting team (cf. chapter 3). The sub-

strategies for identity management, working environment, e-publishing, e-learning, data management and cloud computing were structured according to a standard template.

The sub-strategy for the national organization was developed separately under the supervision of the Program Management. The sub-strategy sets the guidelines for the development of the Program Organization into a permanant organization. A national organization is intended to take over program activities from 2017 onwards. The sub-strategies for all seven fields of activity can be found in Annex D.

The Program Management was responsible for evaluating the sub-strategies from an overall perspective and for drawing up the White Paper. Section 4 summarizes the sub-strategies, shows the dependencies and makes resultant recommendations for the implementation of the program. In the first instance, the SUC P-2 Steering Committee will comment on the validity of these guidelines, followed by the CRUS and finally the SUC.

2.4 Program implementation (2014-2016)

In 2014, the Steering Committee and the Program Management will continue to fulfill their functions for the remainder of the program. In addition, an Expert Panel has been set up in order to evaluate project proposals and assess the professional requirements. In order to realize the actual implementation projects, the Program Management will implement a project management procedure.

The implementation projects entail the implementation of services, the creation of an operational structure and the definition of expert groups to realize solutions. The service providers that are responsible for operating the services created will be incorporated in the organization of the program. How they will be incorporated has yet to be finalized and depends in particular on the future operational model.

3   Architecture

During strategy building phase 1, the consulting team studied the use cases submitted by the community. Requirements were identified and transferred into a functional architecture. The individual function blocks were described and the main requirements specified. This resulted in a so-called "functional architecture" which was used to define a generic service architecture for potential national services.

The service architecture and the underlying function blocks were described in detail in "Foundations for the strategy" [PRG_P2-B].

3.1   Functional architecture

An overview of the functional architecture grouped by fields of activity is shown in graphical form below.
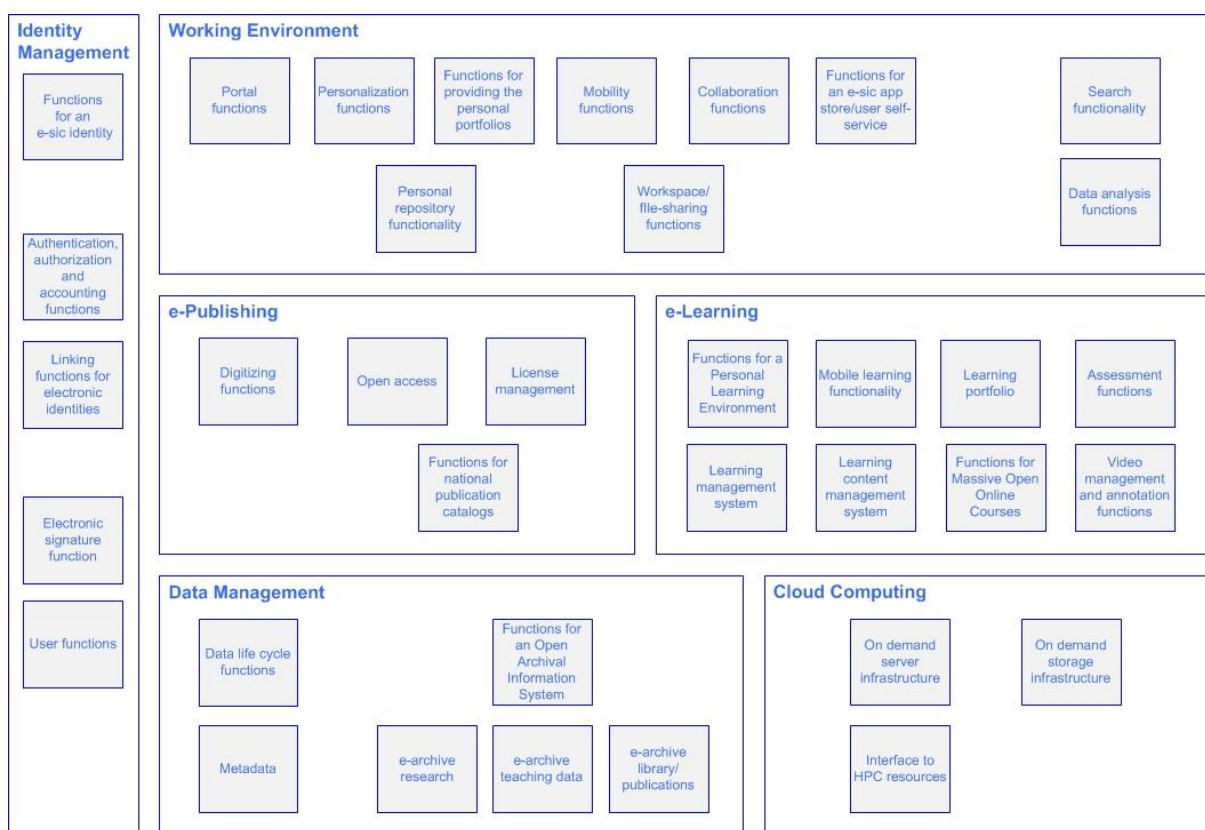
Figure 3: Functional architecture

The function blocks shown here describe functions and tasks relating to information in the scientific environment. They were used to structure the requirements which form the basis for national services.

(The function blocks are not numbered in order of priority.)

Identity Management	
No.	**Function block**
F-IM-1	Functions for an e-sic identity
F-IM-2	Authentication, authorization and accounting functions
F-IM-3	Linking functions for electronic identities
F-IM-4	Electronic signature function
F-IM-5	User functions
Working Environment	
No.	**Function block**
F-WE-1	Portal functions
F-WE-2	Personalization functions
F-WE-3	Functions for providing the personal portfolios
F-WE-4	Mobility functions
F-WE-5	Collaboration functions (wikis, calendar, mail, e-meetings, social networking)
F-WE-6	Functions for an e-sic app store/user self-service (SaaS, Software as a Service)
F-WE-7	Personal repository functionality
F-WE-8	Workspace/file-sharing functions
F-WE-9	Search functionality
F-WE-10	Data analysis functions
e-Publishing	
No.	**Function block**
F-eP-1	Digitizing functions
F-eP-2	Open access
F-eP-3	License management
F-eP-4	Functions for national publication catalogs
e-Learning	
No.	**Function block**
F-eL-1	Functions for a Personal Learning Environment (PLE)
F-eL-2	Mobile learning functionality
F-eL-3	Learning portfolio (training catalog)
F-eL-4	Assessment functions
F-eL-5	Learning management system (admin)
F-eL-6	Learning content management system (content and storage)
F-eL-7	Functions for Massive Open Online Courses (MOOC)
F-eL-8	Video management and annotation functions
Data Management	
No.	**Function block**
F-DM-1	Data life cycle functions
F-DM-2	Metadata
F-DM-3	Functions for an Open Archival Information System (OAIS)
F-DM-4	e-archive research
F-DM-5	e-archive teaching data
F-DM-6	e-archive library/publications
Cloud Computing	
No.	**Function block**
F-CC-1	On demand server infrastructure (IaaS, Infrastructure as a Service)
F-CC-2	On demand storage infrastructure (IaaS, Infrastructure as a Service)
F-CC-3	Interface for HPC resources (high performance computing)

Table 1: List of the function blocks

3.2   Service architecture

The service architecture based on the focus of SUC P-2 (vision, strategy, top-down perspective) was developed by the consulting team to act as the reference and the long-term foundation for developing and managing the service portfolio from a user's point of view.

The service architecture defined the following 17 services that could potentially be developed into national services.

National services	
No.	**Service name**
S-1	Electronic identity
S-2	Portfolio (career, degrees, training courses, own publications, etc.)
S-3	Support for online cooperation
S-4	Personal repository (personal data)
S-5	Repository and use of shared data (papers, projects, etc.)
S-6	Service catalog and self-service for online services (hardware/software/tools)
S-7	Support for publishing papers
S-8	Managing and providing online publications (licenses, open access)
S-9	Digitizing collections (publications, images, maps, cultural heritage, etc.)
S-10	Maintaining digital collections (publications, images, videos, maps, cultural heritage, etc.)
S-11	Archiving data (primary, secondary, projects, etc.)
S-12	Access to digital collections (publications, images, videos, maps, cultural heritage, etc.)
S-13	Access to temporary computer resources
S-14	Access to temporary storage resources
S-15	Online examinations
S-16	Online knowledge transfer
S-17	Managing and providing online learning content

Table 2: List of national services (not numbered in order of priority)

3.3   Relationship between the national services and the function blocks

A national service consists of several function blocks. A function block can be used for more than one national service. The following matrix shows the function blocks that each national service consists of.

Function blocks		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15	S-16	S-17
Identity Management																		
F-IM-1	Functions for an e-sic identity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
F-IM-2	Authentication, authorization and accounting functions	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X
F-IM-3	Linking functions for electronic identities	X		X		X	X	X					X				X	X
F-IM-4	Electronic signature function		X			X										X		
F-IM-5	User functions			X									X	X	X	X	X	

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Working Environment																
F-WE-1	Portal functions						X	X	X		X		X	X	X	X
F-WE-2	Personalization functions	X		X		X									X	X
F-WE-3	Functions for providing the personal portfolios		X	X	X						X					
F-WE-4	Mobility functions	X				X									X	X
F-WE-5	Collaboration functions (wikis, calendar, mail, e-meetings, social networking)		X		X							X				X
F-WE-6	Functions for an e-sic app store/user self-service (SaaS, Software as a Service)					X							X	X		X
F-WE-7	Personal repository functionality			X												
F-WE-8	Workspace/file-sharing functions		X		X							X				
F-WE-9	Search functionality		X	X							X					
F-WE-10	Data analysis functions										X					
e-Publishing																
F-eP-1	Digitizing functions								X							
F-eP-2	Open access						X	X		X	X					
F-eP-3	License management						X	X			X					
F-eP-4	Functions for national publication catalogs						X	X	X	X	X					
e-Learning																
F-eL-1	Functions for a Personal Learning Environment (PLE)														X	X
F-eL-2	Mobile learning functionality														X	X
F-eL-3	Learning portfolio (training catalog)														X	
F-eL-4	Assessment functions													X		
F-eL-5	Learning management system (admin)													X		X
F-eL-6	Learning content management system (content and storage)														X	X
F-eL-7	Functions for Massive Open Online Courses (MOOC)													X	X	X
F-eL-8	Video management and annotation functions													X	X	X
Data Management																
F-DM-1	Data life cycle functions		X		X					X	X					
F-DM-2	Metadata				X		X		X	X	X					
F-DM-3	Functions for an Open Archival Information System (OAIS)									X	X					
F-DM-4	e-archive research	(X)1								X	(X)2					
F-DM-5	e-archive teaching data	(X)1								X	(X)2			X	X	X
F-DM-6	e-archive library/publications	(X)1					X	X	X	X	X	(X)2				
Cloud Computing																
F-CC-1	On demand server infrastructure (IaaS, Infrastructure as a Service)											X				
F-CC-2	On demand storage infrastructure (IaaS, Infrastructure as a Service)												X			
F-CC-3	Interface to HPC resources (high performance computing)											X				

Legend:

X   Function blocks required for the service (Current status from Strategy Phase 1. Modifications may be made when the services are defined in more detail in Strategy Phase 2)

(X)1   Link to data in the archives

(X)2   Read access to data in the archives

Table 3: Matrix showing national services and function blocks

On the one hand, the matrix shows which function blocks are used in each service, and on the other hand it highlights the dependencies when one function block appears in several services. The matrix was used as the basis for developing the services in more detail during strategy building (Phase 2) in order to meet the requirements for an integrated service landscape.

3.4   Input to the strategy groups

The strategy groups had the task of developing sub-strategies for each field of activity based on the proposed service architecture. Each strategy group was allocated the services that were most closely aligned with the specialist focus of the respective field of activity.

Figure 4 shows the allocation of the services to the strategy groups or fields of activity.
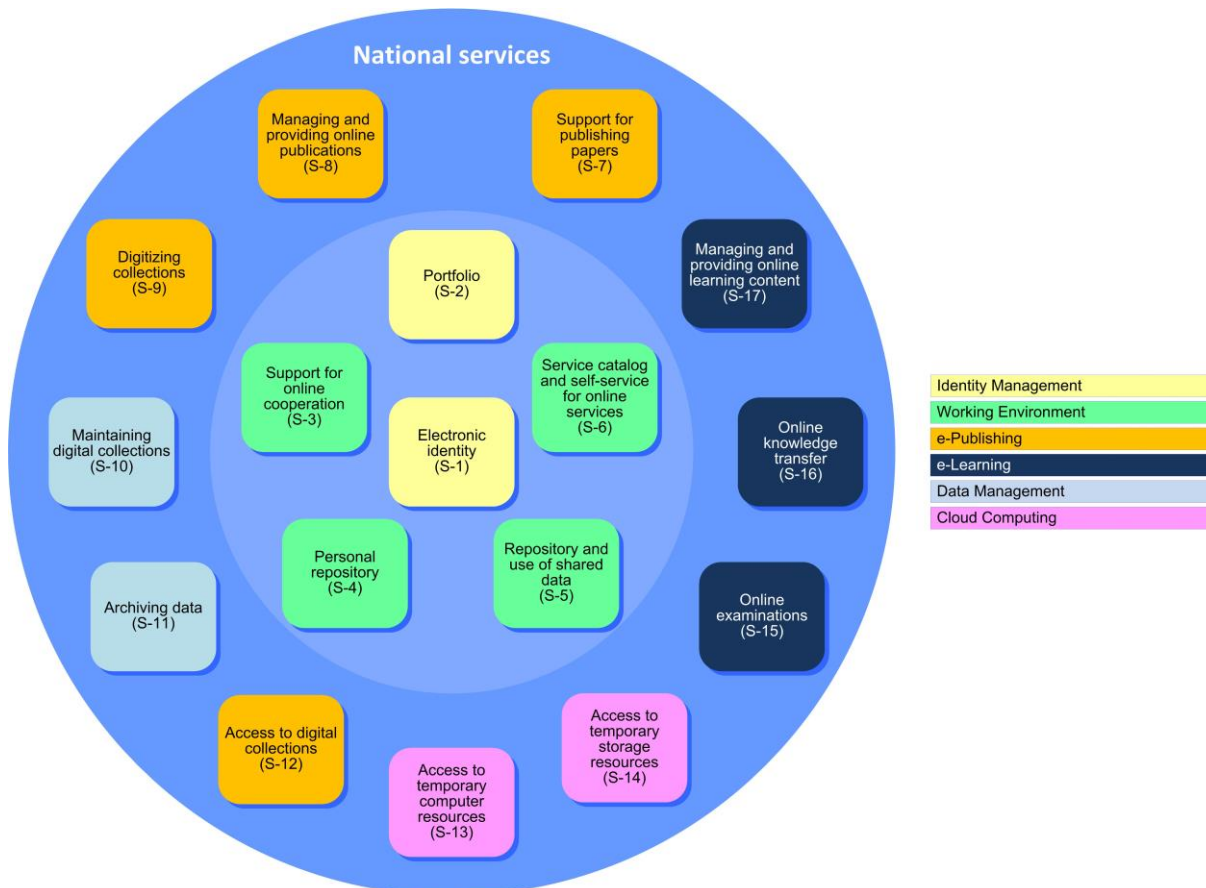
Figure 4: Attribution of National Services to strategy groups

The allocation of the national services to the various fields of activity is a simplification; in reality, there are numerous cross-references between the services. The strategy groups therefore also had to deal with interfaces and overlaps. The aim was to develop implementation strategies that were as appropriate to the project as possible.

The sub-strategy for the national organization was developed outside of the function blocks.

4   Strategy

The main part of the chapter is dedicated to the sub-strategies for identity management, working environment, e-publishing, e-learning, data management and cloud computing. In each sub-chapter, the corresponding sub-strategy is summarized and the proposed implementation actions are presented. There then follows an assessment of these measures from the perspective of the program, according to the following viewpoints:

- technology
- legal issues
- organization
- finances
- recommendations for the choice of projects

The funding recommendations for projects until 2016 are formulated on this basis.

Chapter 4.7 explains the guidelines for a future national organization (operating model) in an independent structure.

4.1   Identity Management

4.1.1   National services included

- S-1 Electronic identity
- (S-2 Portfolio)

4.1.2   Summary of the sub-strategy

Scientific information is produced and used by individuals. In order to provide better support for producers and users of scientific information in future, the sub-strategy proposes a paradigm shift. In a project entitled "Swiss edu-ID", the well-established, federated identity management system for Swiss higher education institutions, SWITCHaai, will be developed from an organization-centric to a user-centric approach. On the basis of the technical standards of SWITCHaai, the aim of the Swiss edu-ID project is to overcome the problems with the current solution in a university environment that is characterized by lifelong learning and the mobility of staff and students:

- identity management linked to an affiliation with one single organization,
- missing support for aggregating attributes from multiple sources,
- inability to deal properly with people with no or multiple affiliations,
- weaknesses when serving non-web-resources or supporting mobile environments.

In a nutshell: User-centrism is the paradigm of the Swiss edu-ID and will replace the primary-organization-centric approach of today's SWITCHaai. When Swiss edu-ID is rolled out, identity management support will continue when individuals leave university, and will still be available should they return to university, e.g. for continued education. In addition, the identity management system will support people who do not belong to a higher education institution but who use its services.

4.1.3   **Cross references to other fields of activity**

The following requirements for the Identity Management sub-strategy have been added or highlighted in other sub-strategies:

S-2 Portfolio

The S-2 (portfolio) sub-strategy is restricted to offering a lifelong identity as a prerequisite for the portfolio. The e-Learning strategy group has identified the portfolio as an action item.

Application

Identity management services act as enablers for services in other fields of action. They only add value when used in a pervasive manner by services in other fields. Swiss edu-ID will host and convey information about individuals between attribute providers and service providers using appropriate interfaces. The list of attributes and interfaces needs to be backed by clear needs and is subject to periodic review, taking into account benefits and provisioning cost. This boils down to the following elements:

- attribute requirements, benefits and provisioning cost
- interface requirements, benefits and provisioning cost
- services requiring identity management, currently not well served by SWITCHaai

The Identity Management strategy group's view is shared by other sub-strategies. The Working Environment sub-strategy emphasizes that the services on a future service platform can only be accessed by single-sign-on authentication mechanisms that make up part of the identity management function. The Cloud Computing sub-strategy also identifies the need to develop new identity management solutions in close cooperation with specific applications.

Persistence and interoperability of personal IDs

The following fields of activity specify the persistence of personal IDs as a requirement: e-Publishing (for the link to author identification), e-Learning (for e-portfolio services in the context of lifelong learning) and Data Management (persistence of people beyond their membership of a specific organization and in an international environment). The Cloud Computing field calls for it to be applied to loosely affiliated individuals in cooperation projects with universities and companies in an international context (inter-federation). The identity management service should link to relevant social identities (ORCID, Google, etc.).

People as originators

The e-Publishing and Data Management fields of activity propose linking identity management with author identification. In the context of the potential applications in the fields of research, bibliometrics and research evaluation, linking people with their scientific output (publications and research data) is of interest. The disambiguation of people to allow publications to be allocated unambiguously is a routine task in libraries. The use of standards such as Open Researcher and Contributor ID (ORCID) or ISNI and the comparison with authority files such as GND or RAMEAU could lead to significant increases in efficiency. This requires the identities of deceased or fictitious people to be taken into consideration.

Process support

For seamless use of cloud computing services, it must be possible to use identities for authentication and authorization in non-Web contexts, such as access to REST APIs, to control access to compute and storage resources via common login and storage protocols.

A major development issue exists when it comes to handling access restrictions and differentiated authorizations. These can apply for the use of resources during data processing or when access to certain data is requested and needs to be granted on a user's identification. Existing authentication and authorization mechanisms like SWITCHaai might not work, e.g. on the UNIX level. In the context of data management, identity management must support system-to-system communication and be

able to make use of information provided on group membership by a "trusted" institution.

In order to enable easy activation of services to all members of Swiss academia, cloud computing should be able to access identities and attributes from identity management services as required for accounting. Identity should also support the security context at the organization, groups, and group levels as provided by participating institutions.

4.1.4   Recommendations for action from the strategy group (action items)

The Identity Management sub-strategy proposes the following action items:

1. Description of the high-level architecture of a Swiss edu-ID service (with an emphasis on those elements that extend the existing SWITCHaai service or deviate from it)
2. Attribute specification for user-centric identity management
3. Exploration of Swiss edu-ID interface extensions
4. Swiss edu-ID V0.5 (making available a first version as a generic identity management backend for services)
5. Swiss edu-ID V1.0 (user self-registration)
6. Exploration of legal and trust framework (in preparation for serving multiple attribute providers)
7. Swiss edu-ID V2.0 (extension adding external attribute authorities)

The sub-strategy was developed in close cooperation with SWITCH and represents an initial implementation plan for the development of a Swiss edu-ID. The action items in the sub-strategy form the development phases of the proposed solution.

4.1.5   Recommendations for implementation

Technology

SWITCHaai is primarily designed to support scenarios where individuals behind a web browser are accessing web-based resources. Serving non-web resources and supporting mobile environments in an effective way require extensions and likely also architectural changes. Conceptual work and service prototyping is needed in this area.

A common language needs to be defined in order to be able to move identity management from the organization with which the user is primarily affiliated to a neutral provider. This language describes the participants and processes (identities, roles, profiles) in identity management (see the sub-strategy for more information on interfaces and standards).

The main risk involved is the heavy dependency of the proposed solution on a unique identifier. Priority must be given to evaluating the long-term future and the feasibility of this approach. It is important that support is provided for a multi-ID world with pseudonyms and weak names, which allows for application-specific namespaces and permission assignments (groups, systems, services).

Legal issues

Existing user-centric approaches without organizational backing currently lack important trust properties (e.g. social media platforms, OpenID). But once important players start using them, they might become very important and add value to our community.

Establishing a mandatory framework for the rights and duties of everyone involved represents a major challenge for the Swiss edu-ID. The sub-strategy plans to allow users to register themselves and to give users an overview of, and control over, their attributes at all times.

Organization

The strategy group is not aware of operational services elsewhere which could serve as a blueprint for the proposed solution. The innovative nature of the project requires effective networking with international developments and standards, as the strategy group proposes. Another factor that will

determine its success is the interaction with other SUC P-2 projects. For this purpose, an advisory board is needed to support and promote the project. The aim is to counteract one of the risks involved in the Swiss edu-ID, which is the failure to agree on a high-level architecture.

SWITCH has been operating the central parts of SWITCHaai since its inception. Due to its ability to provide reasonably "neutral ground" and its being tightly rooted in Switzerland's research and education community, SWITCH is well positioned to assume the role as the operator of the "Swiss edu-ID."

Finances

The program is based on the assumption that SWITCH will make a substantial financial contribution to the development of the solution.

Recommendations for the choice of projects

The development of a Swiss edu-ID based on SWITCHaai is a key factor in achieving the program objectives. The Swiss edu-ID should support a multi-ID approach. This can be defined by surveying the process landscape from the perspective of organizations, service providers and users.

The following aspects should be funded:

IM-1	SWITCH is invited to submit a project application for the development of the Swiss edu-ID on the basis of the Identity Management sub-strategy. The application must: a) take into consideration the requirements presented by the other fields of activity b) propose a well-supported advisory board c) include a business plan for the operation of a Swiss edu-ID d) justify the subsidy that has been applied for and the proposed own funding (the subsidy and the own funding must be kept separate, taking into consideration the business plan for operation).
IM-2	Pilot applications for linking community identifiers (such as ORCID) with identity management.
IM-3	The development of systems which allow for the authentication and authorization of non-web resources via the interface to the Swiss edu-ID.

Table 4: Funding recommendations for Identity Management

4.2   Working Environment

4.2.1   National services included

- S-3 Support for online cooperation
- S-4 Personal repository
- S-5 Repository and use of shared data
- S-6 Service catalog and self-service for online services

4.2.2   Summary of the sub-strategy

The Working Environment sub-strategy proposes an architecture which is comparable with the component-based management interface of a smartphone. Users have a web-based cockpit or dashboard as their single point of access from which they can survey, summarize, manage and operate all the available services. In contrast to a comprehensive portal which includes all the services in a complete and standardized, integrated form, these services represent modular components of a management interface with a design that can be personalized or modified as required. They can be integrated flexibly using predefined, standardized interfaces (APIs) to meet the relevant requirements. The working environment supports inter-institutional cooperation on an international level and gives access to all the available scientific information.

Alongside the web interface for the use of the services, a development platform will provide the available modules and interfaces. If necessary, an execution platform will also be offered. The working environment will be accessed using identity management.

In order to guarantee maximum user acceptance, during the design of the services and the working environment the focus must be on usability and ease of use from mobile devices. A clearing house is responsible for approving new components.

4.2.3   Cross references to other fields of activity

The following requirements have been added or highlighted in other sub-strategies:

Metadata processing/search

The e-publishing strategy group has stated that metadata harvesting via standardized interfaces, a full-text search function and links between author identifiers (such as ORCID) and object identifiers (such as DOI) are needed for the search solutions for e-publishing content, bibliometrics solutions and data mining.

e-Portfolio

In connection with a personal portfolio service, Data Management suggests the analysis of requirements and possible consequences for institutional repositories. Repositories could be a source for the compilation of personal publication lists. Subsequently, the implementation of interfaces between existing publication, e-learning, teaching and administrative tools should be supported.

Personalized environment

E-learning wishes to combine efforts in the domain of personal learning environments (PLE) vs. "personalized environments" as well as in efforts to support mobile functionality.

Service platform

Close cooperation with the program management team is needed to develop the service platform. This is the central tool in the future operational structure which will define the guidelines and interfaces and act as a clearing house. In this context the service platform is the technical aspect of the more comprehensive definition in the national organization sub-strategy.

4.2.4   Recommendations for action from the strategy group (action items)

Introductory note: The numbering of the strategy group's action items corresponds to the numbering of the function blocks. The sequence (non-sequential numbers) was chosen by the strategy group and has been retained for referencing purposes.

WE-1 Service platform:
- *WE-1-1 Interface definition:* The objective of this action item is to define an interface for the service catalog. Services can then register with the catalog via this interface. Each service sends the information needed by the catalog for the presentation of the service using the interface.
- *WE-1-2 Managing access rights:* A suitable personalization function and authentication options are needed to access the applications, for example in order to set up individual services or profiles.
- *WE-1-3 Group administration:* Services that cannot process group information must be equipped to do so. A central service has been proposed to cover all aspects of group and role administration.

WE-5 Collaboration support:
- *WE-5-1 Working scenarios:* The purpose of the collaboration service is to make it easier, as far as possible, for users to create a group. The aim is to define the most important working scenarios and to integrate them into the cockpit.

WE-6 Service shop & license store:
- *WE-6-1 Development platform:* Creation and validation of online services and apps.
- *WE-6-2 Execution platform:* Access to and execution of online services and apps.
- *WE-6-3 Shop platform:* Shop platform for the available services and apps.

WE-2 Personalized environment:
- *WE-2-1 Cockpit:* Overview page for personal events. The cockpit includes a page which displays relevant information for users in a concise and clearly understandable way.

WE-3: Individual portfolio:
- *WE-3-1 Incorporation into the personal working environment:* Users must be able not only to display and edit their personal data in the cockpit, but also to determine which information should be publicly available.
- *WE-3-2 Links with existing personal websites*

WE-4: Functions for mobility:
- *WE-4-1 Access anywhere:* Enabling access to national services from any location and any device. A support desk should be set up to provide the developers of national services with support in defining and implementing their mobile strategy.

WE-7, 8: Personal & shared storage:
- *WE-7, 8-1 Data workflow service:* Creating a working environment for the domain-agnostic (in other words *non*-domain-specific) workflow in data management and research data management.

WE-9: Search:

- *WE-9-1 Defining and analyzing the information sources to be searched:* Defining and analyzing the sources internal and external to the organization which form the operational basis for the search functionality referred to here. For each source:
  - the organization of the content (structure, metadata etc.) and the type of documents and objects (for example, classical scientific publications, multimedia objects) must be analyzed and
  - the document and object procurement process, for example using robots/crawlers/harvesters, OAI-PMH or direct interfaces to databases and repositories, must be defined.

- *WE-9-2 Creating the search index:* The possible structure and creation of the index for the search function is defined on the basis of the results of action item WE-9-1. The index is created by:
  - Accessing the documents automatically (alongside standard methods of automatic indexing and, where appropriate, taking into consideration metadata schemes such as Dublin Core or MARC, semantic clustering) and/or
  - Using a federated search that involves aggregating existing indices.
- *WE-9-3 Designing and implementing the search interface:* The search interface is developed on the basis of the current status of the search functions.

WE-10: Data analysis:

- *WE-10-1: Integrating the data analysis functionality:* Developing a modular architecture which allows for the inclusion of domain-specific analysis modules on the basis of metadata and the content type of files and data flows.
- *WE-10-2: Domain-independent modules* (inter-domain data analysis functions for textual data, such as publications, reports, working papers etc.)
- *WE-10-3: Domain-specific modules* (evaluating domain-specific data and data flows, for example from the fields of bioinformatics, bioimaging, data mining and grid computing).

4.2.5   **Recommendations for implementation**

Technology

The action items describe the development of a service platform which will integrate and offer a comprehensive selection of services. However, first of all certain fundamental principles need to be defined in other fields of activity. Standard products will be used as the tools that have been proposed for supporting cooperation and for the personal work environment etc.

A suitable software platform based on available services must be evaluated for the component-based management interface. After this, interfaces and guidelines must be defined which allow services to be integrated into this platform. The objective is to provide an open platform that enables any services (apps) to be incorporated without problems, including those which have not been financed by the program.

One key component is a search solution that meets the requirements of scientific searches and, as a new feature, is able to index research data and the accompanying metadata. This solution is of central importance for accessing the scientific data.

Legal issues

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Organization

The SUC P-2 services are managed in the working environment and made visible and accessible to external users. The developments in this area are closely related to the design of the service platform in the national organization field of activity and of the working environment and communication

platform of SUC P-2. The relative lack of references by other sub-strategies to the Working Environment field of activity indicates that a number of questions relating to the implementation remain open.

Finances

Because integration in a working environment is to be a component of the individual projects, the program application does not envisage a separate budget [PRG_P2-A]. The assumption is that all projects in the fields of activity which make use of the platform will be implemented. However, separate budget items must be created for financing the requirements specification, evaluation, commissioning and operation of a service platform.

Recommendations for the choice of projects

We are of the opinion that the establishment of a (new) service platform will only prove useful if the relevant services are available. Existing software platforms, such as those used for e-lib.ch, SWITCHtoolbox, Cloudstore, app stores etc., and commercial products, such as SharePoint, Confluence and Open Science Framework, must be evaluated. Once the need for a platform has been demonstrated, the platform can be implemented.

The integration or implementation of services for the service platform will as a rule only be supported if it increases the number of local services and meets a national need. Many of the proposed action items only make sense if the service portal brings together a critical mass of national services (service shop, personalized work environment etc.).

The following aspects should be funded:

WE-1	Service platform:
	    a) Requirements specification and evaluation of a software platform for the management interface
	    b) Definition of a standard for the inclusion and management of the services
	    c) Establishing the interfaces and guidelines.

WE-2	Specification and implementation of a search solution for scientific publications and research data with a metadata hub and search engine, preferably as an extension to an existing solution.
WE-3	Specification and implementation of a group administration system which supports digital rights management and the administration of roles and subgroups, together with working scenarios. The solution provides interfaces that allow other services to use the group administration system. (WE-3 depends on the availability of a new identity management solution and requires close cooperation.)
WE-4	If required: Creation of the development and execution platform. (It is essential that WE-4 is based on WE-1.)
WE-5	If required: Creation of a personalized working environment with a cockpit that gives access to services and information.
WE-6	If required: Integration of services which support cooperation (collaborative functions) and data management (lifecycle management, reuse of research data).
WE-7	If required: Creation of a self-registration function for the service catalog.

Table 5: Funding recommendations for the Working Environment

4.3   E-Publishing

4.3.1   National services included

- S-7 Support for publishing papers
- S-8 Managing and providing online publications
- S-9 Digitizing collections
- S-12 Access to digital collections

4.3.2   Summary of the sub-strategy

At the heart of the e-Publishing sub-strategy is the provision of content or, more precisely, of scientific publications during the transition from the analog to the digital age. By extending licenses, funding open access and linking publication and research data, the aim is to make more scientific content available to a wider range of users. The digitization of content which has previously only been available in analog formats must be extended. Key factors in the processing and visibility of this content include the efficient generation, interoperability and long-term storage of standardized metadata.

There does not seem to be a need for completely new technical solutions in this field of activity. However, services which have previously had a local focus should be networked via open interfaces and standardized metadata and opened up to other services (including a national service portal, but also direct applications within research). Therefore, the need for innovation relates more closely to new forms of organization, cooperative business models and the implementation of new functions, standards and interfaces. A central metadata hub will relieve the burden on the various data providers (repositories, online platforms) and make the data easier to reuse by grouping them together. The creation of new forms of organization, policies and evaluation models and also the funding of open access require the involvement of major stakeholders in the field of research policy, such as the Swiss University Conference (SUC), the Rectors' Conference of the Swiss Universities (CRUS), the Swiss National Science Foundation (SNSF) and the Swiss Academies of Arts and Sciences.

4.3.3   Cross references to other fields of activity

The following requirements for e-publishing have been added or highlighted in other sub-strategies:

Metadata harvesting and management

There are two specific interfaces to the Working Environment field of activity. Searches for scientific content will be carried out by indexing the e-publishing document space. In contrast, e-publishing is the end point of the data management workflow (data citation and data publication). In this area, data sets with persistent identifiers will be fed into the e-publishing document space. Collaboration with cloud computing will be critical where use cases combine service hosting and data processing.

Copyright

The e-Learning field of activity requires a joint approach to resolving copyright issues. This includes offering advice on the publication of teaching materials (open educational resources or OER) and the provision of e-books.

Open access

While data management issues are closely related to technical challenges and implementation, it is expected that the Open Access subgroup of e-publishing will complement this by focusing on issues of policies and guidelines for Open Access. Experience shows that even comfortable repositories will only see limited adoption if awareness, incentives and mandates are missing.

Long-term preservation

In the case of long-term preservation, the requirements of the Data Management field of activity overlap with the e-publishing sub-strategy. If national licenses will be acquired as part of the program, the concerned parties must define the requirements for a national hosting of the acquired content and for its long-term preservation. Only afterwards can reasonable solutions be implemented. There already is a need to preserve content from digitization projects. Such projects should include a perspective for preservation right from the start, building on existing and emerging long-term preservation solutions. E-publishing proposes building on the existing approaches and, for example, in the case of funding for national licenses, extending the framework agreements between the Consortium of Swiss Academic Libraries and LOCKSS and Portico to cover other libraries.

Interfaces and standards

The following interfaces and standards are required:
- For portals, research projects (for example in the digital humanities) and information systems (SNSF P3, universities, the European Research Council – OpenAIRE, ArXiv, PubMed), primarily OAI-PMH, the REST interface, the use of linked open data (LOD).
- APIs for search functions: SRU, SPARQL.
- Metadata compatibility in repositories and online platforms for digital objects: MARCXML, METS, MODS, OAI_DC.
- Metadata standards:
  - Semantics (open access (OA) status, project information, author identification)
  - Format (Dublin Core, CERIF, MODS, LOD); protocol (OAI-PMH, web services).

4.3.4   **Recommendations for action from the strategy group (action items)**

The e-publishing sub-strategy proposes the following action items for implementation:

A *National licenses*

1. Licensing backfile archives of completed volumes of bibliographic databases, online collections, online journals, e-books etc. with access for all Swiss higher education institutions, research bodies and possibly private users (including maintenance of the content, preparation of the metadata, provision of access, management of access and rights, support, hosting and long-term archiving).
2. Licensing current online information products, including the negotiation of open access rights: Storage in repositories (green road) with a focus on rights which are as clear and easy to use as possible; offsetting OA publication costs against license costs to avoid double payments (double-dipping in the hybrid model); communication about the agreements that have been reached. In addition, linking the current licensed volumes to the backfiles using a moving wall.
3. Investigating the additional need for online information resources for researchers, in particular in smaller universities. Drawing up a recommendation for action for the consortium or the national organization which has yet to be set up.

B *Open access (OA)*

1. Contributions to publication costs: Establishing a fund and drawing up criteria for contributing to publication costs in pure gold OA journals and fees for OA monographs. Participation in consortia such as SCOAP3.
2. Establishment of a Swiss open academic publisher for Swiss researchers and academic and non-profit publishers (societies, institutes, universities etc.) which allows OA journals and OA monographs to be published. In technical terms, the central use of Open Journal Systems and Open Monograph Press is recommended.
3. Creation of a national repository for all researchers at public research institutions in Switzerland, including universities of applied sciences, hospitals, non-academic bodies (as a complement to the existing university repositories, as an extension to existing repositories, for example RERO DOC and ZENODO, or as a new facility). New formats such as e-books

should be supported (EPUB2, EPUB3, MOBI) and the institutions should be represented. Studies and pilot projects showing whether and how existing repositories can be used to store and provide (controlled and open) access to research data.

4. Authors' rights: Support for information (searches, automated communication with originators and repositories) on the right to store journal articles in repositories. (Originators and repository managers are often uncertain about which rights apply to the storage of publications in repositories. There are search loopholes relating to Swiss publishers but also to individual journals published by international publishing houses.)

5. Evaluation models: Studies of OA-friendly research evaluation, OA-friendly citation figures and specific recommendations for action (see also B7). Research evaluations that include publication and research data (for example, Altmetrics) increase the incentive for researchers to manage their data in a structured way.

6. Legal reports on licenses and rights of reuse in the case of open access: Licenses for digitized publications and orphan works, licenses and rights of reuse for e-books, rights and licenses for research data (copyright, data protection, intellectual property rights etc.) and for objects purchased for long-term archiving. There are a number of uncertainties in this area for researchers and their service providers (repository managers, libraries, legal services). Legal reports could clarify the situation and form the basis for putting strategies in place.

7. Policies on open access, open data and research data management: Overview of current and planned requirements from major stakeholders, in particular funding organizations such as the EU. On a national level, national policies for data management and open data should be drawn up with the support of the stakeholders mentioned in the summary and in consultation with international organizations (the EU, the German Research Foundation (DFG) etc.). On a university level, the use of existing policies developed by foreign universities is recommended.

8. OA competence centers/network for Switzerland: Bringing together new and existing stakeholders from the field of research policy (SNSF, CRUS, Swiss Academies of Arts and Sciences, State Secretariat for Education, Research and Innovation (SERI) etc.), strategic policy activities in areas such as copyright, orphan works and mandatory second publication rights, collecting key figures and ongoing monitoring of the OA landscape in Switzerland (making OA transparent in Switzerland), reserving a URL for a website (for example, www.openaccess.ch).

C Digitization

1. Digitizing scientific collections: Extending the existing services by providing new content and expanding the existing infrastructure.

2. A national coordination committee for digitization projects: This committee, which is responsible for coordinating digitization projects and enquiries from new partners and for agreeing and exchanging standards and best practices, brings together the individual services.

3. Funds for digitization projects.

4. Institutionalizing the funding bodies for existing platforms and extending them to become genuinely national services open to all Swiss universities. This includes defining processes for bringing new partners on board and developing a sustainable business model.

5. Networking existing and new services using open interfaces and linked open data (LOD).

6. Developing and expanding online platforms: Responsive designs, for example for mobile applications such as apps and tablets, collecting text by integrating OCR and transcription tools.

7. 3D digitization: Requirements analysis and possible support for the creation of a 3D digitization center for mobile use.

D Metadata

1. Metadata exchange and standards: Standardized metadata exchange between repositories and presentation on portals, drawing up and applying common standards for Swiss repositories and other data providers, establishing a clearing house (in connection with the D3

metadata hub) to analyze the current situation and working with the stakeholders to define standardized minimum requirements (taking into consideration multiple languages).

2. Establishing an API for the reuse and integration of data, for example, in the SNSF P3 research platform, developing interfaces for repositories.

3. Establishing a metadata hub for grouping and presenting decentralized metadata using various search and data transfer interfaces: The hub has a flexible structure that allows bibliographic metadata from different domains (libraries, repositories, content providers, research data platforms, the SNSF P3 database) to be processed and made available for reuse, for example via http://opendata.admin.ch as linked open data. The metadata hub and the clearing house (D1) can be affiliated to the national library organization which is to be established.

4. Creation of a name authority file (including corporations) for multilingual Switzerland: Creating concordance between GND and RAMEAU and establishing links with ORCID (for current authors), clarifying the use of a creative commons (CC) license.

E National organization of university libraries

1. Many of the action items (B2, B3, B8, C2, C7, D1 and D3) require national coordination. As a national body only currently exists for licensing online resources (Consortium), there is a need for action in this area. Therefore, we propose an overarching action item which involves establishing a national organization of university libraries. This will be responsible for the various coordination tasks. The individual action items can be passed on to this organization in the form of a mandate which will ensure that this becomes a key part of the existing landscape and that the coordination services are efficient. This also resolves the risk of individual institutions withdrawing their support for the Consortium.

4.3.5   Recommendations for implementation

Technology

In the e-Publishing field of activity, the technical issues have largely been resolved. On the other hand, the increased standardization of metadata and the establishment of interfaces are expected to bring major benefits for the reusability and visibility of e-publishing services. The recommendations of the strategy group on interfaces and metadata should therefore be incorporated into the evaluation criteria for choosing projects.

The provision of high-quality, reusable metadata is a prerequisite for an open market for application-specific and competing search solutions. The proposed metadata hub with the clearing house is a key factor in this respect. In addition, a national search solution must be ported as part of the working environment or closely integrated with it.

Legal issues

The transition into the digital age requires significant changes in areas such as copyright, licenses and rights of use. Competence in these areas of law will increase legal certainty and is an important factor in the production and distribution of digital content and metadata. The following measures support the objectives of the program:

- Informing and advising authors about copyright and rights of use and data producers about reusable licensing of their metadata
- Computerized support for storing, communicating and distributing licenses and rights of use
- Negotiating and communicating open access options in the context of consortium contracts with scientific publishers
- Drawing up expert reports in areas where there is legal uncertainty or the interests of universities need to be represented.

The area of legal issues involves the interests of the e-Publishing, e-Learning and Data Management fields of activity. Where applications are made to establish coordination and advisory bodies,

cooperative proposals should be given preference.

Organization

Specialist body for university libraries

Wide-ranging (preferably public) access to digital content requires a collective approach and contacts in the libraries with the ability to take action. The achievements of the libraries in the analog world, including the joint development of content, procedures involving the division of work and publicly available services, are of questionable value in the digital world or require reorganization.

The establishment of a national organization for university libraries, as proposed by the strategy group, requires consultation and time. In the first phase, it would seem to be more useful to put existing organizations and services on a broader base and to create new business models for national tasks:

- The Consortium of Swiss Academic Libraries already has a funding model which corresponds closely with the objectives of SUC P-2.
- The Swiss National Library and the libraries of the ETH Zurich (ETH) and the Ecole Polytechnique Fédérale de Lausanne (EPFL) are funded by the Swiss Confederation.
- The Conference of Swiss University Libraries brings together the executive boards of the universities and of the ETH/EPFL.

It is conceivable that a specialist body for university libraries could be established under the aegis of swissuniversities. The Rectors' Conference of the Universities of Applied Sciences Switzerland (KFH) and the Swiss Conference of Rectors of Universities of Teacher Education (COHEP) currently have a library committee or specialist group.

Licenses and open access

The Consortium of Swiss Academic Libraries invests around CHF 23 million in licenses each year and negotiates on behalf of the 60 libraries that make up its membership. National licenses have long been desired by the university libraries and have in part already been realized abroad. Negotiating for national licenses will increase the volume and broaden the scope of this work even further. In addition, there is the issue of negotiating open access options for consortium licenses in future.

A total of 18 Swiss higher education and research institutions signed the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. On a local level, they are establishing repositories, developing policies and supporting researchers on the spot. The Swiss National Science Foundation (SNSF), working in coordination with international funding organizations, is the only national body to have an open access policy. Publications from funded projects must be stored in a repository or published in a gold OA publication. A recent development is that funding can be used to pay gold OA publication charges. However, the hybrid method is not supported. The SNSF plans to monitor this regulation in future.

Open access is leading to changes in the traditional publication model and the market is in a state of flux. Unfortunately, no studies or key figures are available on publication behavior in Switzerland. There is networking, but no formal cooperation between the various local initiatives. Therefore, existing approaches need to be reinforced. As a basis for future measures, publication behavior should be monitored and proposals to extend the Consortium of Swiss Academic Libraries and to give it a more strategic focus should be supported. The promotion of open access, on the other hand, requires a dialog with stakeholders in the field of research policy. The proposed measures should support the "green or gold" strategy of the SNSF. Since many local repositories have already been set up whose efficiency is to be increased, the priority lies with implementing the green model. In addition, exemplary gold initiatives should be supported. The so-called hybrid model for open access will not be supported.

Digitization

> *The implementation strategy for digitization has been revised. Refer to the separate documents "Hauptstossrichtung Publikationen, Umsetzungsmassnahme EP-10, Digitalisierung: Analyse zur Strategie" (20.03.2015) as well as "Angepasste Strategie und Umsetzungsmassnahmen" (31.03.2015), both available in German and French.*

E-lib.ch has supported the creation of digitization infrastructures, presentation platforms for different types of documents (e-rara, retro.seals, e-manuscripta, e-codices) and the development of standards. The E-lib.ch projects were given the task of establishing sustainable business models. During the next stage it will make sense to combine further support with increased coordination and to open up the projects to additional participants. Projects for digitizing scientific collections should be supported, rather than those for establishing digitization infrastructures.

Finances

National licenses will make the backfile archive of selected publications available to an open user group covering the whole country in the long term. These require a high degree of investment. Because the scope of national licenses is greater than the immediate needs of individual universities, current investments of the Consortium in current content licenses are counted as an own contribution in SUC P-2. It is expected that the consortium will negotiate open access options for the current consortium licenses.

Figures indicating the publication behavior of researchers in Switzerland are also needed. A study that provides these figures and gives the option of updating them at regular intervals should therefore be financed fully from program funding.

Support for digitization should be continued by funding projects which make available content of national significance for the scientific community. Applications should be based on the full costs (operating and investment costs) of the digitization platforms involved.

Recommendations for the choice of projects

As the content provider of the program, the e-Publishing field of activity provides the scientific content. The funding should be aimed at making publications, objects and data more widely available and in this way should give indirect support for infrastructures.

The following aspects should be subsidized:

EP-1	An application by the Consortium of Swiss Academic Libraries to purchase national licenses for selected publications. The application: a) explains the planned selection criteria b) is based on the DFG's funding criteria c) takes into consideration the changes to the Consortium's organization as a result of its new task Given the national importance of this proposal, SUC P-2 will consider contributions to current content licences as matching funds. The program assumes that the Consortium will support negotiations for open access options for the current licenses.
EP-2	Setting up a study to monitor the publication behavior of researchers in Switzerland.
EP-3	The establishment of a coordination and advisory body (competence center) for open access, copyright and authors' rights in Switzerland. (Potential candidates are invited to apply. Proposals which exploit synergies with other fields of activity will be given priority.)
EP-4	Cooperation projects to improve communication about publishing terms and conditions and authors' rights.
EP-5	Providing access to existing high-quality repositories for interested researchers in Switzerland as a national service.
EP-6	Projects to improve the interoperability of repositories and digitization platforms.
EP-7	Opening up open-access publishing platforms (for example on the basis of Open Journal Systems) as a national service.
EP-8	Participation in the SNSF's or the universities' gold OA applications: Contributions to publishing costs, memberships of OA publishing houses, participation in disciplinary OA consortia.

EP-9	Converting publications owned by universities, scientific societies etc. to an open-access model.
EP-10	Digitizing content of national relevance on an existing digitization platform that is open to participants (retro-seals, e-manuscripta, e-rara, Scriptorium, rero.doc, etc.). The operators of the digitization platforms offer their services at full cost on the basis of a service level agreement (SLA).
EP-11	The establishment of the proposed metadata hub with a clearing house.
EP-12	Cooperative projects for improving the quality of standardized metadata and of authority data.

Table 6: Funding recommendations for e-Publishing

The implementation strategy for digitization has been revised. EP-10 is replaced by the actions EP-10a, b, c, d and e. Refer to the separate document "Hauptstossrichtung Publikationen, Umsetzungsmassnahme EP-10, Digitalisierung: Angepasste Strategie und Umsetzungsmassnahmen" (31.03.2015), available in German and French.

4.4   E-Learning

4.4.1   National services included

- (S-2 Portfolio)
- S-15 Exams with electronic support (e-assessment)
- S-16 Knowledge transfer with electronic support
- S-17 Management and delivery of electronic educational content

4.4.2   Summary of the sub-strategy

Higher education institutions face fundamental changes in the area of technology-enhanced learning. Advances in cloud services, personalization approaches and mobile technologies open up new opportunities for creating complex and large-scale learning environments that were not feasible with conventional approaches before (think of MOOCs). This likewise affects course organization and management, the production and distribution of learning material, didactics, and assessment. Courses, books, textbooks, exams and other didactical content (including Open Educational Resources) as well as personalized data have to be adapted along with many challenging issues to solve, such as data privacy, copyright clearance, plagiarism, obsolescence of formats, interoperability between applications, etc.

Complex learning environments are expensive to develop and difficult to maintain for one single organization. Many educational functions and tools are of interest for all institutions. Besides cost benefits, national services should enhance learning and teaching experiences and in some cases bridge the existing gap between research and education (through case-based learning, inquiry based learning, project-based learning, etc.). Furthermore, current approaches do not allow reusing and repurposing solutions in different contexts and in many cases suffer from usability issues.

National efforts therefore should:

- Promote learning from anywhere at any time;
- Improve teaching interactivity;
- Provide tools to manage all digital learning resources collected during and beyond the students' studies, which include students' learning outcomes and reflections, semester and master theses, e-certificates, OER, links to MOOC courses, eBooks, self-assessments, virtual labs, simulation results, etc.;
- Promote active and collaborative learning made through peer-coaching, interactive content, and technology-enhanced learning spaces, in respect with students' identified needs, based on efficient authoring tools;
- Further develop e-assessment (formative and summative) to improve the quality of exams through innovative, competence-oriented e-assessment formats, better objectivity and control of confounding factors in e-assessments, and higher efficiency of exam administration and correction (automatic and manual) in the face of growing student numbers.
- Help to cope with the increased diversification of technologies and tools so as to provide the Swiss e-learning platforms currently running (Moodle, Olat, ILIAS, Mahara, Chamilo, docendo, etc.) with enhanced functionalities (e.g. e-assessment tools, e-portfolio systems, mobile OS platforms, etc.).

4.4.3   Cross references to other fields of activity

The following requirements for the e-Learning sub-strategy have been added or highlighted in other sub-strategies:

Portfolio (S-2)

Responsibility for the S-2 (Portfolio) national service was assigned to the Identity Management strategy group, but it was included as an action item by the e-Learning strategy group. The Identity

Management sub-strategy focuses on providing a lifelong identity as a prerequisite for the portfolio service and defines the following requirements:

A national service S-2, Portfolio, acts as long-term storage and presentation service for electronically available artefacts documenting one's personal career. Scanned and electronically signed paper-based certificates need to be complemented with electronic artefacts better adapted to modern processes. The impact on the certificate-issuing processes at universities is expected to be substantial. Conceptual work and service prototyping is needed in this area and will cover issues related to electronic signing and verification processes and also novel approaches to issuing certification, e.g. Mozilla Open Badges.

Link to Working Environment

Provided that they meet the requirements of standardized interfaces, all the possible e-learning services can be included as components in the management interface of the service platform.

4.4.4 Recommendations for action from the strategy group (action items)

The e-Learning strategy group proposes the following action items for implementation:

1. E-portfolio service with the following features:

a. Life-long identity building (linked with e-identity services) and learning certification solutions to manage informal learning;
b. A national instance of e-portfolio with import and export functionalities to work with separate HEI local instance platforms (including LMS) and professional and social platforms;
c. Tutoring materials and guidelines for promoting the e-portfolio in the academic community;
d. Advanced functionalities to support reflective practices (through, for instance, visualization tools, annotation tools, templates and wizards).

2. E-assessment services providing a well-focused mix of centralized and local services and an e-assessment consultancy service / national competence center:

a. Centralized and local services featuring:
    I.   A fully digital end-to-end e-assessment workflow with a national public key infrastructure for digital signing of an exam before submission (student), after grading (faculty) and for archiving (faculty, HEI);
    II.   Propose tools supporting peer-assessments in different scenarios (scaling for groups, classes and MOOCs);
    III.   Support e-assessment client-side tools such as lockdown browsers and their mass-deployment as well as tablet-based e-assessment solutions to deliver exams to students and/or support examiners (e.g. in oral exams);
    IV.   Support standardized and well-documented interfaces (APIs) for importing data between different services;
    V.   Improve existing export functionality (e.g. csv-export) in e-assessment tools for storing the assessment results for future analysis;
    VI.   Improve existing e-assessment possibilities in LMS and build connectors to extend their e-assessment functionalities in a more flexible way;
    VII.   Implement or improve didactical and/or psychometric best practice standards of LMS e-assessment functionalities;
    VIII.   Propose tools supporting the preparation of e-assessments;
    IX.   Propose tools supporting the post-processing, analysis and presentation of e-assessments.
b. An e-assessment consultancy service/national competence center providing:
    I.   Identification and implementation of common needs;
    II.   Technical and procedural recommendations and advice to the institutions on the organization and execution of e-assessments;

III.   Clarification on legal and security issues on e-assessments.

3. Knowledge transfer with electronic support

a. Support for mobile services through:
   - I.   Development of a mobile app clearing house for a mobile learning app certification across organizations (currently, no commercial solutions for inter-organizational app-certification exist on any platform);
   - II.   Provisioning of frameworks, guidelines and recommendations for integrating mobile apps into the learning environments and campus information system of the Swiss higher educational sector;
   - III.   Identification of interface requirements between LMS and mobile applications based on a review of the current situation;
   - IV.   Development of educational guidelines for creating integrated, multi-device learning environments.
b. Access to remote labs, scientific data, and simulation and game tools for educational purposes
c. Development and integration of video, textual and rich media annotation tools supporting interaction and knowledge-building processes, including (among others):
   - I.   The possibility for teachers to use these tools to mark students' work (e.g. in medical clinical exams to document students' performance);
   - II.   Promotion of analysis or observation of students' competences based on the analysis of various types of media;
   - III.   Students' self-evaluations to identify their own weaknesses in oral production in autonomous learning contexts;
   - IV.   Annotations of students' and researchers' reading to highlight important knowledge.

4. Management and delivery of electronic educational content

a. E-book publication pipeline support and authoring of educational/research content, featuring:
   - I.   Peer-review, collaborative work, quantitative evaluation, and transcription mode;
   - II.   Better integration of learner interaction with LMS;
   - III.   Repository integration for storing, organizing, and sharing of digital publications, interoperable widgets for interactive multimedia content for e-books (potential synergies with S-8);
   - IV.   Integration with existing e-book authoring environments and production pipelines for platform-independent, interactive e-books;
   - V.   Development of educational guidelines for using e-books in higher education and recommendations of state-of-the art e-book readers on the different mobile platforms.
b. A competence center on legal issues in both e-learning and e-research, featuring:
   - I.   Free access to online resources and tools to allow lecturers, researchers, and staff of Swiss HEI to quickly and easily find specific information on legal aspects and to apply this information in their everyday teaching and research contexts;
   - II.   Delivery of training activities (online and in presence forms);
   - III.   A first-level help-desk support to all Swiss HEI staff to solve legal issues.
c. Self-service tutoring engine featuring:
   - I.   A decision tree to help students follow an adequate learning path with the right ICT tools;
   - II.   A "Tutoring profiler" to support students in their development of ICT competences needed to succeed in their studies.
d. Consolidation of the Swiss eduhub community to allow:
   - I.   Techno-pedagogical best practices to be capitalized and shared within the academic community through the Swiss CCSP e-learning centers and international collaborations ("techno-pedagogical watch," "expertise in setting MOOCs," etc.);
   - II.   Promoting special interest groups (SIG) to address key topics at national level (e.g. e-assessment, MOOCs, e-portfolio, OER, student voice, game-based learning, etc.).

4.4.5　　Recommendations for implementation

Technology

Standards for making e-learning objects interoperable (i.e., SCORM, QTI, IMS, LTI, and more recently "Experience API," EPUB3, etc.) should be applied as much as possible for importing and exporting content (however, standards that are usually a sort of lowest common denominator in e-learning topics should not be used to stifle innovative services). Learning objects deposited into repositories should use metadata standards.

In mobile technologies, it is necessary to reduce the need for custom-tailored vendor-specific solutions and provide interoperable solutions. First, greater flexibility and better integration of mobile applications with LMS is required for creating complex learning and working environments. Secondly, the provisioning of better production facilities for high-quality knowledge resources that is accessible to the academic community on a wide range of devices. In the light of the rapid development of mobile technology, it is important that a careful evaluation is carried out of the likelihood that projects will contribute to sustainable solutions.

Legal issues

In connection with DICE (Digital Copyright for eLearning, SWITCH/AAA project), the e-Learning strategy group proposes the establishment of a competence center for copyright issues. The focus here must be on synergies with related proposals in the e-Publishing, Data Management and Identity Management fields of activity. The Identity Management sub-strategy also refers to DICE in the context of the development of guidelines for data protection.

Legal questions related to e-assessment should be coordinated by the legal departments of each institution, because cantonal laws as well as institutional rules apply.

Organization

The already effective and valuable cooperation within the eduhub community has the potential to be developed into an advisory board in the field of e-learning for the national services. The objective of the eduhub community should also be the increased promotion of the joint use of concepts and infrastructures in order to ensure that resources are used efficiently.

The possibility of expanding the subjects covered by the SIGs (special interest groups) should be investigated in order to take into consideration the didactic and communicative aspects (e-Publishing) and new fields of activity (for example, MOOCs (massive open online courses)).

Finances

The program supports the further development of established local solutions to create national services.

Recommendations for the choice of projects

Since 2000, e-learning in Switzerland has benefitted from several programs: Swiss Virtual Campus (2000-2008), AAA/SWITCH e-Infrastructure of e-Science (2008-2013), and Learning Infrastructure (2013). The organizational outcomes of these three initiatives were on the one hand the Competence, Service and Production Centers CCSP (e-learning centers, one for each institution) along with the Educational Technology Working Group (ETWG) assembly serving as the CCSP board, and on the other hand the launch of the eduhub community. This community, coordinated by SWITCH, encourages the sharing of best practices.

From these programmes and communities a set of services progressively emerged, for instance:

- Some e-assessment tools (SEB, SIOUX, e-OSCE, etc.) along with a community of practice;
- e-voting tools for improving interactivity in auditoriums;
- Self- and peer-assessment tools;
- Lecture recording and video management systems (SWITCHCast, Matterhorn, and other

homemade systems), along with video annotation tools;
- The DICE community for copyright in e-learning;
- Swiss LMS (Moodle, OLAT, ILIAS, etc.) and e-portfolio (Mahara) communities.

Until now, the level of national penetration of the majority of these services has been low.

In general, the requirements placed on the e-Learning sub-strategy are heavily influenced by local conditions, such as the local IT infrastructure, or, for example in the e-assessment, by the needs of different disciplines. Local applications are not covered by the program funding. Therefore, it is important to consider carefully which services must be set up initially and promoted locally and which require a national focus.

The following aspects should be funded:

EL-1	The ongoing development (investment costs) of cooperative, interoperable solutions which will not be subject to competition from commercial solutions in the foreseeable future.
EL-2	The expansion of local services to create services open to participants.
EL-3	Additional costs (investment costs) of solutions of this kind.
EL-4	Cooperative pilot projects for solutions open to participants in new requirements areas (see the action items in e-assessment and knowledge transfer).
EL-5	A competence center for copyright, authors' rights, rights to data (can be combined with e-publishing and data management).

Table 7: Funding recommendations for e-Learning

4.5 Data Management

4.5.1 National services included

- S-10 Maintaining digital collections (publications, images, videos, maps, cultural heritage, etc.)
- S-11 Archiving data (primary, secondary, projects, etc.)
- (S-4 Personal repository)
- (S-5 Repository and use of shared data)
- (S-12 Access to digital collections)

4.5.2 Summary of the sub-strategy

Recording, analyzing, processing and storing research data are activities which are highly specific to each discipline and even to each project. The Data Management sub-strategy takes the heterogeneous nature of these tasks for granted and, therefore, aims to support existing local service providers which are close to their users. By developing interfaces between systems and organizations it will in future be possible to bring about significant improvements in the interoperability and international networking of existing solutions.

The strategy group has carried out an analysis which goes beyond the services assigned to it in order to determine the foundation that needs to be created in data management for the establishment of national services in the other fields of activity. It has identified the following measures for the different aspects of data management, including lifecycle management, metadata processing, long-term archiving, work with data in different usage environments and data for the use of digital publications and learning content:

- **Data lifecycle management:** The establishment of lifecycles is intended to guarantee that research data are stored in accordance with the law and that the storage costs are kept within reasonable limits at any given time by the use of suitable media. Guidelines for effective data lifecycle management will be provided, while the implementation will take place in the different data management systems. These will allow the owners of data to be identified and the data to be classified.
- **Metadata:** A wide range of metadata standards and systems for processing metadata is available for different applications. The generation of standardized metadata should be supported during the process of creating the data. Where metadata are generated automatically, for example during sample preparation or measurement, they should be stored automatically. Where they exist implicitly, for example as measurement file names, they should immediately be converted into an explicit form. A metadata search solution should be developed on the basis of open source software and open standards, which improves the interaction of standards and decentralized systems, allows data to be processed cost-effectively and provides efficient services.
- **Open Archival Information System (OAIS):** The OAIS reference model provides a logical description of the agents, functions and processes in a digital archive. Guidelines and technical components for OAIS-compliant solutions for long-term archiving can be produced centrally. However, the data workflows should be implemented in close cooperation with local users.
- **Research data:** Researchers use data in very varied types of system and software environments. During the different phases of data management (recording, analyzing, processing, publication, etc.), several parties need to access the data. In this area too, a model needs to be developed which will improve the interoperability of existing systems and applications and provide the necessary flexibility in the reuse of research data.
- **Publications/e-Learning:** Digital publications and learning content (but not examination certificates) can be treated in the same way in both conceptual and technical terms. While publication and production processes require local support, the servers can be shared, the operating costs reduced and the impact increased. Metadata play a decisive role in enabling

research data to be identified. One special requirement in this respect is a solution to the problem of the bi-directional reference between online publications and the accompanying research data.

- **Data storage:** Data management requires storage facilities for data in different classes (with different levels of performance, scalability and price) to be made available. Coordinated storage systems with a standardized interface for accessing and moving data can meet the differing requirements of data management and cloud computing. SLAs with several storage providers which also offer a standardized, WAN-compatible interface could enable a suitable provider to be chosen for post- and pre-processing of data and allow small institutions to avoid having to establish their own storage infrastructure. In addition, the management of multiple copies for geo-redundant storage and provision by several providers can be integrated into existing, domain-specific data management systems in order to meet the requirements for the availability of individual providers, to reduce the costs and risks and to simplify and accelerate decentralized processing. The use of different authorization systems could be counteracted by separating the data storage and data management software layers, which is admittedly a challenging task. However, the various questions relating to SLAs, cooperation concepts, adapting existing solutions and charging need to be considered over a longer period.

Data management solutions are currently mainly used on a local level. In contrast, international solutions are specific to certain disciplines and focus on freely available data. They cannot be ignored but must be made available via certain interfaces. Special attention must be paid to data in the fields of medicine and the social sciences, for example, because anonymization requires more complex tools.

Alongside data management concepts and guidelines, the program should therefore promote solutions for overcoming the limits that have been referred to. Within the planned horizon, data management also requires familiar workflows to be evaluated. A readiness to collaborate is a fundamental prerequisite for the success of the program.

4.5.3   Cross references to other fields of activity

The following requirements for the Data Management sub-strategy have been added or highlighted in other sub-strategies:

Metadata processing

The systems in the Working Environment sub-strategy must, on the one hand, be able to access all the recorded metadata. On the other hand, they must be able to include additional metadata in new and existing data sets. This means that metadata editors and query tools are particularly important that enable domain-specific knowledge to be accessed via the metadata pool of the Data Management sub-strategy.

Long-term archiving

E-learning and e-publishing require solutions for long-term archiving and for linking publications and learning content with research data. For long-term archiving, expert reports, concepts, principles and workflows are needed in containers for publications, documents and research data and for shared metadata. Infrastructures and repositories must provide long-term archiving formats in accordance with OAIS. In particular, solutions for hosting documents from national licenses and digitized material from digitization platforms are needed.

Data management plans

E-publishing requires help for researchers in creating data management plans. This includes guidelines for institutions on establishing data infrastructures (interoperability, metadata standards, long-term archiving, access options ranging from closed to open) and the inclusion of subject-based and international repositories (including practices and standards). The emphasis must be placed on the organization, support for researchers and open data (which data must be stored, in what way and

with what type of access?), while the requirements of copyright, data protection and intellectual property rights must be taken into consideration.

Cloud computing

Many applications will combine hosting services and options for data processing which involve data being transferred to or from data management systems, or data from the data management systems being stored from the start in cloud storage systems where they can be processed without being transferred. Therefore, the interfaces to the cloud services will be of crucial importance and should, wherever possible, be standardized across different institutions. Attention should be paid in particular to the interfaces to data-intensive services in order to guarantee good performance and smooth operation.

4.5.4   **Recommendations for action from the strategy group (action items)**

The Data Management strategy group proposes the following action items for implementation:

Lifecycle

1. Define a process, roles, software interfaces (UI and API) and tools in order to best perform data lifecycle management of research data from raw to fully processed and analyzed data. It needs to be generic enough to be customizable to different areas of research and to the peculiarities of different institutions. The process needs to be described well from the point of view of each role. This needs to include interfaces that data management systems need to offer to play well with data lifecycle management systems. The list of software systems to be implemented is a deliverable of this action item.
    Establish guidelines concerning data ownership: Who is in charge of the data, who can decide to finally delete them? Data ownership, data access rights, inheritance or transfer of ownership and other issues have to be defined and implemented. Rules have to be agreed upon and implemented that are according to applicable law regarding intellectual property rights.
2. Based on the list of tools compiled in Lifecycle-01, develop the necessary tools for data lifecycle management.
3. Projects should be funded to adapt existing data management systems to the needs of data lifecycle management by providing the necessary interfaces.
4. Provide methodological help for researchers to sort out what data to keep (i.e. define decision criteria and guidelines centrally and enable on-site support through all stages of the lifecycle).

Metadata

1. Define an operating model for the metadata search service (see also the concept of a metadata hub in e-publishing) providing the following functionalities: harvesting of metadata (push or pull mode?), indexing, querying, and display of retrieved results in a user-friendly environment (see working environment).
    Consider: Establish guidelines on what functional metadata is needed to enable life cycle management and data stewardship and how it can be provided, updated and maintained over time.
    The concept should contain a business model describing how smaller institutions can use the metadata servers operated by larger ones to make available their research metadata.
2. Define and thoroughly document APIs for data providers, data using services which can be used for ingesting, searching, harvesting metadata. In detail, we foresee APIs for these activities:
    o   Data ingestion from research data repositories into the metadata engines
    o   Querying the metadata engine
    Harvesting the metadata, also incrementally for use by other metadata engines or applications (enable federation).
3. Design and implement a search service (technically) which implements the interfaces defined

above, is flexible with respect to metadata schemata, and can be operated as a web of peers updating each other. Deliverable: software and documentation.

4. Projects should be funded to extract metadata from existing research repository / data management systems and ingest it into the metadata search service.

5. Set up methodological help to define appropriate metadata schemas and ensure adequate metadata provision in local data repositories and platforms. E.g. preparation and maintenance of lists of generic and discipline-specific standards, discipline-specific formats and available international frameworks. This information can be provided centrally on the national level, but local helpdesks or support services need to be set up to ensure coherence in practice.

OAIS

1. Clarify and describe the process of how researchers can prepare their data for long-term preservation and how to ingest into the OAIS archive, write down "best practices" and guidelines. This includes shaping the boundaries between core tasks of digital preservation on the one hand and data management (research data from raw to processed and analyzed) or digital asset management (libraries, collections, publications) of "active" data expected to be available online on the other hand. Another aspect is the compilation of additional workflow components and interfaces needed for the OAIS process.

2. In addition to possible complete implementations of OAIS compliant systems, also re-usable key components supporting preservation workflows should be identified and be made fit for re-use. This includes both existing services and tools that are lacking.

3. Quantify the need for an OAIS solution in different institutions. Establish whether there exists a current need for a centralized implementation of an OAIS. (Centralization can also mean the concentration of services in a few larger institutions providing services to other partners, e.g. as regional or discipline-specific services.)
Determine if and which functions of an OAIS can be centralized from a technical point of view. Consider acceptance for those functions being provided centrally for non-public or otherwise sensitive data.

4. Define possible technical interfaces with existing data management or online publication platforms. The interfaces should be as generic as possible and not target one specific implementation of an OAIS.

5. Support existing and upcoming data management / repository services in adapting/creating workable interfaces with an OAIS according to the previously established definitions and standards.

6. Depending on results of OAIS-03: Implementation of OAIS-services by a number of service hubs, possibly with central components, or a more centralized solution.

Research Data

1. Define a data access model, supporting user authentication for end-user tools and system-to-system integration ("data provider model"), an API for how applications can access data in a DM4 (function block F-DM4: e-archive research) repository ("data access API") and an API for how applications can upload data to a DM4 repository ("data ingest API"). The APIs need to be based on open web technologies and need to be independent of a particular research area. Domain-specific details should be represented by configurations of both the data repository and the data user.

2. Adapt existing research data repositories (from any research area) to the defined data provider model by making it implement the data access and data ingest APIs.

3. Develop a model (for a specific research domain) which allows data user tools to auto-configure themselves for accessing DM4 data repositories hosting data for the domain at hand. It should be based on generally accepted domain-specific ontologies. The project has to deliver a reference implementation of an adaption of a tool from this research domain, which allows the tool using the auto-configuration mechanism. Any such model must also include an access API for accessing data in the repositories.
This includes two aspects: the technical means to express compatibility and the subject-

specific implementation.

Publication

1. Support concrete projects for opening up existing institutional repositories for use by partnering institutions, including defining a business model for operation. This might not only be an option for smaller institutions, but also sharing of common repositories between more equally sized partners should be encouraged. In this case, the partners would well be able to run their own repositories, but they decide not to do so to share operational efforts and expenses and share their know-how.

2. Investigate if Open Access and other (existing) repositories can take over basic functions of OAIS-compliant long-term archives and deliver recommendations on how these can be implemented. To this end, run a reference project to enhance one or more existing repositories with OAIS-functions or modules.

3. Reference project: Support existing institutional repositories in implementing workflows and tools to prepare and facilitate a later transfer of data to an existing or planned OAIS-compliant system.

4. *Depending on progress with the agreement on national licenses with publishers:* Evaluate options for hosting licensed content for ongoing access and support implementation of chosen approach (list not claiming completeness):
   o Agreements on prolonged access through publishers.
   o Cooperation with partners with a similar need, e.g. in Germany, the Netherlands or Denmark
   o Evaluation of existing international solutions like LOCKSS and Portico for this particular purpose
   o Hosting in operational services in Switzerland (e.g. existing repositories or – in spite of the different use case – an OAIS).
   o Implementation of a new dedicated solution for the purpose.

5. Examine where interfaces from e-learning or teaching tools to institutional repositories or OAIS systems are missing, and define the requirements for such interfaces.
   → Mandated activity expert group

6. Support the implementation of such interfaces between existing and newly created solutions.

Data Storage

1. SLAs need to be defined and agreed by potential participants.
2. A technical concept for the collaboration of storage providers and data management providers, including technical interfaces, needs to be defined.
3. Existing data management solutions need to be adapted to support the technical interfaces and to support N copies on different storage providers.
4. Compliance of partners and storage environments with SLAs needs to be verified.

4.5.5 **Recommendations for implementation**

Technology

Making research data available beyond institutional boundaries is a main focus of the program. As proposed, the focus should not be on standardization and centralization, but on the interoperability of local solutions. Only those components which cannot be offered locally will be developed centrally. Local data stores should be made available to more participants across institutional boundaries by using appropriate methods and tools.

At the heart of data management are meaningful metadata which support data transport and ensure that data, objects and publications can be easily found in the long-term. Solutions must include experiences from every different area. The program offers the opportunity to incorporate metadata specific to each discipline into well-established metadata frameworks in libraries, data and document servers and archiving initiatives (publication via OAI-PMH, implementation of linked open data, the use

of persistent identifiers, such as DOI, to create the link between research data and publications, etc.).

Data processing and analysis functions cannot be permanently integrated into data management solutions because of the varied requirements in this area. Instead they should have open interfaces which allow for data processing and analysis from data pipelines and workflows. The main aim here is to integrate domain-specific data processing software into generic data management platforms. In addition, a link needs to be created between data management applications and the project management tools in research and research funding institutions. The main focus is on metadata which document the research results in the form of publications and research data. One example is the Swiss National Science Foundation's (SNSF) databases for projects, people and publications. The SNSF is of particular importance because of the leading role that it is likely to play in establishing policies and requirements for data management plans (DMP) in project applications and the resulting compliance requirements for verification and documentation. Finally, by linking research data management with databases of this kind, it will be easier to make the work in this area a permanent component of the evaluation of the overall quality of research projects.

Legal issues

Transparent rights are a decisive factor in the use and processing of data. On the basis of the motto "legal frameworks govern data ownership", the ownership of data must be evident at every stage in the lifecycle. Questions of data protection are particularly important in the field of medical science, but also in the social sciences and other areas. Concerns about data protection can restrict the use of new technologies. On the other hand, data protection can require a certain level of anonymization which can reduce the value of the data for reasonable scientific use. As any form of legal uncertainty puts at risk the acceptance of services which use data of this kind, the legal situation in Switzerland needs to be resolved so that the requirements for individual researchers and for data management solutions are clear. More sophisticated technical solutions may be required.

Organization

The decentralized approach requires methodical support for researchers and institutions. For this purpose, concepts must first of all be developed which can subsequently be evaluated in existing applications and implemented in initial projects. Because long-term cooperation between institutions is essential for the sustainable provision of research data, the program should support this cooperation:

- Researchers need guidelines to enable them to choose the correct metadata and metadata technologies. Funding organizations are increasingly requiring researchers to produce data management plans which are submitted as part of the application for funding. While the institutions must provide essential local support for researchers, the program can help with the creation of guidelines.
- The program can help institutions with documentation and guidelines, with sharing best practices and workflows, and with the establishment and operation of local storage, including transferring information from research projects.

The strategy group proposes the creation of an "activity expert group" to draw up the methodological principles. Here there is the potential for synergies with the e-Science team proposed by the Cloud Computing sub-strategy which could also help researchers with data management. These synergies should be taken into consideration in the application, where possible, and incorporated into the evaluation of project applications.

The strategy group identified the lack of specialist staff with data management skills as a high risk. For this reason, it should be possible to provide funding for training modules.

Finances

Research data is managed in close proximity to the research itself; it is dynamic; in the best cases it is close to the work of international scientific associations, but it is not yet a matter of "common sense". In this environment, it is difficult for central services to function. The sub-strategy focuses on local services which should continue to be financed by the universities that operate them. This applies also

to the improvements made to local infrastructures in the context of the program. Solutions for the integration of these local services will be promoted with the support of the e-Science team.

The strategy group estimates that implementing all the action items will cost around 87 person years or CHF 14.5 million. While concepts and improvements to existing systems have predictable costs, can be financed relatively easily using program funding and will not incur any subsequent costs, the implementation (software development) of a centrally distributed metadata server, for example, is less predictable and also involves maintenance costs. Since much development work will initially be necessary, only a small part of the overall tasks envisaged by the strategy group will be able to be realized in a meaningful manner by 2016.

Shared infrastructures (for example, storage) should be financed by participants on the basis of their level of use. A pay-per-use approach at a research group level or the integration of the costs into the SNSF project funding would also be considered if a central infrastructure is used.

Recommendations for the choice of projects

In accordance with the recommendation of the strategy group, support for applications for implementing the action items listed above should be provided in three consecutive stages:

1. Concept activities for defining processes, interfaces and guidelines in the form of orders.
2. Implementing these interfaces (APIs) and workflows in existing services.
3. Developing new services and workflows.

Projects based on the results of previous activities can only be approved later in the program.

Concept activities should involve customers. One of the main success factors is the establishment of a community for sharing best practices and supporting researchers. The aim of creating an e-Science team across different organizations is to provide ongoing support and reinforcement for the cooperation and integration of local services.

In principle, all the projects referred to in the sub-strategy are deserving of support. However, in the context of the program the focus will be on projects which promote access to research data (metadata search service, OAIS for research data).

The two disciplines of research and information technology, which are characterized by a high level of innovation, come together in the field of data management. For this reason, there is a significant risk that solutions will already be outdated before they are completed. Wherever possible, in-house developments should be avoided. Flexibility is needed both in the concepts and in the management of the program.

The following aspects should be funded:

DM-1	The development of concepts for data lifecycle management, extracting and providing metadata, and long-term storage and archiving. The concepts must define the necessary processes, interfaces and guidelines.
DM-2	The expansion of established local solutions to create services which meet the requirements defined in DM-1 and allow for sustainable operation because of the users and the business case.
DM-3	Pilot projects which use the services on offer.
DM-4	The establishment of a support body for data management and cloud computing questions (e-Science team) (see CC-4).
DM-5	Training modules from different providers
DM-6	A metadata search service (see WE-2, EP-11) (creation of a metadata hub with a clearing house).

Table 8: Funding recommendations for Data Management

4.6   Cloud Computing

4.6.1   National services included

- S-13 Access to temporary compute resources
- S-14 Access to temporary storage resources

4.6.2   Summary of the sub-strategy

Like many other governments, the Swiss government is pushing for a "cloud first" strategy and it is felt that Swiss academia should follow this example. However, academic institutions have been hesitant to endorse or even to allow the use of these services due to possible legal implications of outsourcing data and processing outside the institution/country or concerns about loss of control including vendor lock-in.

There will likely be no single national cloud service in Swiss academia for compute or storage but rather these will serve as categories of cloud services consumed by institutions which could be offered through a marketplace shared with other public institutions. It must also be an option for researchers to use international resources as required for their collaborations or highly specialized resources that apply to only a handful of researchers.

As a result of the examination of the use cases, one of the recommendations of the Cloud Computing strategy group is to extend beyond just the IaaS (Infrastructure-as-a-Service) model and define the concepts of cloud in general as this affects how the IaaS model is leveraged and how other services are delivered with PaaS (Platform-as-a-Service) and SaaS (Software-as-a-Service). Another recommendation is to move away from the term "temporary" for compute and storage as several use cases require indefinite commitments to these services. Furthermore, having the concept of cloud services in place is an important foundation for all national services.

Services could be partnerships with commercial cloud providers, similar to "Internet2 NET+"-services (www.internet2.edu/netplus/cloud-services.html), SURF (www.surfsites.nl/cloud/english) and Janet (www.ja.net), including negotiating contracts for preferential rates. Harmonizing on cloud services from the broad market of providers, or converting an existing tool or resource into a cloud service can benefit multiple organizations and researchers. To prevent projects from being fragmented or not having critical mass, the strategy group suggests establishing a cross-institutional e-Science team in order to ensure a coordinated approach. Such e-Science teams can be found in various other places throughout the world (esciencecenter.nl, nectar.org.au).

There is a vibrant market of commercial offerings in cloud services. In addition, there is a wealth of compute and storage infrastructure operated locally within academic institutions, not just centrally, but also within departments and institutes. More and more of these local installations offer virtualized machines and storage. Nevertheless, they are typically not operated for cloud-like self-service access, and usually restricted to a small set of users. Some research groups are individually exploring the adoption of cloud services for their scientific use cases at many levels. This exploration should happen in a coordinated manner, with a clear understanding of possible legal implications. While it is true that a considerable effort is invested in defining cloud standards at all levels it is also true that, at the moment, none is widely acknowledged, recognized and adopted. Only a heavy emphasis on interoperation will make investing time and effort in standards result in sizeable advances and ensure choices. The adoption of whatever standard should imply a shift to another in the near future.

4.6.3   Cross references to other fields of activity

The following requirements for the Cloud Computing sub-strategy have been added or highlighted in other sub-strategies:

Customer orientation

The strategy group emphasizes that activities need to be driven by actual needs of researchers and educators. One specific requirement comes from the e-Learning field of activity, which would like to develop an environment based on virtual machines for simulation and game environments (for educational purposes) in collaboration with Cloud Computing.

The cloud services should provide simple web-based interfaces for users to request access to and manage compute and storage resources. They should also be accessible through APIs. These APIs should conform to accepted standards wherever possible. There will be an interface to allow users to report and track issues with the services and to assess their health.

The services should provide accounting interfaces to report on resource provision and utilization at a level suitable for institution-based charging and cost control. Accounting should support charge-back to individual users or groups within an institution. Cloud computing should be able to access identities and attributes from identity management services as required for accounting.

In addition to technical interfaces, cloud computing will work with SwiNG to form interfaces to national and international projects, in particular those supporting national and international communities (e.g., EGI, EUDAT, RDA).

Data management

The Data Management sub-strategy specifies infrastructures for the provision of central services which are made available by the Cloud Computing sub-strategy.

4.6.4   **Recommendations for action from the strategy group (action items)**

1. Launch a call for national compute and storage cloud services that address the needs of the Swiss academic community. All Swiss academic institutions should be eligible to use the service. Quality dimensions (such as authenticity, integrity, accessibility, security, etc.) should be controlled systematically with transparent tools and processes. Procedures for collecting usage statistics and enabling billing need to be formalized. The program's strategy for "National Organization" must establish procedures that connect consumers with providers, work with funding agencies to establish business models on how users receive funding to spend on the national services, work with user communities such SwiNG[2] and Eduhub[3], and create incentives for providers to serve the entire Swiss research community.

2. Launch a call for cooperative integration projects. These can define and implement standards for common national access control and usage reporting infrastructure. The standards should align with solutions for federated identity management. Clarify legal and administrative aspects for use of cloud services, such as billing between institutions, data privacy, etc. The call can also investigate the integration of remote IaaS resources into academic institutions' campus ICT infrastructure. Particular attention should be given to SDN (Software-Defined Networking) approaches. Such projects should produce realistic proofs-of-concept.

3. Launch a call for a national e-Science team leveraging the scientific IT support in various institutions and based on the experiences from inter-institutional IT cooperation from such projects as SwissACC, SystemsX and CHIPP. Proposals for the national e-Science team must detail how the team will work together across all strategy areas. The team must support multiple communities from research and education to facilitate cloud adoption. The national e-Science team should tap into institutional expertise and resources, as well as national and international activities.

4. Launch a call for cooperative projects to fund the adoption and development of cloud services based on use cases and community needs. Projects should provide a high and significant level of interoperability among scientific communities and should develop more connectivity

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[2] The Swiss National Grid Association (SwiNG) web site (http://goo.gl/WLhEow)

[3] Eduhub is a Swiss academic e-learning community (http://goo.gl/AQsyzV)

between scientific activities, especially concerning resource sharing.

5. Fund projects of national importance that integrate with international e-infrastructure for research communities (e.g. EGI, Elixir, EUDAT, RDA) so all researchers in Switzerland can benefit from such activities and resources. This should be done in cooperation with the current partners of the respective projects and be driven by requirements from researcher/community needs. In particular, support the continuing membership of Swiss partners in the EGI initiative. This should also connect the Swiss academic community with EGI's pan-European federation of private clouds.

4.6.5   Recommendations for implementation

Technology

In cloud computing, a goal should be to make interoperable and integrated services a requirement whenever necessary or desirable, including commercial partnerships as appropriate. Interoperability is important for broadening choice by creating fair play for providers, helping to avoid getting locked-in to a specific provider that cannot meet all needs or that loses competeveness over time. It can also avoid technical lock-in for developers even if a service may have a compelling business model.

Interfaces to cloud services in Working Environment, Data Management, e-Learning, and e-Publishing will be critical, since many use cases will combine service hosting and data processing, and processed data will need to be transferred to and from the systems used for the other fields. The interfaces should be aligned as much as possible, and where possible cloud services should be standardized across institutions. Particular care should be taken for the interfaces with data intensive services to ensure good performance and smooth operation of cloud services.

Specific cloud services will not be defined or mandated, as it is up to individual institutions and companies to offer services with sufficient market interest to be viable. It is assumed that these will be a combination of commodity cloud resources as well as highly specialized cloud resources (e.g. HPC compute, archive storage). There is a risk that there is not a viable pool of cloud service providers or that the cost model of cloud service providers is not compatible with the funding available to researchers. However, there are sufficient seed cloud infrastructures available that can be used initially (SwissACC, SWITCH).

Attributes of a cloud service as defined by the "Swiss Academic Compute Cloud" Project are:

Self-service	A consumer can unilaterally provision computing capabilities and has immediate access, such as server time and network storage, without requiring human interaction.
On-demand	As needed, at the time when needed, with the possibility of automatic provisioning. No long-term commitments, no up-front investments needed.
Cost-transparent	Paying for effective usage only. Accounting of actual usage transparent to both user and service provider, measured in corresponding terms (hours CPU time, GB per month, MB transfer, etc.)
Elastic, scalable	Capabilities can be elastically provisioned and released, to scale rapidly up and down, matching demand. To the consumer the capabilities might appear unlimited and can be appropriated in any quantity at any time.
Multi-tenant	The provider's computing resources are pooled to serve multiple consumers, with resources dynamically assigned and reassigned according to consumer demand.
Programmable	The services expose a public, programmable API that can be used to drive any aspect of the service programmatically, such that automated processes can be set up on top of the services.

Legal issues

Academic institutions have been hesitant to endorse or even to allow the use of cloud services due to:

- possible legal implications of outsourcing data and processing outside the institution/country,
- local institutional policies limiting how and where data can be stored and processed,
- concerns about loss of control including vendor lock-in,
- the perception that commercial cloud services are more expensive than their own infrastructure in the long run, or incompatible OPEX and CAPEX models.

An important area of work is therefore the agreement on SLAs, legal issues and monitoring. In particular, the legal aspects of the way in which the institutions charge one another for cloud services need clarification.

Organization

The strategy group proposes a cross-institutional e-Science team which is independent of cloud service providers and which supports researchers in using cloud resources. In the future operational model it will have an advisory function and represent Switzerland in international projects and communities (for example, EGI, EUDAT, RDA).

The decisive success factors for the e-Science team are strong roots in a broad field of research, support for researchers which meets their needs and the promotion of cooperation between the institutions.

Finances

The investment costs for building compute and storage capacities to the estimated levels required will be to the order of tens of millions of CHF. Investments in equipment should be funded by the institutions themselves, possibly using contributions from large anchor-user communities. Funding equipment purchases through the program is not recommended, both because the funds available for this area are insufficient and because experience has shown that such contributions often don't result in sustainable service to the wider community.

In terms of services, it is assumed that national services are working on a full cost recovery basis, and the pricing strategy will be variable between providers of the service.

The e-Science team will need a minimum of operational funding in order to support their involvement in this program's activities, as well national and international activities. At a minimum the program should fund 5-25% of an FTE for each institution participating in the program (dependent on the number of researchers and teachers at each institution). In addition, the program will need to provide a certain amount of funding for the team's activities (e.g. travel, organizing training events, presentation), which is estimated to be to the order of 100K CHF per year. There should be funding and co-funding for projects related to international e-infrastructure for research communities (e.g. EGI, Elixir, EUDAT) so that all researchers in Switzerland can benefit from such activities and resources. This should be done in cooperation with the current partners of the respective projects and be driven by requirements from actual use cases and communities. It is estimated that this is to the order for ~200K CHF per year. Funding should partly be allocated to small projects (~500K CHF per year) and approximately 2 million CHF per year to larger cooperative projects.

Recommendations for the choice of projects

In the Cloud Computing strategy, the focus is on developing and providing services in the university environment which can make use of commercial offerings. The cooperation between institutions (provider and user) is decisive. The offerings should include all the essential features of cloud computing. It should also be possible to integrate them into the future identity management solution. The use of cloud resources in research should be supported and simplified by a support body (e-Science team) and by training modules.

The following aspects should be funded:

CC-1	The development of cloud services on a national level (service description, SLA, marketing, advisory board). However, the infrastructure costs must be paid by the service users (business case).
CC-2	Cooperative integration projects which involve aspects of cloud computing and propose or implement solutions. The subject areas include access management, reporting, charging, legal solutions, hybrid cloud and integration into international e-infrastructures.
CC-3	Pilot projects which use the services on offer.
CC-4	The establishment of a support body for data management and cloud computing questions (e-Science team) (see DM-4).
CC-5	Training modules for the use of cloud resources.

Table 9: Funding recommendations for Cloud Computing

4.7   Operating model (national organization)

In 2017, the projects funded by the program should lead to a service infrastructure that has the necessary financial viability to operate on a sustainable basis. Setting up a national organization (with a stable structure and a clear legal framework) that will continue the work of the Program Organization is part of the program.

In contrast to the six preceding sub-strategies, the guidelines for setting up a national organization will be developed outside the service architecture.

4.7.1   Setup actions

The following actions have already been begun in preparation for the first call for proposals:

1. **Classification of services:** Establishing a classification system for services to be used as a prioritization method. The first version must already be available for the first evaluation as part of the program.
2. **Evaluation process and expert committee:** Establishing an evaluation process and evaluation criteria for selecting and financing projects and services and setting up an expert committee. The first version must already be available for the first call for proposals as part of the program.
3. **Regulations governing own funding contributions:** Establishing regulations for financing projects to govern own funding contributions from the institutions involved. The first version must already be available for the first call for proposals as part of the program.
4. **Advisory boards:** Setting up advisory boards as part of the commissioning of services.

The following actions are planned during the future progress of the program:

5. **Setting up the national organization:** Setting up the national organization starting with the program setup with the program office, Steering Committee and group of experts. Gradual clarification of any affiliation opportunities, responsibilities and processes.
6. **Setting up a supervisory body:** Determining the responsibilities and processes and recruiting members, unless a host organization with a suitable supervisory body can be used.

The "National Organization" strategy group has proposed the principles and bodies required for setting up a national organization on the basis of the Program Management. They are described in the sections that follow.

The transition from the Program Organization to a national organization can be represented as follows:
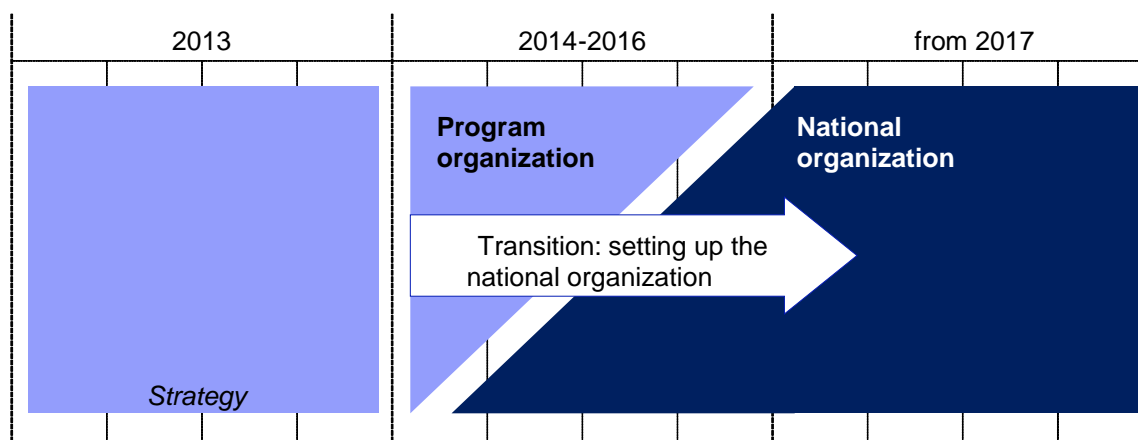

Figure 5: Setting up the national organization

4.7.2　　Principles

The strategy group responsible identified the following principles as prerequisites for establishing a national organization:

a. In Switzerland, only decentralized service models are successful that are supported by skilled volunteer service providers with a high level of acceptance and that allow voluntary access to services.

b. The national organization will be a streamlined, credible coordinator that does not provide any services itself. It will only perform tasks that need to be carried out centrally.

c. In order to optimize the staffing requirement for the administrative tasks, the national organization should preferably join an existing host organization. The SUC is in charge of the national organization and will be responsible for arranging for it to join an organization.

d. The national organization will be made up of an administrative unit and advisory boards. These will be recruited from experts from the various stakeholders.

e. A supervisory body will control the national organization's business. This can either be an independent committee or the supervisory body of the host organization, if it is a national committee.

f. The national organization will be responsible for implementing the strategy and its continuing development. It will also follow developments on the market and international activities.

g. The national organization will define principles, criteria and processes for determining the priority of services and projects and will ensure that they are implemented.

h. The national organization will plan and coordinate the funds it is given and allocate them according to the principles of efficient and effective use. It will promote the provision of a sustainable funding base.

i. The national organization will define open, stable interfaces and policies that enable the service platform to be developed dynamically. It will ensure its implementation and compliance.

j. The national organization will manage the service catalog of the national services. It will monitor adherence to the providers' Service Level Agreements (SLAs), acting as a quality guarantee.

k. The national organization will carry out marketing and communications activities for the service platform.

l. The national organization will be able to represent Switzerland in international bodies in the field of "scientific information provision."

m. Projects and applications for the further development of services will be evaluated by an expert committee whose independence must be guaranteed.

4.7.3　　Bodies

Decentralized service providers

All institutions listed in chapter 1.5 can be service providers: service providers that already perform tasks that benefit the universities (SWITCH, Consortium of Swiss Academic Libraries, etc.) and commercial providers. The latter should only be commissioned directly by the national organization in exceptional cases (see principle b). Services will usually be provided indirectly via an affiliated institution.

National organization

Central administrative unit:

In order to complete the tasks specified in the principles, the following roles must be filled:

- Management board
- Service management
  - o Portfolio management
  - o SLA management
  - o Service architect
- Project management/Project support

Advisory boards:

For each service or group of services, an advisory board will be appointed to be responsible for the strategic development of the service or group of services. Experts from the following stakeholders will be represented on this board:

- Service providers
- Service users
- Potential service providers and customer groups within or outside of the higher education sector.

International experts can also be appointed.

Attachment to an organization:

The national organization should join an organization that can provide the following administrative support:

- Assistance/translations
- Communications and marketing/outreach
- Finance and controlling
- Legal services
- Human resources
- Procurement and contract management (possibly).

The General Secretariat of the CRUS or the future joint Rectors' Conference of the Swiss Universities is the main host organization or organizational anchor point.

If the national organization cannot join a host organization, additional costs are to be expected.

Supervisory body:

A supervisory body will control the national organization's business. It will be appointed by the SUC that is responsible for the strategic and financial framework. It will be in charge of developing the program and will make decisions on financing projects and services. It can be an independent committee or the supervisory body of the host organization, if it is a national committee.

During the program, this role is being assumed by the program's Steering Committee.

Expert committee

The expert committee will review project applications and applications for the operation of services. It will prepare recommendations for the approval of funding for the attention of the supervisory body. When reviewing applications, additional expert opinions can be sought to expand the range of disciplines and avoid conflicts of interest.

4.7.4   **International references**

To create a successful foundation for a national organization, the Swiss federal structures must be taken into consideration. It is therefore worth learning about developments in other countries with a federalist structure, such as Germany. When comparing solutions, factors such as the differences in size or the variety of languages spoken in Switzerland must be taken into account.

4.7.5   **Recommendations for implementation**

The following aspects should be funded:

NO-1	Program office/setting up the national organization
NO-2	Service platform: Requirement specifications and evaluation of a software platform for the management interface, definition of a standard for the inclusion and management of services, and establishing the interfaces and guidelines.

Table 10: Funding recommendations for the operating model

5   Implementation

For the implementation, an overview of the funding recommendations for the individual fields of activity was analyzed and the recommendations were assigned to four key areas of focus. The information from the strategy groups, prioritized from the program's perspective and taking into account potential synergies between the fields of activity, serves as the basis of the 2014-2016 budget. The estimates for ongoing operation from 2017 must be regarded as very rough benchmarks.

5.1   Ongoing commitments

Around CHF 45 million (CHF 45,312,000) is available for the 2013-2016 grant period, made up of grants from university funding (UFG, CHF 37 million), the ETH Board (CHF 6 million) and funding for universities of applied sciences (FHSG, CHF 2 million).

Besides financing the Program Organization, five initiatives were supported in 2013. In the case of the projects "Swiss Academic Compute Cloud", "Learning Infrastructure" and "E-lib.ch," transitional financing was secured for initiatives that are crucial to the program. These projects have now been completed and those responsible must submit new applications within the framework of SUC P-2. Fixed sums have been allocated to the projects "E-codices" and "Kooperative Speicherbibliothek Schweiz" ("Swiss cooperative data storage library") until 2016. Both projects are integrated in the program strategy.

These commitments total around CHF 8 million (CHF 8,119,000):

- Swiss Academic Compute Cloud: CHF 582,000 (2013)
- Learning Infrastructure: CHF 1,368,000 (2013)
- E-lib.ch: CHF 2,030,000 (2013)
- E-codices: CHF 2,016,000 (2013-2016)
- Kooperative Speicherbibliothek Schweiz (Swiss cooperative data storage library): CHF 1,000,000 (2013-2016)
- Program office: CHF 1,150,000 (2013)

This leaves around CHF 37 million worth of funding for 2014-2016.

5.2   Key areas of focus and budget

Several areas of overlap and interconnections were worked out between the fields of action in the sub-strategies. In order to enable coherent processes and a prioritization of the support recommendations, the implementation actions were bundled in four packages of measures: "Publications", "e-Science", "Basis" and "Services".

These key areas of focus for implementing the strategy are derived from the logical architecture of the envisaged information and service infrastructure:

- Two "information pools" prepared by the "Publications" and "e-Science" measure packages, using the rough and processed research data,
- The key focus area "Basis" with the organizational and technical measures that are necessary to set up electronic services on a national level and for their long-term operation,
- and "Services" with the implementation measures that build on this foundation and enable the processing, preparation and subsequent use of research data, e.g. in the field of e-Learning.

Each key area of focus was assigned a rough budget framework for the duration of the program. The four key areas of focus and their budgets are outlined below:

1. **Publications:** Expanding the number of electronically available publications and improving access to electronic scientific information. In the area of open access, the green road will take priority in terms of funding.

> Approximately CHF 22 million is available for these tasks.
> CHF 5 million has been estimated for ongoing operation from 2017.

2. **eScience:** Supporting data lifecycle management and the long-term preservation or archiving of research data through concepts, tools and cloud computing support. Cooperation across institutional boundaries is crucial for these projects.

> These projects are to be financed in stages up to an approximate total of CHF 3 million.
> Ongoing operation from 2017 is estimated at CHF 1 million.

3. **Basis:** Creating the technical and organizational prerequisites for providing services at a national level.

> Approximately CHF 7 million is available for this area.
> The financing of ongoing operation from 2017 is estimated at CHF 3 million.

4. **Services:** Expanding existing "informal" services (service design, service description, SLA, costs and charging), publication on the service portal and setting up relevant advisory boards.

> Approximately CHF 5 million is available for these tasks.
> Ongoing operation from 2017 is estimated at CHF 1 million.

The funds for Program Management and setting up the national organization are included in the implementation actions and budget.

The budgets for the four key areas of focus are to be understood as benchmarks. Adherence to the budget depends on the viable project proposals received.

Some, but not all, of the planned services are to be self-sustaining from 2017. For continuing the services that have been set up, the budget from 2017 was estimated very roughly, based on the sub-strategies, and amounts to CHF 10 million per year.

5.3 Implementation actions

The below table presents an overview of all the implementation actions and budgets for the program. Each action has been given a priority. As some actions build on other completed ones, they have also been roughly assigned to phases 1-3. Phase 1 actions can be applied for immediately, while actions from phases 2 and 3 can only be applied for when prerequisites have been met.

The following funding recommendations have been combined to form one recommendation:

- CC-4 → DM-4
- DM-6 → WE-2
- EL-5 → EP-3
- EP-11 → WE-2
- NO-2 → WE-1

No.	Implementation action	Priority (1-3)	Phase (1-3)
Publications:	**CHF 22 million (until 2016), CHF 5 million per year (from 2017)**		
EP-1	An application by the Consortium of Swiss Academic Libraries to purchase national licenses for selected publications. The application: a) explains the planned selection criteria b) is based on the DFG's funding criteria c) takes into consideration the changes to the Consortium's organization as a result of its new task Given the national importance of this proposal, SUC P-2 will consider contributions to current content licences as matching funds. The program assumes that the Consortium will support negotiations for open-access options for the current licenses.	1	1
EP-2	Setting up a study to monitor the publication behavior of researchers in Switzerland.	1	1
EP-4	Cooperation projects to improve communication about publishing terms and conditions and authors' rights.	1	1
EP-6	Projects to improve the interoperability of repositories and digitization platforms.	1	1
EP-8	Participation in the SNSF's or the universities' gold OA applications: Contributions to publishing costs, memberships of OA publishing houses, participation in disciplinary OA consortia.	2	1
EP-9	Converting publications owned by universities, scientific societies etc. to an open access model.	2	1
EP-10	*EP-10 is replaced by the actions EP-10a, b, c, d and e. Refer to the separate document "Hauptstossrichtung Publikationen, Umsetzungsmassnahme EP-10, Digitalisierung: Angepasste Strategie und Umsetzungsmassnahmen" (31.03.2015), available in German and French.*	1	1
EP-12	Cooperative projects for authority files and for improvements in the quality of standardized metadata.	2	1
WE-2	Specifying and implementing a search solution for scientific publications and research data with a metadata hub and search engine, preferably as an extension to an existing solution. (Includes EP-11 and DM-6)	1	1
eScience:	**CHF 3 million (until 2016), CHF 1 million per year (from 2017)**		
DM-1	The development of concepts for data lifecycle management, extracting and providing metadata, and long-term storage and archiving. The concepts must define the necessary processes, interfaces and guidelines.	1	1
DM-2	The expansion of established local solutions to create services which meet the requirements defined in DM-1 and allow for sustainable operation because of the users and the business case.	1	2
DM-3	Pilot projects which use the services on offer.	1	2
DM-4	The establishment of a support body for data management and cloud computing questions (e-Science team). (Includes CC-4)	1	1
DM-5	Training modules on data management and metadata.	1	2
CC-5	Training modules for the use of cloud resources.	1	1
Basis:	**CHF 7 million (until 2016), CHF 3 million per year (from 2017)**		
IM-1	SWITCH is invited to submit a project application for the development of the Swiss edu-ID on the basis of the Identity Management sub-strategy. The application must: a) take into consideration the requirements presented by the other fields of activity b) propose a well-supported advisory board for appointments c) include a business plan for the operation of a Swiss edu-ID d) justify the subsidy that has been applied for and the proposed own funding (the subsidy and the own funding must be kept separate, taking into consideration the business plan for operation)	1	1
IM-2	Pilot applications for linking community identifiers (such as ORCID) with identity management.	2	2

No.	Implementation action	Priority (1-3)	Phase (1-3)
IM-3	The development of systems which allow for the authentication and authorization of non-web resources via the interface to the Swiss edu-ID.	2	2
WE-1	Service platform: Requirements specification and evaluation of a software platform for the management interface, definition of a standard for the inclusion and management of services and establishing the interfaces and guidelines. (Includes NO-2)	2	2
WE-3	Specification and implementation of a group administration system which supports digital rights management and the administration of roles and subgroups, together with work scenarios. The solution provides interfaces that allow other services to use the group administration system. (WE-3 depends on the availability of a new identity management solution and requires close cooperation.)	2	2
WE-4	If required: Creation of the development and execution platform. (It is essential that WE-4 is based on WE-1.)	3	3
WE-7	If required: Creation of a self-registration function for the service catalog.	3	2
EP-3	The establishment of competence centers for copyright and authors' rights, as well as rights to data and open access. Potential candidates are invited to apply. (Proposals which exploit synergies with other fields of activity will be given priority.) (Includes EL-5)	1	1
CC-1	The development of cloud services on a national level (service description, SLA, Marketing, advisory board). However, the infrastructure costs must be paid by the service users (business case).	1	1
CC-2	Cooperative integration projects which involve aspects of cloud computing and propose or implement solutions. The subject areas include access management, reporting, charging, legal solutions, hybrid cloud and integration into international e-infrastructures.	1	2
NO-1	Program office/national organization	1	1
Services:	**CHF 5 million (until 2016), CHF 1 million per year (from 2017)**		
WE-5	If required: Creation of a personalized working environment with a cockpit that gives access to services and information.	3	3
WE-6	If required: Integration of services which support cooperation (collaborative functions) and data management (lifecycle management, reuse of research data).	3	2
EP-5	Providing access to existing high-quality repositories for interested researchers in Switzerland as a national service.	2	1
EP-7	Opening up open access publishing platforms (for example on the basis of Open Journal Systems) as a national service.	2	1
EL-1	The ongoing development (investment costs) of cooperative, interoperable solutions which will not be subject to competition from commercial solutions in the foreseeable future.	2	1
EL-2	The expansion of local services to create services open to participants.	2	1
EL-3	Additional costs (investment costs) of solutions of this kind.	2	1
EL-4	Cooperative pilot projects for solutions open to participants in new requirement areas (see the action items in e-assessment and knowledge transfer).	2	1
CC-3	Pilot projects which use the cloud services on offer.	1	2
Total funding grants:	**CHF 37 million (until 2016). Approximately CHF 10 million will be required each year from 2017.**		

Table 11: Implementation actions

5.4   Project applications and briefs

The goal of the program – the joint use of national services that are offered in a decentralized fashion by universities and university-related institutions – requires a change in attitude. The universities must be ready to participate in a new "market" as both providers and users – both "top-down" through the inclusion of management bodies (SUC/CRUS, university managements) and the sponsoring organizations (SBFI, SNSF) – and also "bottom-up", through the practical provision of high-quality offerings.

This process can only be controlled to a certain extent. It is largely dependent on whether the proposed implementation actions correspond to the universities' own projects. It is fundamentally the authorized institutions that are called upon to submit project applications (see Section 0). Only a few actions will be implemented directly in collaboration with service providers that already perform tasks that benefit all universities (namely SWITCH and the Consortium of Swiss Academic Libraries).

Usually, applicants are expected to make own funding contributions that are equal to the subsidy for which they are applying ("matching funds"). Collaborative projects are particularly welcome. The projects are to be funded regardless of affiliation to an institution. If a project is of little benefit to the institution leading it, a reduced own funding contribution can be requested.

Implementation projects should build on existing services as far as possible and take into account national and international standards and best practices.

If it transpires during the course of the program that there are no applications for projects that are necessary as a basis for a dynamic service infrastructure, the Program Management will initiate appropriate implementation measures in a targeted manner.

5.5   Evaluation

The project applications will be reviewed by a group of experts that will prepare recommendations for the attention of the Steering Committee. The Steering Committee will decide whether to approve applications. Advisory boards will be tasked with supervising development projects for national services. They should ensure that customer requirements are taken into consideration.

Project applications will be evaluated according to the following three criteria:

   A. Formal correctness (eligibility to apply, completeness, etc.)
   B. Compliance with the White Paper
   C. Quality

A and B will serve as filters and ensure a good standard before the quality is evaluated.
The quality of the project applications (C) will be evaluated using the following criteria:

- C.1 Benefits and strategic importance for the program:
     o Significance for the project portfolio
     o Impact
     o Quantifiable benefit (e.g. increase in efficiency)
     o International importance
- C.2 Feasibility:
     o Professional quality ("soundness of approach")
     o Chances of success
     o Project team (record of achievement/references)
     o Proximity to customers
     o Observance of legal frameworks
     o Consideration of technical conditions

- C.3 Financing model/ business case:
  - o Implementation costs
  - o Operating costs
  - o Sustainability
  - o Potential users
  - o Billing model

The key criterion for the approval of projects is sustainable national benefit. Prerequisites for this are the commitment, ability and reputation of the provider and evidence of sustainable financial viability thanks to a sufficiently large customer base (business case). The services should be available to the entire Swiss university community.

The evaluation process can be depicted in graphic form as below:
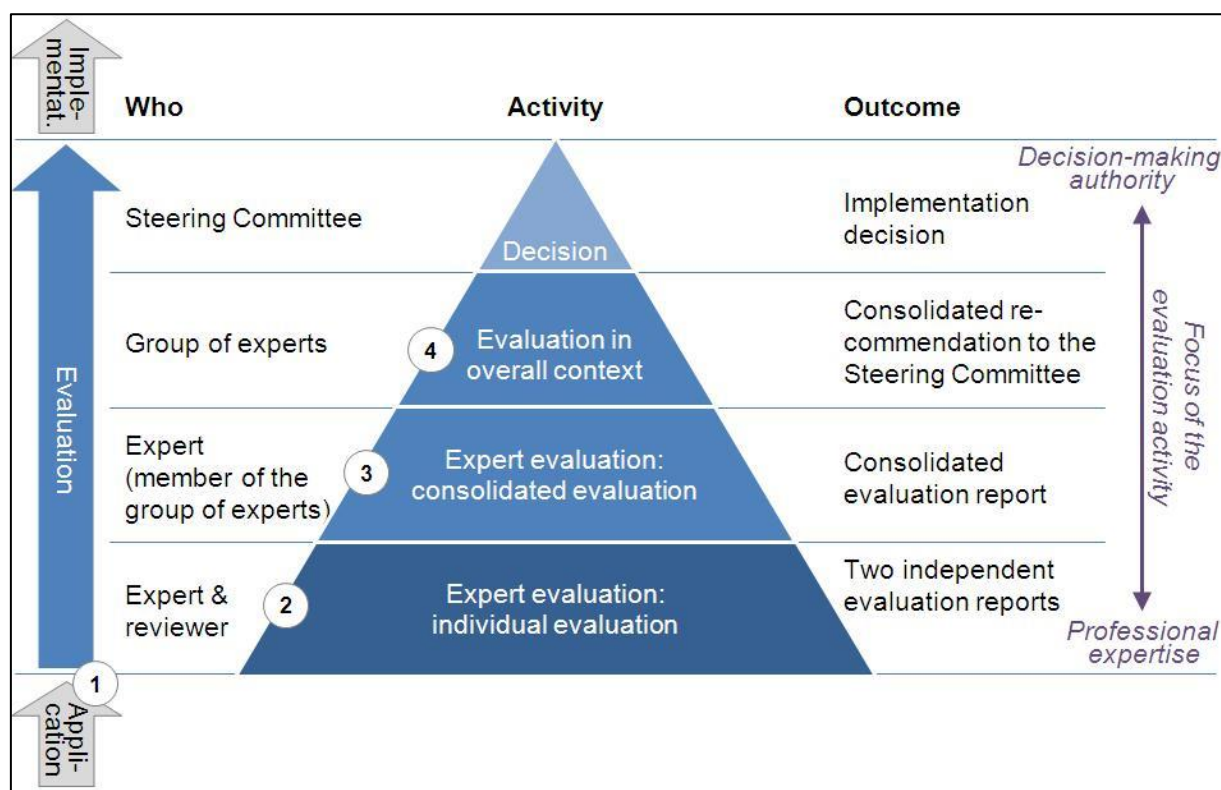
Figure 6: Evaluation process

The Steering Committee appoints a permanent group of experts to review the project applications. They are responsible for the specialist evaluation of project applications. The committee comprises seven to ten experts from Switzerland and abroad, who collectively meet the following requirements:

- Proven expertise
- (Political) independence
- Ability to speak several languages (German, French, English)
- A link to the Swiss federal system
- Appropriate diversity in terms of gender and age
- Availability (for travel)

External reviewers are also asked to evaluate the project applications.

The Steering Committee makes decisions about project applications based on the recommendations of the group of experts and ensures the support of higher education policy.

As the body responsible for the program, the SUC has the right to influence its course.

Annex A   International efforts

Table 12 below lists a sample of similar activities in other countries. The list details comparable programs and efforts in other countries. It makes no claim to be either complete or entirely up to date.

Horizon 2020 European Research Infrastructures, including e-Infrastructures	*Country:* EU, European Commission
	Description:
	The efficiencies of scale and scope achieved by a European approach to the construction, use and management of research infrastructures, including e-infrastructures, will make a significant contribution to boosting Europe's research and innovation potential. Activities aim at developing European research infrastructures for 2020 and beyond, fostering their innovation potential and human capital and reinforcing European research infrastructure policy.
	Link: http://ec.europa.eu/programmes/horizon2020/en/h2020-section/european-research-infrastructures-including-e-infrastructures
	Areas of overlap with Program SUC P-2: General CRUS P-2 program

Horizon 2020 Open Access, Open Data	*Country:* EU, European Commission
	Description:
	Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020 Guidelines on Data Management in Horizon 2020
	Link: http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf (11.12.2013) http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf (11.12.2013)
	Areas of overlap with Program SUC P-2: Fields of action "e-Publishing," "Data management"

Science Europe Roadmap	*Country: - (Science Europe)*
	Description:
	This Roadmap, approved by the Science Europe General Assembly on 21 November 2013, constitutes Science Europe's action plan to contribute to the elements of a successful research system. It acts as a framework for voluntary collective activity, providing a long-term strategy, which will be reviewed regularly and updated as the research landscape, and Science Europe itself, evolves. The Roadmap identifies nine Priority Action Areas: • Access to Research Data • Cross-border Collaboration • Gender and Other Diversity Issues • Open Access to Research Publications • Research Careers • Research Infrastructures • Research Integrity • Research Policy and Programme Evaluation • Science in Society
	Link: http://www.scienceeurope.org/uploads/PublicDocumentsAndSpeeches/ScienceEurope_Roadmap.pdf (December 2013)

	Areas of overlap with Program SUC P-2: General CRUS P-2 Program, fields of action "e-Publishing," "Data management"
LERU Open Access, Data Management	*Country: - (League of European Research Universities, LERU)*
	Description:
	The LERU Roadmap Towards Open Access LERU Roadmap for Research Data
	Link: http://www.leru.org/files/publications/LERU_AP8_Open_Access.pdf (June 2011) http://www.leru.org/files/publications/AP14_LERU_Roadmap_for_Research_data_final.pdf (December 2013)
	Areas of overlap with Program SUC P-2: fields of action "e-Publishing," "Data Management"
BSN - Bibliothèque scientifique numérique	*Country: France*
	Description:
	The Bibliothèque scientifique numérique (BSN) wants to place relevant scholarly information and high-performance tools at the disposal of every teacher, researcher and student. The BSN was created in 2009 on the initiative of the Ministry for Higher Education and Research ("ministère de l'enseignement supérieur et de la recherché"), drawing on numerous persons from universities and research institutions.
	Link: http://www.bibliothequescientifiquenumerique.fr
	Areas of overlap with Program SUC P-2: fields of action "e-Publishing," "Data Management"
Wissen-schaftsrat (German Council of Science and Humanities)	*Country:* Germany
	Description:
	Wissenschaftsrat (German Council of Science and Humanities): „Empfehlungen zur Weiterentwicklung der wissenschaftlichen Informationsinfrastrukturen in Deutschland bis 2020" Overall strategy for the further development of scientific information infrastructures in Germany.
	Link: http://www.wissenschaftsrat.de/download/archiv/2359-12.pdf (13.07.2012).
	Areas of overlap with Program SUC P-2: Application and general CRUS P-2 program, fields of action "e-Publishing," "Data Management"
Priority Initiative „Digital Organisation"	*Country:* Germany
	Description:
	The Priority Initiative "Digital Information" (2008-2017) is a joint initiative of the Alliance of Science Organisations in Germany that aims to improve the provision of information in research and teaching. The initiative is pursuing the goal of the Alliance of Science Organisations: to guarantee the broadest possible access to digital publications, research data and other source materials and thus ensure that they can be used in other research contexts; to create an optimal framework for the international distribution and reception of German publications and research data; to ensure the long-term availability of the digital media and contents that have been acquired from around the world and their integration in the digital

	research environment; and to support IT-based research by means of innovative information technologies and digital methods. On a commission from the Gemeinsame Wissenschaftskonferenz des Bundes und der Länder ("Joint Science Conference of the Federal and State Governments", GWK) the Commission "The future of information infrastructure" has been occupied with the question as to how researchers in future will have to deal with scientific information and data in order to secure them and make them accessible for further research processes. Under the guidance of the Leibniz Society, this high-powered group of experts has drafted an overall concept for this series of issues.
	Link: http://www.allianzinitiative.de/en/start/ http://www.allianzinitiative.de/fileadmin/user_upload/KII_Gesamtkonzept.pdf (April 2011)
	Areas of overlap with Program SUC P-2: fields of action "e-Learning," "e-Publishing," "Data Management"
"Taking digital transformation to the next level"	*Country: Germany*
	Description:
	Strategy Paper: Taking digital transformation to the next level: the contribution of the DFG to an innovative information infrastructure for research (03.07.2012). The development of a coordinated system of information infrastructures for scientists and scholars should be understood as a dynamic process in which researchers' technical working environments and their needs as users are both interdependent and subject to continuous change and adaptation. Against this backdrop, the present strategy paper Taking Digital Transformation to the Next Level: The Contribution of the DFG to an Innovative Information Infrastructure for Research further develops the funding strategies for scientific library services and information systems which the DFG has been pursuing since 2006. It discusses current challenges to scientific information infrastructures, takes on new developments, and identifies areas to be enhanced with targeted funding initiatives.
	Link: http://www.dfg.de/download/pdf/foerderung/programme/lis/strategy_paper_digital_transformation.pdf (03.07.2012)
	Areas of overlap with Program SUC P-2: fields of action "e-Publishing," "Data Management"
SURF's seventh Strategic Plan	*Country:* The Netherlands
	Description:
	SURF is the collaborative organisation for ICT in Dutch higher education and research. SURF brings together ICT professionals within networks and collaboration projects for knowledge sharing with regard to ICT-driven innovation. By making innovations available at attractive conditions and facilitating connections between technology and people, SURF ensures the continued optimal utilisation of the opportunities offered by ICT. Thanks to SURF, students, instructors and researchers in the Netherlands have access to the best possible Internet and ICT services. Every four years, SURF sets out its strategic policy aims in a Strategic Plan, mapped out in coordination with the affiliated institutions. This plan sets out the main ICT developments that will be impacting on higher education and research over the years ahead.

	SURF's seventh Strategic Plan in a row describes the developments in ICT for Dutch higher education and research for the period 2011-2014. It also highlights the priorities.
	Link: http://www.surf.nl http://www.surf.nl/en/knowledge-and-innovation/knowledge-base/2010/surfs-strategic-plan-2011-2014.html (15.06.2010)
	Areas of overlap with Program SUC P-2: all fields of action
JISC programmes	*Country:* UK
	Description:
	Jisc programmes support and innovate the use of ICT in education and research. Vision: To make the UK the most digitally advanced education and research nation in the world. Mission: To enable people in higher education, further education and skills in the UK to perform at the forefront of international practice by exploiting fully the possibilities of modern digital empowerment, content and connectivity.
	Link: http://www.jisc.ac.uk/whatwedo/programmes/
	Areas of overlap with Program SUC P-2: alle Handlungsfelder
XSEDE - The Extreme Science and Engineering Discovery Environment	*Country:* US
	Description:
	XSEDE is the most powerful and robust collection of integrated advanced digital resources and services in the world. It is a single virtual system that scientists can use to interactively share computing resources, data, and expertise. Scientists and engineers around the world use these resources and services - things like supercomputers, visualization and data analysis systems and tools, and data collections - to propel scientific discovery and improve our lives. They are a crucial part of research in fields like earthquake modeling, materials science, medicine, epidemiology, genomics, astronomy, and biology. XSEDE supports 16 supercomputers and high-end visualization and data analysis resources across the country. More details on these resources are available on the Resources area.
	Link: https://www.xsede.org/
	Areas of overlap with Program SUC P-2: Handlungsfeld „Cloud Computing", „Working Environment", „e-Learning"

Table 12: International efforts

Annex B   Bibliography

Label	Title	Author	Web address	Checked
FHSG	SR 414.71: Bundesgesetz über die Fachhochschulen (Fachhochschulgesetz) vom 06.10.1995 www.admin.ch/opc/de/classified-compilation/19950279 (17.01.2014)	Die Bundesversammlung der Schweizerischen Eidgenossenschaft	http://www.admin.ch/opc/de/classified-compilation/19950279	14.04.2014
FIFG	SR 420.1: Bundesgesetz vom 14.12.2012 über die Förderung der Forschung und der Innovation	Die Bundesversammlung der Schweizerischen Eidgenossenschaft	http://www.admin.ch/opc/de/classified-compilation/20091419	14.04.2014
HFKG	Bundesgesetz über die Förderung der Hochschulen und die Koordination im schweizerischen Hochschulbereich, Vernehmlassungsfassung vom 30.09.2012 (Zum Zeitpunkt der Veröffentlichung des White Paper ist dieses Gesetz noch nicht in Kraft)	Die Bundesversammlung der Schweizerischen Eidgenossenschaft	http://www.admin.ch/opc/de/federal-gazette/2011/7455.pdf	14.04.2014
PRG_P2	Über das SUK-Programm 2013-2016 P-2 "Wissenschaftliche Information: Zugang, Verarbeitung und Speicherung"	CRUS	http://www.crus.ch/isci	14.04.2014
PRG_P2-A	Program request: SUC 2013-2016 P-2 „Scientific information: access, processing and safeguarding"	CRUS	http://www.crus.ch/isci	14.04.2014
PRG_P2-B	Foundations for the strategy	Consulting Team (IBM Schweiz AG)	http://www.crus.ch/isci	14.04.2014
PRG_SUK	Übersicht über die SUK-Programme in der Finanzierungsperiode 2013-2016	SUK	http://www.cus.ch/wDeutsch/beitraege/2013-2016/SUK-Programme/index.php	14.04.2014
SERI_RM	Swiss Roadmap for Research Infrastructures	SERI	http://www.sbfi.admin.ch/themen/01367/02040/index.html?lang=en	14.04.2014
UFG	SR 414.20: Bundesgesetz vom 8.10.1999 über die Förderung der Universitäten und über die Zusammenarbeit im Hochschulbereich (Universitätsförderungsgesetz)	Die Bundesversammlung der Schweizerischen Eidgenossenschaft	http://www.admin.ch/opc/de/classified-compilation/19995354/index.html	14.04.2014

Table 13: Bibliography

Annex C   Glossary and list of abbreviations

Abbreviation	English	Explanation / Web address
CRUS	Rectors' Conference of the Swiss Universities	http://www.crus.ch
eduhub	eduhub is a community for new learning technologies at Swiss institutions of higher education.	https://www.eduhub.ch
e-sic	e-science	
EPFL	Ecoles Polytechnique Fédérale de Lausanne	http://www.epfl.ch
ETH	Swiss Federal Institute of Technology Zurich	http://www.ethz.ch
ETWG	Educational Technology Working Group	https://www.eduhub.ch/community/etwg-educational-technology-working-group/
FIFG	Federal Act on the Promotion of Research and Innovation	See bibliography
HFKG	Federal Act on the Funding and Coordination of the Higher Education Sector (Higher Education Act)	See bibliography
JISC	Joint Information Systems Committee	http://www.jisc.ac.uk
OA / Open Access	Open Access promotes free access to scientific publications funded by the public. It expects researchers to self-archive their publications or publish in open access journals.	http://www.snf.ch/en/researchinFocus/dossiers/open-access/Pages/default.aspx
OAIS	Open Archival Information System (ISO 14721)	http://public.ccsds.org/publications/archive/650x0m2.pdf
ORCID	Open Researcher and Contributor ID	http://orcid.org/
SERI	State Secretariat for Education, Research and Innovation SERI	http://www.sbfi.admin.ch/
SLA	Service Level Agreement	
SNSF	Swiss National Science Foundation	http://www.snf.ch
SUC	Swiss University Conference	http://www.cus.ch
SWITCH	SWITCH provides innovative, unique internet services for the Swiss universities	http://www.switch.ch
UFG	Federal Act on University Funding and Cooperation in the Field of University Education (University Funding Act)	See bibliography

Table **14**: Glossary & list of abbreviation

Annex D   Sub-strategies

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for identity management

Version 1.0: 11.10.2013
Contact: isci@crus.ch

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Roberto	Mazzoni	Universität Zürich/UZH
Wolfgang	Lierz	ETH Library

1. National services within the field of action

Scientific information is created and accessed by individuals. We want to make those individuals more efficient, more effective and ultimately more successful. Reshaping the identity services of our community is one aspect of supporting that goal.

1.1. S-1: Electronic identity

For over a decade, the Swiss academic community has been supported by a federated identity management solution: SWITCHaai. All individuals affiliated to any organization of the academic community may use their "AAI account" to access services provided by their own organization or elsewhere with one set of credentials. The service S-1 "Electronic Identity" will build upon the achievements of SWITCHaai, improve on its support for lifelong learning and will realize synergy gains by centralizing some functions of identity management under the brand name "Swiss edu-ID". In particular, it will address the following shortcomings:

- Identity management linked to the affiliation with one single organization
- Lack of support for aggregating attributes from multiple sources
- Inability to deal properly with people with no or multiple affiliations
- SWITCHaai offers very good support serving individuals behind a web browser, but shows weaknesses when serving non-web-resources or when supporting mobile environments

In a nutshell: User-centrism is the paradigm of the "Swiss edu-ID" and is replacing the primary-organization-centric approach of today's SWITCHaai. When "Swiss edu-ID" is rolled out, identity management support will continue when individuals leave university. And it is still available in case they return to university, e.g. for continued education.

1.2. S-2: Portfolio

The portfolio service NS-2 is a place to store all achievements of an academic career: diplomas, certificates, publications, etc. As we can see, this only works in a user-centric environment: in a SWITCHaai scenario, students typically get their diploma at the moment that they lose their SWITCHaai identity and at the same time lose access to their portfolio service. In a "Swiss edu-ID" scenario, they keep their identity and can continue to access the portfolio service and thus the electronic representation of their diplomas and certificates.

2. Foundations, key functions and services

2.1. Overview

2.1.1. Electronic identity

All services offering personalization require some form of identity management. Instead of leaving it up to each and every service to deal with identity management, it is proposed to harmonize and to partially centralize identity management in the education and research environment in Switzerland and therefore establish the service "Swiss edu-ID". Service elements include:

- User-centric, unique and persistent (preferably lifelong) identity service available to all academic users in Switzerland, not depending on a current affiliation with an organization. It is specifically designed to survive changes in affiliation and status and should even support users who were never affiliated with any Swiss university but are only registered to use their services, such as libraries in particular.
- This identity should offer the capability to survive the owner of the identity and maintain the link between authors and publications, even after the death of the author.
- This unique identity acts as container to host or link to resources hosting additional information about the user owning this identity, such as affiliations, roles and rights.

- This identity service will largely be based upon the technical standards of the existing SWITCHaai framework
- The roll-out of the identity service is implemented as a migration from the current SWITCHaai service.
- Interoperability to similarly scoped, relevant identity services - nationally and internationally - is important for services addressing a multinational audience. On the national level, the SuisseID needs to be investigated as a priority. The eID activities of the EU need be investigated as the international extension of the SuisseID and the inter-federation service of GÉANT and eduGAIN as the international extension of the SWITCHaai.

2.1.2.   Portfolio

Contrary to the existing SWITCHaai service, "Swiss edu-ID" identities will survive the affiliation of individuals with a particular organization. In a typical SWITCHaai scenario, identity management support stops working once a student receives a certificate or diploma and leaves the university. But since "Swiss edu-ID" continues to offer identity management to students leaving university, it can support lifelong learning scenarios much better. The portfolio service envisaged will allow all lifelong learners to keep their certificates in one place, if they wish to do so. The e-Portfolio service proposed in the e-learning sub-strategy offers similar functionality and also proposes to host portfolio documents as referenced above, and preferably electronically signed to make them unforgeable.

2.2.   Existing services and ongoing projects

The service SWITCHaai, which is well established and operates very successfully, is the basis upon which the "Swiss edu-ID" will be built.

Several projects address shortcomings of the SWITCHaai with community-specific approaches (e.g. the SSO private IDP "libraries.ch" project of the ETH Library, currently under development). Those projects may provide valuable experience for building the "Swiss edu-ID". A timely set-up of the "Swiss edu-ID" will help to address the risk that those projects will have to build many infrastructure elements on their own, and that working together with "Swiss edu-ID" will be hampered in the longer run.

2.3.   International references and standards

The higher education sector, and even more so the research sector, enjoys strong international collaboration. It is therefore of utmost importance that international trends are followed up on, or even influenced to stay compatible with the approach to identity management solutions being created in Switzerland. One such example is the eduGAIN service of GÉANT, where SWITCHaai is participating.

e-Gov standards and initiatives for identity management may become relevant to our environment once they become reasonably pervasive and easily accessible. The SuisseID currently does not fulfil those criteria, but should be kept under observation. The same applies to the international framework of the SuisseID, the eID framework of the EU (STORK project).

Existing user-centric approaches without organizational backing currently lack important trust properties (e.g. social media platforms, OpenID). But once important players start using them, they might become very important and add value to our community. While Mozilla persona/OpenBadges is still in early stages of adoption, ORCID seems to be becoming the de facto standard for identifying authors of scientific publications and for providing long-lived, bidirectionally unique, personal identifiers to authors. Mozilla persona/OpenBadges should be kept under observation and specific use cases might get piloted. ORCID should be considered for integration with "Swiss edu-ID" by making the ORCID-identifier an attribute.

Collaboration with initiatives of similar scope should be actively pursued. We are not aware of existing national services similar in scope to the envisaged "Swiss edu-ID", but the eduID.se initiative of the Swedish research and education network SUNET serves similar goals and collaboration should be sought.

2.4.   Innovation required

Moving from an organization-centric to a user-centric identity management solution for our community is at the core of this sub-strategy. A well-established, organization-centric identity management service exists in Switzerland - SWITCHaai -, as well as many relevant building blocks and frameworks for moving towards a user-centric solution. But we are not aware of operational services elsewhere, which could serve as blueprint for our own solution. We therefore need to address the implications of user-centrism and develop new services:

- A centrally provided identity management platform, which is designed for longevity and provided on "neutral ground" in the sense that it is not tied to the users' organizational affiliations.
- Agree on a legal framework of rights and obligations of all involved parties
- Agree on a sustainable, financial framework
- Extend the existing attribute specification of SWITCHaai to deal appropriately with multiple, simultaneous information providers adding attributes, and to allow for historic attributes (e.g. earlier affiliations).
- Agree on a technical and organizational framework, including migration scenarios from the current organization-centric model to the future user-centric electronic identity

SWITCHaai is primarily designed to support scenarios where individuals behind a web browser are accessing web-based resources. Serving non-web-resources and supporting mobile environments in an effective way requires extensions and likely also architectural changes. Conceptual work and service prototyping is needed in this area.

The national service NS-2, Portfolio, acts as long-term storage and presentation service for electronically available artefacts documenting one's personal career. Scanned and electronically signed paper-based certificates need be complemented with electronic artefacts better adapted to modern processes. The impact on the certificate-issuing processes at universities is expected to be substantial. Conceptual work and service prototyping is needed in this area and will cover issues related to electronic signing and verification processes, and also novel approaches to issuing certification, e.g. OpenBadges.

2.5.   Action items

Action Item 1: "Swiss edu-ID" high-level architecture

The main goal of this document is to describe the high-level architecture of the "Swiss edu-ID" service with an emphasis on those elements that extend the existing SWITCHaai service or deviate from it. At the core of this document is therefore the most important deviation from the existing SWITCHaai: the decoupling of identity management from the most important organization with which a user is currently affiliated. It will define a terminology (a "common language") to describe identity management entities and processes, e.g. identities, roles, profiles. It will cover the following aspects:

- scope (bearers of identities, e.g. real vs. dead people and imaginary figures/companies/ institutions, Swiss vs. international individuals),
- stakeholders, roles and responsibilities,
- privacy, security and legal aspects,
- impact on and integration into existing and future identity management processes of the universities,
- interoperability with existing academic and non-academic identity management systems,
- single sign-on functionality

Action Item 2: Attribute specification for user-centric identity management

The existing attribute specification of SWITCHaai needs to be reviewed and extended to support multiple, simultaneous attribute providers, to allow for historic attributes (e.g. earlier affiliations). At the same time, adding a set of self-provided attributes should be considered such as are known from social networks, such as avatars, nicknames etc., as should support for pseudonymity. The first

version of this specification will define the initial set of attributes for the "Swiss edu-ID" V1.0 and define the framework for adding additional attributes later. Those attribute specifications need to be available well in time for implementation in the next version of the "Swiss edu-ID".

Action Item 3: Studies on "Swiss edu-ID" interface extensions

Offering additional interfaces can be agreed to, after reviewing expected benefits and accepting the provisioning costs. Existing requirements from other fields of action back the following additional interfaces: API access (for service providers and attribute providers) will allow one to query the identity platform without user interaction, under strict guidelines. The OAuth interface (users and providers) is particularly suited for supporting mobile service scenarios. Other studies might deal with integration of non-AAI-ready resources and non-web-based resources (Computer login, WLAN).

Action Item 4: Service "Swiss edu-ID" V0.5

Many services envisaged from other fields of action require an identity management service backend, preferably already during early stages in their development phase. It is therefore important that the first version of the "Swiss edu-ID" be made available in a very timely fashion. V0.5 will offer a rudimentary identity management service platform largely based on existing service elements of the SWITCHaai test federation. Based on provisional specifications and interfaces, it will serve as a generic identity management backend of services. "Swiss edu-ID" V0.5 will be available at the end of June 2014.

Action Item 5: Service "Swiss edu-ID" V1.0

V1.0 of the "Swiss edu-ID" offers self-registration for individuals wishing to interact with institutions of tertiary education and research in Switzerland. It allows individuals the option of validating their self-provisioned personal core attributes to meet standard levels of assurance. The goal is to meet the requirements of library and e-Portfolio use for individuals without SWITCHaai accounts (currently under development within the SSO private IDP "libraries.ch" project of the ETH Library). This service will additionally allow individuals losing their existing SWITCHaai-access (e.g. ending their studies or changing their employer) to "migrate" to a "Swiss edu-ID". Even though only identities with a standard level of assurance are served, the service infrastructure is designed for serving identities with an advanced level of assurance. This service will be available by the end of 2014 for individuals and service providers.

Action Item 6: Legal and trust framework studies

Going from "Swiss edu-ID" V1.0 to V2.0 has one very substantial implication: While V1.0 serves attributes from one source only (the central service operator), V2.0 will serve attributes from a multitude of attribute providers. This is a necessary step for combining the organizational trust of the existing SWITCHaai with user-centrism with the "Swiss edu-ID" without the need to migrate between identity management platforms. But at the same time, it adds complexity to the legal and trust framework and increases the number of stakeholders. To prepare for this step, preparatory studies need be carried out. They need to cover the following issues:

- Legal framework: Roles and obligations of all participants, with a particular view to data protection issues and necessary actions. Development of legal guidelines. Foundation of a competence center. Provide training (something like DICE).
- "Swiss edu-ID" governance model: parties in charge of overseeing and guiding the "Swiss edu-ID" on an operational and strategic level.
- Trust level framework: quality level specs for attributes and authentication, with a special view to who needs to trust whom and how much.
- Personal identifiers: feasibility assessment for using personal identifiers, specifically the use of AHVN13 for the purpose of uniquely identifying individuals and using it as an attribute value.
- Special attention need to be granted to acceptance factors of end users.

Action Item 7: Service "Swiss edu-ID" V2.0

Subsequent versions of the "Swiss edu-ID" service will build on their predecessor and add functionality. A major additional functionality in V2.0 is the option of adding external attribute

authorities to enrich the set of attributes.

3. Dependencies and interfaces

3.1.   Prerequisites from other strategy projects

Identity management services act as an enabler for services in other fields of action. As such, identity management does not have specific requirements towards other fields of action. But on the other hand it only adds value when used in a pervasive manner by services in other fields. The most important expectation towards other fields of action is their willingness to make use of the identity management services at hand.

The identity management service hosts and conveys information about individuals between attribute providers and service providers using appropriate interfaces. The list of attributes and interfaces needs to be backed by clear needs and is subject to periodic review, taking into account benefits and provisioning cost. This boils down to the following elements:

- attribute requirements, benefits and provisioning cost
- interface requirements, benefits and provisioning cost
- services requiring identity management, currently not well served by SWITCHaaiTop of Form.

3.2.   External interfaces

The most important parties interacting with the identity service and their interfaces are described below:

3.2.1.   The user-facing interface: the owner of the identity managed by the "Swiss edu-ID" service

A web-based self-service portal - as part of the identity management service - allows the user to view all attributes available about himself (the owner of the identity), to identify the source of those attributes, and to control the release of those attributes to service providers. It also serves as a focal point to initiate and support identity management processes, e.g. validation and revalidation of supporting documents and attributes (e.g. ORCID, passport/ID card references, postal address).

3.2.2.   Attribute authorities: contributors of attributes

- Attribute authorities need to control the context in which information (attributes) about users is made available to service providers
- This interface follows the SAML standard and stays the same as in use by SWITCHaai

3.2.3.   Service providers: operators of services relying on a well-functioning identity management service

- Service providers rely on getting enough information about users requesting access, including an indication of trustworthiness of this information
- This interface follows the SAML standard and stays the same as in use by SWITCHaai

3.2.4.   Other interfaces

Offering additional interfaces can be agreed to, after reviewing expected benefits and accepting the provisioning costs. Existing requirements from other fields of action back the following additional interfaces:

- API access (for service providers and attribute providers): This interface will allow one to query the identity platform without user interaction, under strict guidelines.
- OAuth interface (users and providers): This interface is particularly suited for supporting mobile service scenarios.

3.3.   Further dependencies and relevant external factors

AHVN13 is a bidirectionally unique identifier issued by the Swiss government to individuals, either at birth or at immigration time. It is mandatory for all employees in Switzerland, but also for all students of Swiss universities. It is used (among others) for reporting to the statistics department of the Swiss government. Using AHVN13 as an attribute in the electronic identity is desirable, as it could result in increased quality and considerable savings, but its use is heavily regulated and restricted to the social insurance area and only partly for the education area. The implications of making AHVN13 available to the electronic identity need be assessed.

The core standards of SWITCHaai were chosen back in 2003, in particular SAML. While SAML is expected to stay the primary standard for identity federations for the foreseeable future, other standards exist, namely OAuth and OpenID, and need be reviewed periodically so that they are supported in addition to SAML.

SWITCH has been operating the central parts of the SWITCHaai since its inception. Due to its ability to provide reasonably "neutral ground" and its being tightly rooted in the research and education community of Switzerland, SWITCH is also well positioned to assume the role as operator of the "Swiss edu-ID". It is proposed to make an early decision about the operator of the "Swiss edu-ID" due to the dependencies of all other National Services on timely provisioning of the envisaged identity service.

4. Economic efficiency/availability of funding

4.1.   Implementation costs

4.2.   Operational costs

The SWITCHaai service has been running for over a decade on a sustainable business model. Service and identity providers provide their respective services out of their own budget and also cover their respective operational costs out of their own regular budgets. The centrally operated services run by SWITCH are covered through contributions of all SWITCH primary customers. Contrary to the operational model of SWITCHaai, registered end users are not necessarily affiliated with a SWITCH primary customer.

The cost sharing/business model will be further refined in action items, but the following properties are assumed at this moment in time:

- As much as possible, stakeholders should continue to pay for the components under their direct control following the example of the SWITCHaai.
- A cost-sharing model needs to be found for centrally operated services on behalf of the whole community, or potentially for stakeholders contributing substantially more than their "fair share".
- No charge is foreseen to be levied from registered individuals for basic identity management. This avoids setting up a complex billing infrastructure and helps to achieve maximum coverage of users. From an end-user perspective, identity management is not creating value *per se*; the value of identity management lies in the services it enables.
- It is for the reason above that the cost-sharing model relies on contributions from services relying on the "Swiss edu-ID", rather than on contributions from end users. A "sponsoring scheme" might help to identify specific services of relevant common benefit to add to the cost-sharing model (with some form of sponsoring letter from SWITCHaai participants, known from SWITCHaai)

- The relative stability of charges incurred per year is important for many stakeholders in the public sector and should be accepted as a design goal of the cost-sharing model.

4.3.   Customer benefit

Unique identification and access provision across the Swiss higher education landscape.

Central identity management is mainly an investment in infrastructure. Direct benefits are small compared to benefits generated from projects / process improvements built on central identity management. Nevertheless, some benefits are generated directly or by integrating the newly planned "Swiss edu-ID" combined with the existing AAI service.

For this implementation of central identities linked to local accounts & identity implementations, benefits to different customer groups will occur. Currently we see three main groups gaining benefits from the "Swiss edu-ID":

4.3.1.   Benefits from an end-user's perspective:

- Reduction of effort when changing attributes: Centrally synchronized ID attributes are available in all attached systems after changing, which reduces effort on the part of the user.
- It will be possible to identify persons definitely, for example in collaboration or library systems, regardless of their local login; this eases the establishing of contacts.
- A user will be able to use any of his logins across all higher education platforms, but will get the same access rights depending on his central identity. This way, the end user working at several institutions will be able to use only one login and does not need to maintain different ones.

4.3.2.   Benefits from SWITCH / the IT department's perspective

- The centrally provided identity will be the base for the provision of cloud-based-services.
- Eases the administration of users / profiles for inter-institutional platforms.

4.3.3.   Benefits from the administration's perspective

- Administrative processes can be streamlined, as already existing persons do not need to be identified / locally created for admission services a second time.
- Local effort is minimized on address / name changes also inter-institutionally.
- (Future scenario:) The "Swiss edu-ID" can be the base for outsourcing specific internal university services.

5. Implementation plan and risks

5.1.   "Swiss edu-ID" high-level architecture

The "Swiss edu-ID" high-level architecture document is the foundation for building up the service elements of the "Swiss edu-ID". It is therefore very time-critical, and efforts should be made to ensure timely delivery. It is proposed to mandate this document instead of putting it to an open tender.

5.2.   Studies

Studies will be devoted to resolving open issues and making it possible to completely define the scope and the architecture of the "Swiss edu-ID" in an iterative fashion. Such studies can be commissioned any time, but must be completed at least six months ahead of the planned delivery date of the next "Swiss edu-ID" Version for which it is envisaged.

5.3.   "Swiss edu-ID" V0.5

Timely provision of an identity backend for testing purposes is crucial for the development of services relying on an existing identity service. "Swiss edu-ID" V0.5 will be available at the end of June 2014. It will largely be based on existing service elements of the SWITCHaai test federation.

5.4.   Attribute specification for user-centric identity management

The attribute specification is an important input document for the design of the "Swiss edu-ID". For "Swiss edu-ID" V1.0, it needs to be available by mid-2014. It is therefore proposed not to put this action item to an open call, but to directly mandate it to SWITCH, which should fulfil this task by collaborating with the people involved with specifying the attributes of SWITCHaai.

5.5.   "Swiss edu-ID" V1.0

"Swiss edu-ID" V1.0 will allow the registration of individuals on a production platform with basic functionality. It will be available by the end of 2014.

5.6.   Legal and trust framework studies

These sub-studies are required input for the implementation of "Swiss edu-ID" V2.0, which will be the final version made available during the CRUS-P2. These studies will involve many stakeholders and need tight management by a well-networked coordinator. The final outcomes of all sub-studies need to be achieved by mid-2015.

5.7.   "Swiss edu-ID" V2.0

Subsequent versions of the "Swiss edu-ID" add additional functionality. V2.0 will offer the inclusion of externally provided attributes. It will be available by the end of 2015.

5.8.   Pilot projects

A number of CRUS P-2 projects must be selected to provide input about "Swiss edu-ID". A strong interaction between those projects and the development of "Swiss edu-ID" V1.0 and "Swiss edu-ID" V2.0 is expected and must be managed.

The selection of the pilot projects needs engagement at program level and may occur based on the following (partially conflicting) criteria:

- Timeline of projects: pilot projects that wishing to influence "Swiss edu-ID" V1.0 must be able to deliver input before the start of the development of "Swiss edu-ID" V1.0 (June 2014) and pilot projects based on "Swiss edu-ID" V1.0 will have to provide feedback until June 2015.
- Sequence of projects: pilots should be selected based on a (yet to be defined) sequence of projects. For instance, a project about providing raw storage space could be a prerequisite for a project about delivering remote data backup services and therefore should be given priority.
- Merit: pilot projects should satisfy criteria (yet to be defined) such as sustainability, meaningfulness, coverage of needs, innovation, … (similar to AAA projects).
- Even distribution across areas: each area should, if possible, be granted a pilot project (this is a political consideration to ensure momentum in each area).
- Candidate pilots might include: Service prototypes for private library customers, cloud storage, WLAN access, e-portfolio, ORCID, attestation services for validating paper diplomas and certificates etc.

5.9.   Risks

It is a well-accepted fact that the existing organization-centric identity management shows serious deficiencies in trying to guarantee seamless access to scientific information in an environment exposed to life-long learning and migrating researchers. It is equally well accepted that user-orientation is the key to overcoming these hurdles. But the transition is not easy and the devil is in the detail. While most of the technical components are available and well tested, the business concepts behind this transition are not. The highest risks associated with identity management and establishing "Swiss edu-ID" services therefore are therefore primarily located in the consensus-finding process of action item IM-1 ("Swiss edu-ID" high-level architecture) and action item IM-6 (Legal and trust framework studies). It is therefore proposed to start as soon as possible with action item IM-1, and to start with action item IM-6 shortly after concluding action item IM-1. This will ensure that major obstacles are identified and dealt with early enough in the process not to endanger the success of the program.

6. Conclusions and priorities

Action Item	Impor-tance	Alignment with program goals	Availability of funding / business case	Implemen-tation risks	National benefit	Implemen-tation effort	Operation al effort
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
"Swiss edu-ID" high-level architecture	1	1	1	4	1	1	0
Attribute specification for user-centric identity management	1	1	1	3	3	1	1
"Swiss edu-ID" V0.5	2	1	1	1	2	1	1
"Swiss edu-ID" V1.0	1	1	1	2	2	3	2
Legal and trust framework studies	1	1	1	6	1	2	0
"Swiss edu-ID" V2.0	1	1	1	3	1	3	2
Studies on "Swiss edu-ID" interface extensions	3	1	1	3	3	1	0

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for working environment

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1. National Services Within the Field of Action

Das Arbeitsgebiet Working Environment umfasst gemäss den Grundlagen zur Strategie insgesamt vier "Nationale Services":

- S-3: Unterstützung zur elektronischen Zusammenarbeit
- S-4: Service-Katalog und Self-Service von elektronischen Dienstleistungen
- S-5: Persönliche Ablage
- S-6: Ablage und Nutzung von gemeinsamen Daten

Zum besseren Verständnis der grundlegenden Architektur des Working Environment kann die komponentenbasierte Verwaltungsoberfläche mit der Benutzeroberfläche eines Smart-Phones illustriert werden, bei dem der Benutzer die einzelnen Services bzw. Applikationen in Form von Apps auf einer allgemeinen Oberfläche installiert bzw. verwaltet. Es gibt dabei eine allgemeine Oberfläche, im Prinzip eine Art Cockpit, von der aus alle Software-Services verwaltet werden sowie innerhalb dieser Umgebung eine Reihe mehr oder weniger unabhängig voneinander installierter Software-Module, die mehr oder weniger stark über die Ebene der Verwaltungs-Software bzw. untereinander verbunden sind.

Aufbauend auf diesen vier Grunddienstleistungen und den damit zusammenhängenden Funktionsblöcken sowie den darunter liegenden Use Cases wurde ein Grundkonzept für eine Arbeitsumgebung entwickelt, das den nachstehenden Anforderungen genügen soll bzw. für das nachstehende Prämissen formuliert werden (siehe auch Abbildung 1 unter Punkt 5 Implementation Plan):

1. Im Zentrum des Working Environment steht ein Cockpit oder Dashboard als Single-Point of Access, von dem aus die Benutzer und Benutzerinnen alle Services überblicken, zusammenstellen, verwalten und steuern.
2. Es soll demnach kein umfassendes Portal zur Verfügung gestellt werden, in dem alle Services fertig und einheitlich integriert sind.
3. Die Services stellen sich in diesem Kontext vielmehr als modulare Komponenten einer variabel gestaltbaren und personalisierbaren Verwaltungsoberfläche dar.
4. Die Integration der Services geschieht über a priori definierte und standardisierte Schnittstellen (APIs).
5. Innerhalb dieser Arbeitsumgebung soll die institutionelle, aber auch die länderübergreifende Kollaboration in den Gebieten des Data Management, E-Publishing und E-Learning gewährleistet sein.
6. Der Zugang zur Arbeitsumgebung geschieht über das Identity Management.
7. Die digitalen Ressourcen (Rechen- und Speicherkapazität) werden über das Cloud Computing zur Verfügung gestellt.
8. Die Verankerung in der schweizerischen Hochschullandschaft wird über eine nationale Organisation sichergestellt.
9. Die Entwicklung der Services im Sinne des User Experienced Design muss sichergestellt werden.
10. Die Einbindung der Services geschieht über ein Clearing House.

2. Foundations, Key Functions and Services

2.1. Overview

Die vier nationalen Services können als grundlegend für eine umfassende wissenschaftliche Infrastruktur angesehen werden und sind, vom Standpunkt des kollaborativen Managements des Datenlebenszyklus gesehen, eng miteinander verflochten. So bilden die persönliche als auch die gemeinsame Ablage und Nutzung von Daten die Grundlage für eine effektive virtuelle Zusammenarbeit, was letztlich zu einer Zusammenlegung von S-5 und S-6 führen sollte. Auf diesen Datensätzen bauen dann die kollaborativen Werkzeuge S-3 auf, die aus dem Service-Katalog der elektronischen Dienstleistungen ausgewählt und innerhalb der Arbeitsumgebung ausgeführt werden.

Die praktische Umsetzung dieser Services geschieht dann über die Ebene der Funktionsblöcke WE-1 bis WE-10.

Beschreibung der Funktionsblöcke aus der Sichtweise der Strategiegruppe

WE-1 Service Platform (vorher: Portal-Funktionen)
Die Service-Plattform stellt den zentralen Einstiegspunkt für die schweizweite Bereitstellung wissenschaftlicher Informationsressourcen und Dienstleistungen dar. Es handelt sich dabei um eine webbasierte Oberfläche bzw. ein Interface im Sinne einer Toolbox mit einem Single-Point-of-Access. Der Nutzer oder die Nutzerin (= Wissenschaftler, Forscherin, Dozent, Studierender) stellt sich hier seine Tools und Funktionalitäten zusammen und/oder sucht nach Ressourcen.

Ein (weiteres) allumfassendes Portal zu erstellen macht keinen Sinn. Stattdessen soll ein schlanker Service-Katalog im Sinne einer Toolbox dem Benutzer die externen Dienste anbieten. Die Anbindung der Dienste an einen Katalog anstelle einer Integration in ein Portal ermöglicht eine modulare Architektur mit einer losen Kupplung zwischen Dienst und Katalog. Als externe Dienste kommen sowohl bereits bestehende Angebote wie auch die neu zu erstellenden nationalen Services in Frage. Dienste sind nicht nur technischer Natur, sondern es kann sich auch um Dienstleistungen (Kompetenzzentren) oder Dokumentation handeln.

Die Funktionsblöcke **WE-5 Collaboration Support** (vorher: Collaboration-Funktionen) und **WE-6 Service Shop & License Store** (vorher: Funktionen für einen e-sic-App Store (User Self-Service, Software as a Service) werden WE-1 direkt zu- bzw. nachgeordnet und im Strategiepapier jeweils unmittelbar nach WE-1 besprochen.

Die in WE-5 angedachten Funktionen verstehen sich als integrative Bestandteile von WE-1. Es geht dabei weniger um die bereits existierenden kollaborativen Werkzeuge (wie Wikis, e-Meeting usw.) sondern um eine effektive Einbindung in die Service-Plattform, d.h. die Arbeitsumgebung.

Ebenso verhält es sich mit WE-6, bei dem jedoch der grösste Entwicklungsbedarf besteht, da bislang keine gut unterstützte und ausgereifte SaaS-Plattform bzw. ein damit einhergehender Katalog von Services existieren.

WE-2 Personalized Environment (vorher: Funktionen für eine Personalisierung)
Unter Personalisierung können zwei unterschiedliche Aspekte verstanden werden: zum einen die Personendaten, die im Working Environment zur Verfügung gestellt werden sollen, zum anderen die Personalisierung der Service-Plattform (WE-1).

Der erste Aspekt wird bereits im Identity Management adressiert und hier als nicht prioritär angesehen. Als prioritär wird vielmehr der zweite Aspekt angesehen, der zur Entwicklung eines Cockpits oder Dashboards führt, das zudem die Funktionalität eines eScience-Working Environment gewährleisten soll.

WE-3 Individual Portfolio (vorher: Funktionen für die Bereitstellung des persönlichen Portfolios)

Aus der Perspektive der Arbeitsgruppe ist die Erstellung einer zentralen Plattform, die die akademische Karriere der Benutzer dokumentiert, nicht sinnvoll, da die Benutzer dies schon auf den unzähligen akademischen und professionellen Netzwerken (LinkedIn, ResearchGate, Academia usw.) oder auf der persönlichen Website ihres Instituts oder ihrer Universität bereits tun.

WE-4 Functions for Mobility
Der Trend zu BYOD (Bring your own device) hat sich an den Hochschulen schon weitestgehend durchgesetzt. Auf der Entwicklungsseite hat sich beim Design von neuen Applikationen ein 'Mobile First'-Ansatz etabliert. Das bedeutet für die nationalen Dienste des Working Environments, dass diese ohne Einschränkungen auf mobilen Endgeräten benutzt werden können. Zwei Ansätze erlauben dies:

- Die nationalen Dienste bieten ein App für die wichtigsten Betriebssysteme (iOS, Android, Windows Phone) an.

- Die webbasierten Dienste passen sich dynamisch den Bedingungen der mobilen Geräte an (Responsive Design mit Media Breakpoints; skalierende Bilder; gleichbleibende Performance dank kleinerer Datenmengen bei langsamen Verbindungen).

Wird der Begriff 'Mobilität' weitergefasst, sind mobile Geräte lediglich ein Teilaspekt. Es sind die Menschen selbst, die mit ihrer steigenden Mobilität neue Bedürfnisse wecken. Sie wollen überall und jederzeit online sein, was durch WLAN und Mobilfunknetz möglich gemacht wird. In der Schweiz enthalten die meisten Mobilabos ein Datenpaket mit einer begrenzten Datenmenge. Dies schränkt den Spielraum bei der Verwendung datenintensiver Dienste (Dropbox, Video) ein. Hier empfehlen sich Massnahmen, die diese Hindernisse abbauen.

WE 7,8 Personal & Shared Storage (zusammen gelegt, vorher: Persönliche Ablagefunktionalitäten und Workspace and Filesharing Funktionen)

Hier bestehen zwei verschiedene Kategorien von persönlichem und geteiltem Speicher.

- Dropbox: Für persönliche Dokumente und Daten, die man sicher ablegen möchte, ist ein Service, wie man ihn von Dropbox.com kennt, ausreichend.
- Forschungs- oder Projektdaten: Für grössere Mengen von Forschungsdaten, die projektspezifisch in diversen Gruppen und Untergruppen bearbeitet werden, braucht es ebenfalls eine Ablage. Diese sollte für den persönlichen Gebrauch wie auch für den geteilten Gebrauch vorgesehen sein. Die Ablage sollte die spezifizierten Authentifizierungs- (Identity Management) und Autorisierungs- (Gruppenverwaltung) Mechanismen benutzen und ans Working Environment gekoppelt sein. Dieser Use Case kann jedoch eine sehr domänenspezifische Ausprägung haben und hängt sehr stark mit dem jeweiligen Data Life Cycle sowie den Metadaten jeder einzelnen Domäne zusammen. Hier bietet sich die Erstellung einer Arbeitsumgebung für den domänenagnostischen Workflow an.

Der erste Anwendungsfall (Dropbox) wird als nicht prioritär angesehen, die besondere Priorität des zweiten Anwendungsfalls (Forschungsdaten) führt dazu, dass WE-7 und WE-8 gar nicht getrennt voneinander betrachtet werden können, was zur Zusammenlegung der Funktionsblöcke geführt hat.

WE-9 Search (vorher: Suchfunktionalität)

Gefordert wird eine Suchmaschine, die allen Anforderungen einer herkömmlichen wissenschaftlichen Suche entspricht (vgl. Google Scholar), die darüber hinaus jedoch in der Lage ist, Forschungsdaten sowie die dazu gehörigen Metadaten zu indexieren und wiederzufinden. Im Sinne eines Ressource Discovery Systems ist zwischen der Suche in einem internen (Personal & Shared Storage) sowie einem externen Bereich (im Prinzip dem Web) zu unterscheiden.

Die Suchmaschine stellt sich demnach als massgebliche Erweiterung herkömmlicher Suchangebote wie etwa swissbib oder dem Webportal e-lib.ch dar, in dem sie sich nicht auf Katalogisate, Digitalisate und Webseiten beschränkt.

Die Suchmaschine sollte die Mehrzahl der nachstehend aufgeführten Kriterien erfüllen:

- Föderierte Suche, die den Content (Daten und Metadaten) aller zugänglichen Repositorien speichert, sofern sie nicht als privat deklariert wurden. Darunter fallen u.a. lokale Dateien, Datenbanken, Daten in der Cloud sowie das Web. Die Suche erstreckt sich auf alle Daten, unabhängig vom jeweiligen Format
- Mehrsprachigkeit hinsichtlich Query-Processing, Indexierung, Retrieval und Präsentation der Ergebnisse
- Personalisierung der Suche, insbesondere hinsichtlich des Relevance-Ranking
- Multi-Media-Suche: Suche nach Text-, Audio- und Videodateien
- Wissenschaftliche Suche mit Pearl-Growing-Funktionalität (vgl. Google-Scholar-Funktionalität „Related Articles"), die von jedem Dokument, unabhängig vom Datentyp, gestartet werden kann

- LOD-Extension: Die Suchmaschine ist in der Lage, LOD-Dokumente, insb. aus dem Open Access-Bereich, in den Suchraum mit aufzunehmen und gleichzeitig einen eigenen LOD-Hub für die im Rahmen der Infrastruktur erstellten RDF-Triples zur Verfügung zu stellen.

WE-10 Data Analysis

Die Datenanalyse ist eine extrem domänen-spezifische Aufgabe. Sie benötigt eine Kombination von Funktionen und Dienstleistungen, die bereits aufgeführt wurden:

- e-Science Portal: Jede Datenanalyse kann man als App oder entsprechendes Gateway betrachten.
- Data Lifecycle / Metadaten: Daten, die analysiert werden sollen, muss man extrahieren und die Resultate wieder zurückschreiben; die Ergebnisse der Analyse selbst werden als Provenance Daten in die Metadaten eingespeist.
- IaaS: Die Analyse als solche hat unter Umständen Bedarf nach Rechenleistung, die man sich aus der Cloud holen kann.
- Federated Identity Management: Der Zugang zu den Daten, den Katalogen und der IaaS geschieht mit demselben User Account.

Priorisierung der Funktionsblöcke

Aufgrund der begrenzten Restlaufzeit des Projekts sowie des zu erwartenden Budgetlimits wurde in der Abschlussphase der Arbeit der Strategiegruppe „Working Environment" eine Priorisierung der zehn Funktionsblöcke vorgenommen. Dabei wurde zwischen einer extrem hohen (+++) und einer extrem niedrigen Priorisierung (---) unterschieden.

Als höchst prioritär werden die Funktionsblöcke **WE-1 Service Platform**, **WE-2 Personalized Environment**, **WE-5 Collaboration Support** und **WE-7,8 Personalized Environment & Shared Storage** angesehen, da sie sich direkt aus den National Services des Papiers „Grundlagen zur Strategie" und den User Stories des ursprünglichen Projektantrags ableiten und in ihrer Gemeinsamkeit die Basis für eine kollaborativ ausgerichtete Arbeitsumgebung darstellen, wie sie unter Punkt 1 dieses Arbeitspapiers dargestellt wurde.

Im Fall von Funktionsblock **WE-2 Personalized Environment** betrifft dies jedoch allein die Aspekte der Benutzeroberfläche, nicht die des persönlichen Profils, dessen Priorität als niedrig eingeschätzt wurde und zudem bereits vom Identity Management adressiert wird.

Die Funktionsblöcke **WE-7,8 Personal & Shared Storage** wurden zusammengelegt, da sie unter Berücksichtigung der besonderen Anforderungen eines kontinuierlichen Workflow für das Data Management nur gemeinsam Sinn machen. Die hohe Priorisierung ergibt sich aus der besonderen Bedeutung für die effiziente Handhabung des Data Lifecycle, die reine Datenablage und das reine File-Sharing gelten als technisch gelöst und haben keine erhöhte Priorität.

Funktionsblock	Priorität
WE-1: Service Platform WE-1-1 Schnittstellendefinition WE-1-2 Zugriffsrechteverwaltung WE-1-3 Gruppenverwaltung WE-1-4 Servicekatalog	**+ + + (hoch)**
WE-5: Collaboration Support WE-5-1 Working Scenarios	**+ + + (hoch)**
WE-6: Service Shop & License Store WE-6-1 Development Platform WE-6-2 Execution Platform WE-6-3 Service-Katalog	**+ + (mittel-hoch)**

Funktionsblock	Priorität
WE-2: Personalized Environment WE-2-1 Cockpit	**+ + + (hoch)**
WE-3: Individual Portfolio	**- - - (nicht prioritär)**
WE-4: Functions for Mobility WE-4-1 Access Anywhere	**+ (mittel)**
WE-7,8: Personal & Shared Storage WE-7,8-1 Data Workflow Service	**+ + + (hoch)**
WE-9: Search WE-9-1 Definition & Analyse der zu durchsuchenden Informationsquellen WE-9-2 Erstellung des Suchindex WE-9-3 Konzeption & Realisierung des Such-Interface	**+ (mittel)**
WE-10: Data Analysis	**- (niedrig)**

Tabelle 1: Priorisierung der Funktionsblöcke

WE-6 Service Shop & License Store wurde aufgrund des hohen Innovationscharakters eine mittlere bis hohe Priorität zugewiesen.

WE-4 Functions for Mobility wurde eine mittlere Priorität gegeben, da es sich hierbei um einen orthogonalen und nachgeordneten Funktionsblock handelt, der keine grundlegende Kernfunktionalität des Working Environment enthält, sondern lediglich eine andere technische Charakteristik (User Interface) aufweist.

WE-7 Search erhielt gleichfalls eine mittlere Priorität, da es bereits sehr gut funktionierende Suchmaschinen gibt, die ggfs. direkt in die Arbeitsumgebung integriert werden können, allerdings an die neu entstehenden Ressourcen angepasst werden müssen.

WE-10 Data Analysis erhielt eine niedrige Priorität, zum einen aufgrund der hohen Heterogenität der Use Cases, zum anderen aufgrund der hohen Unsicherheit, ob tragfähige Ergebnisse im Rahmen des Projekts vorzeigbar wären. Die aufgeführten Action Items haben eine hohe Forschungsrelevanz, sind aber letztlich für die Erstellung einer effizienten Arbeitsumgebung nicht unmittelbar notwendig bzw. den Hauptaspekten des Working Environment nachgeordnet.

WE-3 Individual Portfolio wurde als völlig nachrangig eingeschätzt, da eine effektive wissenschaftliche Kollaboration auch ohne persönliches Portfolio denkbar ist.

Tabelle 1 enthält nur die Action Items von jenen Funktionsblöcken, die für eine Projektumsetzung in Betracht gezogen werden. Die Action Items zu allen Funktionsblöcken, unabhängig von ihrer Priorisierung, sind vollständig in Abschnitt 2.5 dieses Strategiepapiers aufgeführt. Unter Punkt 6 dieses Strategiepapiers wurden gleichfalls nur jene Action Items aufgeführt, die sich aus den als prioritär angesehenen Funktionsblöcken ableiten.

2.2.   Existing services and ongoing projects

WE-1 Service Platform

- e-lib.ch bzw. Wissensportal ETH: Es handelt sich dabei in beiden Fällen um ein Portal als zentralen Einstiegspunkt zu wissenschaftlichen Informationsressourcen und Dienstleistungen im Sinne eines Resource Discovery Systems. Im Zentrum steht ausserdem die gleichzeitige Suche über mehrere Ressourcen (Bibliothekskataloge, Repositories, Digitalisate usw.). Im Gegensatz dazu ist die innerhalb des Working Environment zu entwickelnde Service Platform als Oberfläche zu verstehen, in der mittels geeigneter Schnittstellen verschiedene Komponenten zusammengestellt und für den jeweiligen Zweck (persönliche Arbeitsumgebung, Gruppenverwaltung usw.) genutzt werden können.
  Allenfalls weist das Action Item WE-1-4 (Service-Katalog) die meisten Ähnlichkeiten mit dem Konzept des Frontend von e-lib.ch als Portal auf.
- SWITCHtoolbox: Die SWITCHtoolbox ist eine einfache Web-Applikation, mit der auch unerfahrene Benutzer auf intuitive und unkomplizierte Weise Gruppen von Personen erstellen können. Jeder Gruppe können entsprechend der jeweiligen Bedürfnisse verschiedene Dienste (Wiki, Mailingliste, Forum, Dokumentenablage) zugewiesen werden. Die Dienste laufen unabhängig von der Toolbox und erhalten von dieser lediglich die Informationen über die Gruppenzugehörigkeit des jeweiligen Benutzers sowie dessen Rolle innerhalb der Gruppe.
- swissbib.ch: siehe WE-9 Search

WE-5 Collaboration Support

- SWITCHtoolbox (s.o.)
- SWITCHaai Group Management Tool (GMT): GMT ist eine Web-Anwendung zur Erstellung und Verwaltung von AAI-Benutzergruppen mit unterschiedlichen Berechtigungen. Die Gruppen können flexibel zur Zugriffskontrolle für eigene Web-Anwendungen eingesetzt werden.
- wiki.systemsx.ch: Die SystemsX.ch Wiki ist ein Service des SyBIT Projekts (gehostet von der ETH Zürich). Das Tool wird von vielen Projekten und Forschungslabors als Wiki verwendet.
- Grouper von Internet2: Open-Source-Toolkit zum Verwalten von Benutzergruppen. Grouper versteht sich als Infrastruktur für die Verwaltung von IDs und zugehörigen Informationen über Benutzer und kann in Anwendungen und Repositories intergriert werden.
- elba (ETH)/ellba (UniBe): Baukastensysteme zur Kollaboration

WE-6: Service Shop & License Store

Auf internationaler Ebene werden unterschiedliche Anstrengungen unternommen, um „Science Gateways" zu erstellen:

- SCI-BUS Projekt (www.sci-bus.eu): erstellt auf europäischer Ebene Gateways für unterschiedliche Communities, die dieselbe Technologie verwenden. Die „Execution Platform" baut auf Liferay und gUSE auf, zwei komplementären Technologien, die es zugeschnittenen Community Portalen ermöglichen, hochskalierte Simulationen durchzuführen.
- Das amerikanische Science Gateway Institute (www.sciencegateways.org) koordiniert die Anstrengungen, wissenschaftliche Dienstleistungen anzubieten.
- Vereinzelt werden in einigen Domänen spezielle Schnittstellen erstellt, denen es jedoch an Interoperabilität mangelt, bspw. für die Bioinformatik: ExPASy (http://www.expasy.org/) in der Schweiz oder Entrez am NIH (http://www.ncbi.nlm.nih.gov/), das Galaxy Projekt (http://galaxyproject.org) oder Sybit (www.sybit.net).

WE-2: Personalized Environment

Personalisierte Arbeitsumgebungen werden in mehreren Kontexten und den entsprechenden Strategiegruppen diskutiert: Im eLearning-Bereich spricht man von 'Personal Learning Environment' (PLE), im Identity Management von Portfolio sowie benutzerzentrierter elektronischer Identität und bei eScience kennt man das Electronic Lab Notebook. Der Funktionsblock weist Ähnlichkeiten mit Netvibes oder iGoogle auf, wobei zu beachten ist, dass iGoogle mittlerweile eingestellt wurde.

Bereich	Bezeichnung	Beispiele
Identity Management	Portfolio	Mahara (https://mahara.org/)
eScience	Electronic Lab Notebook	Labguru (http://www.labguru.com/)
eLearning	Personal Learning Environment (PLE)	ROLE Project (http://www.role-project.eu/)

WE-3: Individual Portfolio

Die Universität Genf hat im AAA-Programm eine Vorstudie für einen Portfolio-Dienst gemacht. SWITCH wird demnächst einen solchen Dienst bereitstellen. Desweiteren wird auf diverse Webplattformen wie ResearchGate, LinkedIn, Xing, Academia.edu usw. verwiesen.

WE-4: Functions for Mobility

- eduroam, SWITCHconnect, SWITCHpwlan: Dienste für die Benutzung von öffentlichen und akademischen WLAN-Infrastrukturen national und international

WE-7,8: Personal & Shared Storage

Existierende Dropbox Services:

- ETH Polybox: Dropbox-Dienst, allen ETH-Angestellten und Studenten zugänglich
- DocExchange: Dropbox-Dienst, der an der Uni Basel für Nutzer mit AAI-Login zur Verfügung gestellt wird.
- myNAS: Die EPFL bietet allen Mitarbeitenden damit die Möglichkeit, virtuelle Laufwerke bzw. Speicher remote zu nutzen.
- SWITCH plant, einen analogen Dienst für alle Institutionen zu lancieren.

Werkzeuge für den Workflow des Datenmanagements:

Hier werden derzeit eine ganze Reihe domänenspezifischer Initiativen in Forschungsprojekten wie MIIDI (Minimal Information Standard for reporting an Infectious Disease), AMIGA (Analysis of the interstellar Medium of isolated Galaxis), DARIAH (Digital Research Infrastructure for the Arts and Humanities) und vielen anderen mehr entwickelt.

WE-9 Search

- Schweizweite Projekte im Rahmen von e-lib.ch:
  - swissbib: Bei swissbib handelt es sich um einen Metakatalog. Im Zentrum steht die Möglichkeit einer übergreifenden Suche. Neben der reinen Suche enthält swissbib einen umfassenden Metadatenpool, der über unterschiedliche Schnittstellen verfügbar ist. Die Kompetenzen in diesem Bereich könnten insbesondere für das Action Item WE-1-1 von grosser Bedeutung sein.
  - Infonet Economy
  - RODIN
- Wissenschaftliche Suchmaschinen wie etwa Google Scholar oder Microsoft Academic Search
- Suchmaschinen-Tookits wie z.B. Lucene / SoLr

W-10 Data Analysis

- webLyzard: Web Intelligence und Big Data Analysetool. webLyzard analysiert grosse Datenmengen wie z.B. Datenreihen oder Texte auf Basis mehrsprachiger semantischer Algorithmen und stellt die Ergebnisse mit Hilfe visueller Verfahren dar. Über Wissenslandkarten werden die wichtigsten Themen in grossen Dokument-Archiven herauskristallisiert; hierarchische Netzwerk-Visualisierungen erlauben Rückschlüsse auf die Bedeutung und Interpretation von Themen innerhalb bestimmter Zielgruppen.
- A4-Mesh: Projekt zum Aufbau drahtloser Mesh-Netze (Netze, die sich selbständig aufbauen und konfigurieren), um die Netzabdeckung vorhandener Internet-Netzwerke auszuweiten. Diese können in Campus-Netzwerken oder durch Anschluss von Sensoren oder Wetter-Messstationen in abgelegenen Gebieten ohne hohe Bandbreite eingesetzt werden.

- PSI Online und Offline Datenanalyse: Das Paul Scherrer Institut (PSI) betreibt komplexe Grossforschungsanlagen, die grosse Datenmengen produzieren. Externe Wissenschaftlerinnen und Wissenschaftler können an den Anlagen Experimente durchführen und mit diversen Methoden analysieren.

2.3.   International references and standards

In diesem Kapitel finden auch kommerzielle Produkte Erwähnung, die als Messgrösse in Bezug auf Funktionalität und Benutzerfreundlichkeit dienen können.

WE-1 Service Platform
- Cloudstore (govstore.service.gov.uk/cloudstore): Umfasst einen Service-Katalog und ein Dashboard. Die britische Verwaltung fungiert dabei als Clearing House.
- Apple App Store/Android Market/Windows Store: Mobile App-Kataloge, die als Clearing House die Dienste vor der Einstellung überprüfen.

WE-5 Collaboration Support
- Microsoft Sharepoint, Google Apps, Atlassian Confluence: Kollaborative Arbeitsumgebungen
- Open Science Framework: Kollaborations-Suite für wissenschaftliche Projekte

WE-2 Personalized Environment
- Netvibes: Dashboard für Social Media
- Windows 8: Die Tiles auf dem Startscreen zeigen die Aktivitäten in den Diensten.
- Google Now: Eine App, die den Nutzer mit momentan relevanten Infos versorgt.

WE-3 Individual Portfolio
- LinkedIn, Xing: Soziale Netzwerke für die Pflege von Geschäftskontakten
- ResearchGate, Academia.edu: Dito für Kontakte in Forschung und Akademie

WE-7,8 Personal & Shared Storage
- Dropbox, Google Drive, Microsoft SkyDrive: Kommerzielle Anbieter von Speicherlösungen nach dem Freemium-Prinzip
- mydrive.ch, securesafe.ch, filesync.ch, speicherbox.ch: Analoge Anbieter mit Datenhaltung in der Schweiz
- DCC (dcc.ac.uk): Data Curation-Kompetenzzentrum für britische Universitäten

WE-9 Search
- Google Scholar/Microsoft Academic Search: Wissenschaftliche Suchmaschinen
- Lucene / Solr: Suchmaschinen-Toolkits

2.4.   Required innovation

WE-1 Service Platform: Für die Service Platform besteht die Hauptinnovation in der Definition eines Standards zur Einbindung der Software und zum Handling der Services innerhalb der Arbeitsumgebung bzw. in der Bereitstellung eines entsprechenden Service Handlers. Insbesondere hier ist bei der Entwicklung auf User Experienced Design zu achten, um eine maximale Benutzerakzeptanz sicherzustellen, so dass letztlich auch nur Funktionen bereitgestellt werden, die sich der Nutzer auch wünscht oder die für ihn von Nutzen sind.

Die zur Service Platform gehörenden Funktionsblöcke **WE-5 Collaboration Support** und **WE-6 Service Shop & License Store** weisen folgende innovative Mehrwerte auf:

a) WE-5: die institutionen- und länderübergreifende Gruppenverwaltung, das Digital Rights Management sowie die Verwaltung von Rollen und Untergruppen und das Erstellen von Arbeitsszenarien

b) WE-6: Als neu zu erstellendes Clearing House für Software-Services per definitionem innovativ, da keine vergleichbaren Vorarbeiten existieren.

Der Funktionsblock **WE-2 Personalized Environment** erhält durch die individuelle bzw. gruppenbezogene Gestaltung der Arbeitsumgebung eine gewisse Innovation. Eine besondere Innovation besteht aufgrund der Konzeption des Working Environment (wie unter Punkt 1 beschrieben) auch im unterschiedlichen, das heisst personen- oder gruppenbezogenen Zugriff auf Pools und Tools, je nach Studien- bzw. Forschungsprojekt.

Für den Funktionsblock **WE-4 Functions for Mobility** besteht kein unmittelbarer innovativer Mehrwert, diese Funktion sollte dennoch zur Verfügung gestellt werden. Es besteht auch die Möglichkeit, dass sich die Benutzerakzeptanz für einige Funktionalitäten (bspw. durch ein mobiles Laborbuch) erhöht.

Die Funktionsblöcke **WE-7 und 8 Personal & Shared Storage** sind per se nicht innovativ, wenn sie sich auf einen "Dropbox-Service" beschränken, da es bereits eine Vielzahl von ähnlicher Software grosser Anbieter gibt. Eine innovative Lösung bietet allein eine Sichtweise, die diese Funktionsblöcke als Grundlage für den Workflow des Data Management sieht und innerhalb derer eine eindeutige Adressierbarkeit der Daten mit persistenten Identifikatoren für eine spätere Nachnutzung gewährleistet ist.

Ähnliches gilt für den Funktionsblock **WE-9 Search**. Auch hier gibt es bereits eine Reihe von Suchmaschinen mit hoher Performanz, sowohl auf internationalem als auch auf nationalem Gebiet. Ein Mehrwert ergäbe sich allein in der Erweiterung des Suchraums auf neue Ressourcen, die im Bereich des Data Management entstehen (d.h. durch Metadaten strukturierter Forschungsdaten mit persistenter Adressierbarkeit).

Der Funktionsblock **WE-10 Data Analysis** weist einerseits den höchsten Innovationsgrad auf, andererseits ist der Bereich der Knowledge Discovery Systeme aufgrund der Domänenspezifizität der erstellten Prototypen noch weit von der Bereitstellung breit einsetzbarer, praxisrelevanter Systeme entfernt, so dass eine direkte Integration in den Bereich des Working Environment nach derzeitigem Stand der Dinge kaum zu gewährleisten ist.

2.5.   Action items

WE-1 Service Platform

- *WE-1-1 Schnittstellendefinition*: Ziel dieses Action Item ist die Definition einer Schnittstelle für den Servicekatalog. Über dieses Interface kann sich ein Dienst beim Katalog registrieren. Der Dienst schickt über die jeweilige Schnittstelle die Informationen, welche der Katalog für die Präsentation benötigt.
  Die Festlegung des Schnittstellenformats ist eine prioritäre Aufgabe. Ziel ist es, den Diensten schnellstmöglich einen funktionellen Prototyp der Schnittstelle zur Verfügung zu stellen, damit diese schon von Beginn an für diese Schnittstelle entwickeln können. In dieser Phase muss der Servicekatalog selber noch nicht zur Verfügung stehen. Über die Schnittstelle sollen sowohl technische (REST API) als auch nicht-technische (Web-Formular) Dienste kommunizieren können. Die unter WE-6-1 vorgeschlagene Entwicklungsplattform soll die client-seitigen Aspekte der Schnittstellenkommunikation zur Verfügung stellen.

- *WE-1-2 Zugriffsrechteverwaltung*: Der Zugriff auf Anwendungen erfordert die Umsetzung geeigneter Personalisierungsfunktionen bzw. Authentifizierungsmöglichkeiten, zum Beispiel für das Einrichten individueller Dienste oder Profile. Weiter ist die Implementierung von Single-Sign-On-Lösungen für den Zugriff auf Angebot und Services zu evaluieren und mittels entsprechender Zugriffsrechte (z. B. via SWITCHaai) zu prüfen. Dieses Action Item ist stark abhängig von den im Strategieprojekt Identity Management entwickelten Action Items.

- *WE-1-3 Gruppenverwaltung*: Collaborations-Suiten, welche die wichtigsten Dienste für eine erfolgreiche Zusammenarbeit anbieten, gibt es bereits in grosser Anzahl. Alle diese Suiten haben ein Konzept für Gruppenzugehörigkeiten und Rollenvergabe eingebaut. Es macht daher wenig Sinn, einen weiteren Dienst mit denselben Funktionalitäten anzubieten. Etwas anders sieht die Sache aus, wenn es darum geht, einem Dienst, der bisher nicht mit Gruppeninformation umgehen konnte, diese Fähigkeit beizubringen. Damit diese Dienste das Rad nicht alle nochmals selber erfinden müssen, wird ein zentraler Dienst vorgeschlagen, der alle Aspekte der Gruppen- und Rollenadministration abdeckt:

  - Gruppenmitglieder hinzufügen, einladen und entfernen
  - Den Mitgliedern unterschiedliche Rollen und Rechte zuweisen
  - Die Schnittstelle erlaubt anderen Diensten, die Gruppeninformationen abzufragen.
  - Die Unterstützung verschiedener Authentifizierungsmechanismen (Swiss Edu-ID; Active Directory; SWITCHaai, OpenID Connect/OAuth2)
  - Externe Authentifizierung: Ein Dienst kann die Entscheidung, ob er einer Person Zugriff gewährt, an eine externe Instanz delegieren.
  - *WE-1-4 Service-Katalog*: Der Katalog listet alle Anwendungen ('Apps') auf und kategorisiert sie entsprechend ihres Bestimmungszwecks. Durch die definierten Schnittstellen kann sich ein Dienst beim Katalog registrieren und ist somit „abrufbar". Der Service-Katalog ist eng verknüpft mit dem Funktionsblock WE-6 und macht somit zusammen mit der Development Platform (Action Item WE-6-1) und Execution Platform (Action Item WE-6-2) den eScience-App-Store aus. Ein Clearing House führt zu verschiedenen Zeitpunkten während und vor Ende des Projekts Abnahmetests bezüglich Funktionalität durch.

Die Action Items WE-1-1 bis WE-1-4 sowie WE-2-1 sind eng miteinander verknüpft: Die Aggregation der Dienste im Katalog (WE-1-4) ebenso wie die Festlegung und Abfrage der Zugriffsrechte (WE-1-2) und der Gruppeninformationen (WE-1-3) erfolgt über die unter WE-1-1 beschriebene Schnittstelle.

WE-5 Collaboration Support

- *WE-5-1 Working Scenarios*: Jede Gruppe setzt sich aus anderen Mitgliedern zusammen, aber die Gründe für die Bildung einer Gruppe sind oft ähnlich. Studenten wollen untereinander eine Arbeit schreiben, Dozierende wollen mit ihren Assistenten und Zuhörern in Kontakt treten, Forschende kollaborieren in einem gemeinsamen Forschungsprojekt, und administratives Personal gründet eine Arbeitsgruppe, um institutionsübergreifende Fragestellungen zu erläutern. Das sind alles nur Beispiele, aber bei genauer Betrachtung lassen sich Muster erkennen. Ein Kollaborationsdienst sollte den Benutzern bei der Erstellung der Gruppe – soweit möglich – die Arbeit abnehmen. Dazu kann er den Benutzer nach seinem Anwendungsszenario fragen. Basierend darauf kann er dann innerhalb der Gruppe gleich die üblicherweise benötigten Rollen erstellen, beispielsweise Dozent, Assistent und Studierende bei einer Vorlesung. Denkbar ist auch, dass gleich eine Suite von Diensten, die im Gruppenkontext Sinn machen könnten, vorgeschlagen wird. Dieses Action Item hat zum Ziel, die wichtigsten Working Scenarios zu definieren und in den zugehörigen Dienst – das Cockpit wäre dafür ein logischer Kandidat – zu integrieren.

WE-6 Service Shop & License Store

- *WE-6-1 Development Platform*: Erzeugung und Validierung von Online-Services oder Apps:
  - Erzeugung und Validierung
  - Platform mit klarer API und 'pluggable interfaces'
  - Integration des Identity Management
  - Deployment & Policy Management
  - Ein Entwicklungs-Framework stellt den Entwicklern von nativen Applikationen auf mobilen Geräten ein Basisgerüst zur Verfügung, welches einige wichtige Funktionen

(Authentifizierung, Unterstützung für nationales Dienste-Austauschformat) bereits mitbringt.

- *WE-6-2 Execution Platform*: Zugang und Ausführung von Online-Services und Apps
  - Mehrere Plattformen, die dieselbe Technologie benutzen, sind denkbar
  - Möglicher Gebrauch zugrundelegender Ressourcen, wie etwa Cloud-IaaS
  - Zugang zu Daten-Ressourcen und Datenbanken
  - Integration des Identity Management
  - Weitere integrierte Module, etwa Search (WE-9) oder Mobility (WE-4)
  - Möglichkeit, Apps oder zugehörige Service-Portale zu erstellen

- *WE-6-3 Shop Platform*: Shop Platform zur Verfügung stehender Services oder Apps
  - Listet alle Apps auf
  - Beschreibung mit Link zur Community-Dokumentation

WE-2 Personalized Environment

- *WE-2-1 Cockpit*: Übersichtseite auf personenbezogene Ereignisse
  Der Servicekatalog ist eine unpersönliche Liste von Diensten. Das hilft einer Person bei der Entscheidung, welche Dienste für sie relevant sind. Nachdem diese Entscheidung getroffen worden ist und die Person die entsprechenden Dienste für sich abonniert hat, wird sie interessiert sein zu erfahren, was in den Diensten läuft. Dies wird als zentrale Aufgabe der persönlichen Arbeitsumgebung angesehen.
  Das Cockpit enthält eine Seite, auf welcher die Benutzerin die für sie relevanten Informationen auf kompakte und übersichtliche Weise angezeigt bekommt. Diese Angaben werden von den angehängten Diensten über die Schnittstelle (WE-1-1) ans Cockpit gemeldet und von diesem aggregiert und ansprechend aufbereitet, bspw. über Cards für Informationszusammenfassung oder Timelines für zeitbasierte Events. Falls die Benutzerin detailliertere Informationen aus einem Dienst benötigt, kann sie diesen direkt aus dem Cockpit starten. Sie verlässt dann das Cockpit und wird auf den Dienst umgeleitet. Mittels Off-Screen-Navigation kann die Verbindung zwischen Cockpit und Dienst aufrechterhalten werden. Das Cockpit bietet zudem zusätzlich Schnittstellen für den Abgleich mit bereits existierenden Standardapplikationen, wie etwa dem Kalender, an.

WE-3: Individual Portfolio

- *WE-3-1 Einbindung in die persönliche Arbeitsumgebung*
  Der Benutzer soll im Cockpit seine personenbezogenen Daten nicht nur anzeigen und editieren können, sondern auch bestimmen, welche Informationen öffentlich zugänglich sein sollen. Wie bei WE-2 sind die Hauptattribute:
  - Namen, Titel, Berufsbezeichnung
  - Adressen
  - Avatar, Passfotos
  - Kontaktdaten (Telefon, E-Mail, Skype, Twitter usw.)

  Es sollte dem Benutzer trotzdem möglich sein, zusätzlich noch sein CV oder seine Publikationsliste aufzuschalten oder seine akademische Laufbahn zu dokumentieren.

- *WE-3-2 Verlinkung mit bestehenden persönlichen Webseiten*
  Es soll den Benutzern v.a. die Möglichkeit gegeben werden, auf bestehende persönliche Webseiten zu verweisen und ihr öffentliches Profil mit ihrem Portfolio auf bestehenden Online-Netzwerken zu verlinken.

WE-4: Functions for Mobility

- *WE-4-1 Access Anywhere*: Orts- und geräteunabhängigen Zugriff auf nationale Services ermöglichen
  Um die Entwickler von nationalen Services bei der Festlegung und Umsetzung ihrer mobilen

Strategie zu unterstützen, sollte eine Support-Infrastruktur geschaffen werden. Mögliche Aufgaben einer solchen Stelle:

- o Evaluation der Projekteingaben im Hinblick auf ihre mobile Strategie. Der Mobilstrategieplan (Mobile Strategy Plan) würde zu einem Kriterium des Projektantrags – analog zum Data Management Plan bei wissenschaftlichen Projekten.
- o Unterstützung der Projekte bei der Umsetzung ihrer mobilen Strategie durch technische Expertise. Diese Unterstützung geschieht über Dokumentation (Style Guides, Empfehlungen, Best-Practices), technische Lösungen (Framework für Entwicklung) und/oder personellem Support (Entwickler, Designer).

Ein ortsunabhängiger Zugriff bedingt eine permanente Internetverbindung. Den Mitarbeitenden und Studierenden an schweizerischen Hochschulen stehen zwei Produkte von SWITCH zur Verfügung, welche ihnen den WLAN-Zugriff an allen Hochschulen (SWITCHconnect) sowie über öffentliche Hotspots (SWITCHpwlan) erlaubt. Was fehlt, sind Möglichkeiten für externe Besucher und Gäste sowie der Zugriff an Orten ohne Hotspot. Um diese beiden Lücken zu schliessen, werden diese Lösungen vorgeschlagen:

- o Spezifische Datenpläne mit Mobiltelefonbetreibern aushandeln, welche als Teil ihres Datenplans den 'Gratiszugriff' auf nationale Dienste ermöglichen.
- o Alle Angehörigen von Hochschulen sollten die Möglichkeit haben, Externe/Gäste unkompliziert freizuschalten und ihnen dadurch Internetkonnektivität über das WLAN/Netzwerk zu erlauben.

WE-7,8: Personal & Shared Storage

- *WE-7,8-1 Data Workflow Service*: Erstellung einer Arbeitsumgebung für den domänen-agnostischen (d.h. den nicht-domänenspezifischen) Workflow des Data Managements bzw. Forschungsdatenmanagement mit nachstehenden Komponenten:
    - o Arbeitsumgebung für die Projektplanungs- und Aufsetzungsphase
    - o Erzeugung und Ablage eindeutig adressierbarer Forschungsdaten (Creation or Reception)
    - o Teilen der Forschungsdaten auf Arbeitsgruppenebene (Sharing)
    - o Erstellung der Metadaten in einem allgemeinen Metadaten-Editor mit Zugang zum Metadaten-Pool (Customization of Metadata)
    - o Indexierung für eine Suche (Indexation) (siehe Funktionsblock WE-9 Search)
    - o Auswertung und Auswahl der Daten (Appraisal & Selection)
    - o Bereitstellung einer Suche zum (Wieder-)Auffinden der Daten (Search & Discovery) (siehe Funktionsblock WE-9 Search)
    - o Sicherstellung des Transfers zu Data Citation und E-Publishing: Dies bedingt 'standard-compliant', maschinenlesbare und strukturierte, digitale Datenobjekte (Access, Use and Re-Use).

WE-9: Search

- *WE-9-1 Definition & Analyse der zu durchsuchenden Informationsquellen*
  Definition und Analyse von organisationsinternen und -externen Quellen, die als operative Grundlage für die avisierte Suchfunktionalität dienen sollen. Für jede Quelle muss
    - o der inhaltliche Aufbau (Struktur, Metadaten usw.) und die Art der Dokumente bzw. Objekte (z.B. klass. wiss. Publikationen, multimediale Objekte) analysiert und
    - o die Dokument- bzw. Objektbeschaffung, z.B. über Roboter/Crawler/ Harvester, OAI-PMH oder direkte Schnittstellen zu Datenbanken bzw. Repositorien

  festgelegt werden.

- *WE-9-2 Erstellung des Suchindex*
  Der mögliche Aufbau und die Erstellung des Index für die Suchfunktion wird auf Basis der Ergebnisse von Action Item WE-9-1 definiert. Die Erstellung des Index geschieht durch

- o eine automatische Erschliessung der Dokumente (neben Standardmethoden der automatischen Indexierung ggf. auch Berücksichtigung von Metadaten-Schemata wie Dublin Core oder MARC, Semantisches Clustering), und/oder mittels
  - o einer föderierten Suche (‚federated search'), durch die Aggregation bereits bestehender Indices.

- *WE-9-3 Konzeption & Realisierung des Such-Interface*
  Das Such-Interface wird gemäss dem aktuellen Stand bzgl. der Suchfunktionen aufgebaut, beispielsweise mit
    - o einfacher/erweiterter Suche
    - o Ranking, Filter/Facetten, Permalink
    - o visueller Standortanzeige, virtuellen Buchregalen und ähnlichen Visualisierungs-formen
    - o Rechtschreibkorrektur, Begriffsvorschläge („Meinten Sie…"), Begriffswolken
    - o Kataloganreicherung (aus den Medien selbst wie z.B. Inhaltsverzeichnis, Cover-Abbildung)
    - o Personalisierung, RSS-Feeds
    - o Tagging, Kommentierung, Bewertung, Blog, Wiki, Forum, Bildern, Videos, Podcasts
    - o Empfehlungen, „Ähnliche Titel", Verlinkungen zu externen Informationen
    - o Trefferweiterverarbeitung (Literaturverwaltung, Social Community)
  Speziell für das Ranking sind sinnvolle Kriterien (in Abhängigkeit der verwendeten Informationsquellen) zu definieren (z. B. unter Berücksichtigung von Zitationen, Autoren, Publikationsrankings usw.).

WE-10: Data Analysis

- *WE-10-1: Integration der Datenanalysefunktionalität*
  Entwicklung einer modularen Architektur, welche basierend auf den Metadaten und dem Content-Typ von Dateien und Datenströmen die Einbindung domänenspezifischer Analysemodule erlaubt.
    - o Die Analysemodule können unabhängig voneinander entwickelt und erweitert werden (maximale Flexibilität bei der Finanzierung, Weiterentwicklung und Planung der Analysefunktionalität).
    - o Sämtliche Analysemodule bieten Schnittstellen für den Export von Rohdaten, Kennzahlen und Visualisierungen in geeigneten und offen zugänglichen Formaten (CSV, SVG, …) an.

- *WE-10-2: Domänenunabhängige Module* (domänenübergreifende Datenanalysefunktionen für textuelle Daten wie zum Beispiel Publikationen, Reports, Working Papers usw.)
    - o Entwicklung eines Moduls zur automatischen Datenstrukturierung
        - ▪ Generierung von on-the-fly Ontologien basierend auf dem relevanten Datenset (zum Beispiel Forschungsfeld, gespeicherte Publikationen, Institution usw.)
        - ▪ Automatische Erstellung von Wissenslandkarten
        - ▪ Automatische Trendanalyse
        - ▪ Erstellung von entsprechenden Visualisierungen
        - ▪ Möglichkeit des Datenexports
        - ▪ Navigation anhand der erstellten Visualisierungen
    - o Entwicklung eines Moduls zur automatischen Zitationsanalyse und Bereitstellung von Funktionen zur Ermittlung der Relevanz verschiedener Outlets für spezifische Forschungsfelder
        - ▪ Automatische Erkennung von Autoren und Outlets in textueller Information inklusive Grounding und Disambiguierung
        - ▪ Geographisches Tagging von Quellen und Experten (Darstellung von lokalen Experten und Wissensclustern)
        - ▪ Berechnung von Publikationsstatistiken und von relevanten bibliographischen Kennzahlen
        - ▪ Visualisierung anhand der Analysedimensionen (geographisch, Soziales Netzwerk, zeitliche Publikationsstatistiken, ...)

- *WE-10-3: Domänenspezifische Module* (Auswertung von domänenspezifischen Daten und Datenströmen)
  - Bioinformatik: Entwicklung von Analysemodulen zur Automatisierung der Deep Sequence Data Analyse
    - Unterstützter Content Type: Rohdaten aus der Deep Sequence Data Analyse (zum Beispiel Varianten des Genoms, Genregulierungen, ...)
    - Komponenten: Pre-processing, Analysemodule, Visualisierung
  - Bioimaging: Entwicklung von Analysemodulen zur Analyse des Datenstroms von hochauflösenden bildgebenden Verfahren wie zum Beispiel Röntgendetektoren mit hoher Auflösung
    - Verfahrenspezifisches Pre-processing
    - Berechnung und Darstellung von relevanten Kennzahlen
  - Data Mining: Entwicklung von Analysemodulen zur Auswertung von Internet-Verkehrsdaten wie zum Beispiel Server-Logdateien
    - Serverspezifisches Pre-Processing
    - Berechnung und Darstellung relevanter Kennzahlen
  - Grid Computing: Entwicklung von Analysemodulen zur Auswertung von Sensordatenströmen. Domänen- und anwendungsspezifisches Pre-processing, Datenanalyse und Visualisierung.

3. Dependencies and Interfaces

3.1. Prerequisites from other strategy projects

Identity Management: Identity Management und Working Environment müssen bei der Umsetzung des Projekts Hand in Hand gehen, das heisst, dass der Zugang zur Plattform des Working Environment nur über Single Sign-On Authentifizierungsmechanismen des Identity Management geschehen kann.

Data Management: Im Fall des Data Management besteht ein besonderer Overlap: So soll über das Working Environment der Workflow für das Data Management zur Verfügung gestellt werden. Innerhalb des domänen-agnostischen Workflows wird dabei dem Metadaten-Editor eine besondere Bedeutung zukommen, da er über den Metadaten-Pool des Data Management den Zugang zum domänenspezifischen Wissen ermöglicht.

E-Publishing: Zum E-Publishing bestehen zwei besondere Schnittstellen: zum einen im Bereich der Suche in wissenschaftlicher Information, zum anderen als Endpunkt des Workflow für das Data Management (Data Citation and Data Publication). Im ersten Fall soll dies über die Indexierung des Dokumentenraums von E-Publishing geschehen, im zweiten Fall werden mit persistenten Identifikatoren ausgezeichnete Datensätze in den Dokumentenraum des E-Publishing eingespeist.

E-Learning: Sämtliche möglichen E-Learning-Services können als Komponenten in die Verwaltungsoberfläche der Service Platform eingebunden werden, sofern sie die Vorgaben der standardisierten Schnittstellen erfüllen.

Cloud Computing: Hier besteht kein direkter Overlap. Aufgrund des Verständnisses der Cloud "The cloud ends where the understanding of the services begins" wird von einer Tier-Architektur ausgegangen, bei der die Cloud die unterste Schicht bildet, auf der dann die Services und letztlich die Service Platform aufsetzen.

Nationale Organisation: Hier besteht kein technischer Overlap, allerdings ist die Zusammenarbeit mit der nationalen Organisation von höchster Wichtigkeit für die Entwicklung und Implementation der Service Platform (im Sinne einer nationalen Verankerung in den Institutionen nach der Fertigstellung). Wie unter Punkt 5 dieses Strategiepapiers festgehalten, besteht ein hohes Risiko, dass ohne Unterstützung seitens der nationalen Organisation die Gesamtziele des Working Environment bedroht sind.

3.2.   External interfaces

Das Working Environment bietet zwei Interfaces an:

- *Web*-Interface für die Benutzer des Service-Katalogs und des Cockpits
- *REST*-Schnittstelle (WE-1-1), über welche die Dienste Informationen zur Gruppenzugehörigkeit (WE-1-3) einer Person abfragen können. Die Dienste können darüber auch ihren Eintrag im Service-Katalog (WE-1-4) verwalten sowie Aktivitäten ans Cockpit (WE-2-1) melden.

3.3.   Further dependencies and relevant external factors

An anderer Stelle ausgeführt, siehe insb. 3.1 und 5.

4. Economic Efficiency / Availability of Funding

4.1.   Implementation costs

Die Entwicklungskosten sind aufgrund eines fehlenden Finanzierungsplans nicht zu beziffern, aus diesem Grund wurden in der Tabelle der Action Items unter Punkt 6 keine genauen Zahlen angegeben. Die Umsetzung aller Funktionsblöcke WE-1 bis WE-10 wird im Vergleich zu den anderen Handlungsfeldern mit hoher Wahrscheinlichkeit den grössten monetären Aufwand mit sich bringen. Daher wurde eine entsprechende Priorisierung innerhalb der Strategiegruppe Working Environment vorgenommen, um den Entwicklungsaufwand in einem realistischen Rahmen zu belassen.

Entsprechend der in der Tabelle der Action Items vorgenommenen Einschätzung können die Implementationskosten grob mit ca. 47 Personenjahren oder Full-Time-Equivalents eingeschätzt werden.

4.2.   Operational costs

Der in diesem Strategiepapier formulierte Ansatz einer komponentenbasierten Verwaltungsoberfläche wurde insbesondere deshalb ausgewählt, um die mit der Nachnutzung verbundenen operativen Kosten möglichst gering zu halten. Entsprechend der unter Punkt 6 des Strategiepapiers durchgeführten Einschätzung wird von Maintenance-Kosten in Höhe von 22 Personenjahren (oder Full-Time-Equivalents) ausgegangen, wobei es sich um eine grobe Einschätzung handelt.

4.3.   Customer benefit

Der grösste Mehrwert für den Benutzer ergibt sich aus der Tatsache, dass die integrierbaren Services in der Arbeitsumgebung nicht vorgegeben, sondern nutzerzentriert konfigurierbar sind. Wie unter Punkt 1 dieses Strategiepapiers aufgezeigt, wird es zwar eine Verwaltungskomponente geben, jedoch kein umfassendes Portal mit hohem Aufwand für Support & Maintenance.

5. Implementation Plan and Risks

Bezüglich der Umsetzung des Projekts kann folgende Empfehlung ausgesprochen werden: Die Entwicklung der Service Platform (d.h. insb. die Funktionsblöcke WE-1, WE-5 und WE-6, auch WE-2) könnte über Mandate vergeben werden, bspw. an die Institution, die für den späteren Betrieb und die Ausführung des Business Case verantwortlich ist.

Ebenso sollte die Usability entwicklungsbegleitend über ein Mandat sichergestellt werden. Für andere

Funktionsblöcke (WE-4, WE-6, WE-7,8 und WE-9) sollten Projektausschreibungen erfolgen.

Die grundlegende Architektur als Vorgabe für die Implementation wird in Abbildung 1 in Form eines UML-Diagramms veranschaulicht.
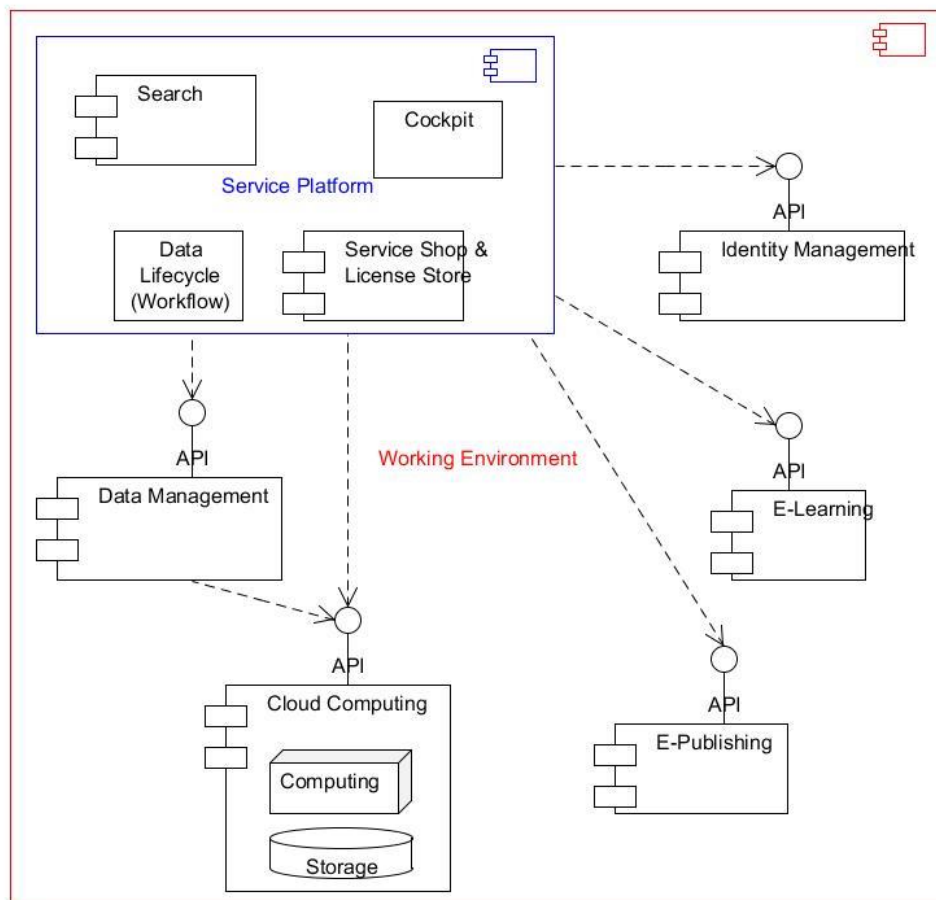

Abbildung 1: Architektur Working Environment (UML Diagramm)

Für die Umsetzung wird folgender grober Zeitplan vorgeschlagen:

Jahr			2014				2015				2016	
Quartal	1	2	3	4	1	2	3	4	1	2	3	4
WE-1												
WE-1-1	Schnittstellendefinition											
WE-1-2									Zugriffsrechteverwaltung			
WE-1-3									Gruppenverwaltung			
WE-1-4		Servicekatalog										
WE-5												
WE-5-1									Working Scenarios			
WE-6												
WE-6-1	Development Platform											
WE-6-2					Execution Platform							
WE-2												
WE-2-1		Cockpit										
WE-4												
WE-4-1	Access anywhere											
WE-7,8												
WE-7,8-1	Data Workflow Services											
WE-9												
WE-9-1	Definition und Analyse der zu durchsuchenden Informationsquellen											
WE-9-2		Erstellung des Suchindex										

Tabelle 2: Zeitplan

Die Risiken für eine Implementierung werden weniger im technischen Bereich als vielmehr innerhalb einer ganzen Reihe von nicht-funktionalen Rahmenbedingungen gesehen. Diese betreffen

a) den gesamten organisatorischen Bereich: „Wer übernimmt die Koordination für die hochschulübergreifende Implementierung der Arbeitsumgebung?"
b) den juristischen Bereich: „Wer überwacht die Rechtmässigkeit der individuell deponierten Daten, wenn sie mit anderen geteilt werden?"
c) Fragen bezüglich der Usability: „Wie wird die Benutzerfreundlichkeit der Arbeitsumgebung bzw. der einzelnen Services sichergestellt?"

6. Conclusions and Priorities

Action Item	Importance	Alignment with program goals	Availability of funding / business case	Implemen-tation risks	National benefit	Implemen-tation effort	Operational effort
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
WE-1-1 Schnitt-stellendefinition	1	1	n.a.	1	1	1	1
WE-1-2 Zugriffsrechtever-waltung	1	1	n.a.	2	1	2	1
WE-1-3 Gruppen-verwaltung	1	1	n.a.	2	1	2	1
WE-1-4 Service-Katalog	1	1	n.a.	2	1	3	2
WE-5-1 Working Scenarios	1	1	n.a.	1	1	3	1
WE-6-1 Development	2	1	n.a.	2	2	6	2

Action Item	Importance	Alignment with program goals	Availability of funding / business case	Implemen-tation risks	National benefit	Implemen-tation effort	Operational effort
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
Platform							
WE-6-2 Execution Platform	2	1	n.a.	2	2	6	2
WE-2-1 Cockpit	1	1	n.a.	2	1	6	3
WE-4-1 Access Any-where	3	1	n.a.	4	3	1	1
WE-7,8-1 Data Workflow Service	1	1	n.a.	5	1	6	2
WE-9-1 Definition & Analyse der Informations-quellen	3	1	n.a.	1	3	2	1
WE-9-2 Erstellung der Suchindices	3	1	n.a.	3	3	5	3
WE-9-3 Konzeption & Realisierung des Such-Interface	3	1	n.a.	2	3	4	2

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for e-publishing

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1. National Services Within the Field of Action

Das Strategiefeld E-Publishing befasst sich mit der Versorgung der wissenschaftlichen Community in der Schweiz mit (elektronischer) wissenschaftlicher Information (S-8 – Bewirtschaftung und Bereitstellung von elektronischen Publikationen) als Grundvoraussetzung für erfolgreiche Forschung und Lehre. Dies betrifft den Zugang zu kostenpflichtigen wissenschaftlichen Publikationen von kommerziellen Verlagen und zu Open-Access-Publikationen (S-8) sowie die Veröffentlichung von Artikeln und E-Books unter Open Access (S-7 – Unterstützung beim Publizieren). Weiter betrifft es die Digitalisierung analoger Inhalte, die für die Wissenschaft relevant sind (S-9 – Digitalisierung von Sammlungen), sowie ihre Veröffentlichung (S-12 – Zugang zu digitalen Sammlungen). Diese Inhalte sowie diejenigen von Open-Access-Repositorien sollen zudem langfristig verfügbar sein (S-10 – Erhaltung von digitalen Sammlungen). Aus unserer Sicht spielen nationale Koordination und standardisierte Metadaten eine sehr wichtige Rolle bei der Vernetzung der verschiedenen Dienste (nicht nur im E-Publishing). Unsere Ausführungen zum Thema Metadaten dienen insbesondere den Teilstrategien Data Management und Working Environment als Input.

Das Handlungsfeld E-Publishing hat sich als sehr heterogen und gross erwiesen. Es umfasst sehr unterschiedliche Aspekte, die alle hohe Implikationen auf die Forschungslandschaft Schweiz inkl. Forschungspolitik und wissenschaftliche Bibliotheken aufweisen. Es wurden vier Teilstrategien entwickelt, die als Dokumente von der Gruppe erarbeitet, diskutiert und verabschiedet wurden. Diese vier Dokumente wurden im vorliegenden Strategiepapier E-Publishing zusammengefasst. Im Zweifelsfall sind die Teilstrategien massgeblich. Zum besseren Verständnis werden diese Teilstrategien oder Teilhandlungsfelder nummeriert und beigelegt.

A.   Nationallizenzen für elektronische Publikationen von Wissenschaftsverlagen (S-8 und S-7) → Action Item eP-1
B.   Förderung von Open Access (S-7 und S-8) → Action Item eP-2
C.   Digitalisierung von für die Wissenschaft relevanten Inhalten und Online-Publikation der Inhalte (S-9, S-10 und S-12) → Action Item eP-3
D.   Metadaten (F-DM-2 Metadaten) → Action Item eP-4

2. Foundations, Key Functions and Services

2.1.   Overview

Aufgrund mangelnder nationaler Förderung und Koordination ist die Schweiz im Vergleich zu anderen Ländern im Bereich E-Publishing ins Hintertreffen geraten. Die Hochschulen und ihre Bibliotheken als Hauptakteure in diesem Handlungsfeld haben sich bisher primär um die Versorgung der eigenen Hochschule gekümmert und – ausser beim Konsortium der Schweizer Hochschulbibliotheken und bei einigen Projekten im Rahmen von e-lib.ch – weniger die Schaffung nationaler Services im Fokus gehabt. Die Landschaft ist entsprechend geprägt von zahlreichen Services, die aber kaum mit anderen Anbietern/Bibliotheken koordiniert werden. Es gibt z.B. Repositorien, die oft mit Websites der Forschenden, der Hochschulbibliografie und anderen Diensten innerhalb der Hochschule verknüpft sind. Deshalb macht lokaler Betrieb und Support für die Forschenden Sinn. Repositorien verfügen auch über offene Schnittstellen (OAI-PMH), doch fehlt die Instanz, welche diese Daten zusammen mit anderen Angeboten und mit Blick auf die Schweizer Forschungsleistung bewirtschaftet und der interessierten Öffentlichkeit sowie für administrative und wissenschaftliche Nachnutzung zur Verfügung stellt. Auch bei Open Access agiert jede Hochschule für sich, und es fehlen hier nationale Policies, Evaluationsmodelle sowie rechtliche Abklärungen, die alle auch von der Forschungspolitik und Organisationen wie SUK, CRUS, SNF, Akademien Schweiz etc. mitgetragen werden müssten. Zudem erhalten in anderen Ländern Forschende nationale Unterstützung (auch finanzielle Förderung) bei den Publikationskosten in Open-Access-Zeitschriften und -Verlagen, wodurch Schweizer Forschende im Vergleich benachteiligt sind. Der Hauptgrund, weshalb Forschende ihre Werke nicht

mit OA und ihre Daten oftmals gar nicht publizieren, ist letztlich der fehlende Reputationsgewinn im Vergleich mit den etablierten lizenzgebundenen Publikationswegen. Weil OA im Vergleich zu diesen neu ist, wird OA in klassischen Evaluationen, die oftmals an Metriken wie den Impact Faktor gebunden sind, systematisch benachteiligt. Deshalb sollen zum Themenbereich Open Access und Datenpublikation und zu neuen Verfahren (Altmetrics) Studien durchgeführt und dann Empfehlungen daraus an die wichtigsten Schweizer forschungspolitischen Organisationen abgegeben werden (siehe 2.4.). Die Ergebnisse sollen dann in nationale Policies einfliessen.

Bei der Digitalisierung sind mit der Förderung von e-lib.ch und dank der grossen Investitionen der jeweiligen Bibliotheken mehrere Digitalisierungszentren geschaffen worden. Zudem wurden von e-lib.ch Projekte gefördert, die in Kooperation mehrerer Bibliotheken quasi nationale Services für einen bestimmten Medientyp erbringen (e-rara.ch, retro.seals, e-codices). Diese Services werden durch e-manuscripta (für neuzeitliche Handschriften) ergänzt. Diese Dienste stehen jedoch nicht allen offen und verfügen noch über keine langfristig gesicherte Trägerschaft und Finanzierung.

Grundlegendes Ziel im Bereich Metadatenerstellung und -verarbeitung ist einerseits die effizientere Nutzung der erfassten Daten durch Forschung, Lehre und Partnerinstitutionen (SNF, European Research Council ERC, Universitätsverwaltungen u.a.) und andererseits die längerfristige Speicherung dieser Daten zusammen mit allenfalls erstellten digitalen Inhalten aber auch nicht digitalen Objekten. Standardisierte und harmonisierte Metadaten erlauben zudem die Nachnutzung durch Dritte, u.a. in Forschungsprojekten, und die Publikation als Open Data zur Nutzung als Linked Open Data. Sie erhöhen zudem die Sichtbarkeit der Schweizer Forschungsergebnisse im nationalen und internationalen Rahmen (was insbesondere auch für Open Access gilt). Bislang werden diese Aufgaben – wenn überhaupt – durch die jeweiligen Institutionen individuell oder teilweise kollaborativ erledigt. Dies führt zu einer starken Fragmentierung von Dienstleistungen und erschwert letztlich die Nutzung durch Lehre und Forschung. Um eine optimale Abstimmung im Bereich Metadaten zu erreichen, ist eine Zusammenarbeit mindestens auf nationaler Ebene unumgänglich.

Im Handlungsfeld E-Publishing sehen wir deshalb einen grossen Handlungsbedarf bei der nationalen Koordination inkl. Policies, bei der Standardisierung von Metadaten und bei der Öffnung bestehender Services (Repositorien, Online-Plattformen) über besser definierte und neue Schnittstellen.

QuickWin: Wir empfehlen den Hochschulen und ihren Bibliotheken die Einrichtung einer nationalen Organisation, die als Ansprechpartnerin für die zahlreichen Aufgaben (Trägerschaft Konsortium, Koordination Digitalisierung, Genehmigung Digitalisierungsprojekte, Betrieb Metadatenhub, Betrieb Kompetenzzentrum Open Access, Unterstützung Open-Access-Publikationskosten) auftreten kann. Zu berücksichtigen in der Teilstrategie „Nationale Organisation".

2.2.   Existing services and ongoing projects

A.   Konsortium der Schweizer Hochschulbibliotheken / Consortium of Swiss Academic Libraries (CSAL)[4], seit 2000 zuständig für die Verhandlung von Lizenzen für E-Journals, Datenbanken und E-Books im Auftrag von rund 60 teilnehmenden Bibliotheken. Das Konsortium steht in einem Spannungsfeld zwischen den Ansprüchen der Bibliotheken und der Position der Anbieter (Verlage).

B.   Im Bereich Open Access gibt es einige Dienste an den einzelnen Universitäten und Hochschulen, vor allem im Bereich Repositorien und vereinzelte Mitgliedschaften bei Open-Access-Verlagen, aber noch kaum nationale Services. Bei den Repositorien sind Rero.doc und Zenodo prinzipiell auf einen institutionsübergreifenden Einsatz vorbereitet. Der SNF hat kein ausgewiesenes Budget zur Förderung von Open-Access-Veröffentlichungen; allfällige Publikationskosten müssen die Forschenden aus ihren Forschungsgeldern begleichen.

C.   Im Bereich Digitalisierung und Online-Publikation von digitalen Inhalten sind im Rahmen von e-lib.ch Angebote entstanden, an denen mehrere Bibliotheken beteiligt sind: e-rara.ch (digitalisierte alte Drucke), retro.seals.ch (digitalisierte wissenschaftliche Zeitschriften), e-

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[4]   http://lib.consortium.ch/index.php

codices.ch (digitalisierte mittelalterliche Handschriften) und e-manuscripta.ch (handschriftliche Quellen). Weiter gibt es Projekte im Bereich Zeitungsdigitalisierung (Scriptorium an der BCU Lausanne für Waadtländer Zeitungen, http://scriptorium.bcu-lausanne.ch/) sowie ein nationales Projekt der Nationalbibliothek: Schweizer Presse online (http://newspaper.archives.rero.ch). Im Bereich Digitalisierung von Videos ist Memoriav tätig. Online-Angebote von Videos werden vor allem im Bereich E-Learning bereitgestellt, u.a. von Switch oder von einzelnen Hochschulen.

D. Im Bereich Metadatenhubs/Suchmaschinen gibt es die Projekte www.swissbib.ch (Metadatenhub und Suchmaschine) und www.e-lib.ch (Suchmaschine). Im Projekt Open Data (http//opendata.admin.ch) werden Behördendaten der Schweiz als LOD (Linked Open Data) zugänglich gemacht. Die ETH Zürich betreibt einen DOI-Service in Zusammenarbeit mit DataCite (www.doi.ethz.ch)

2.3.   International references and standards

A. Nationallizenzen "Classics" in Deutschland, zu 100 % von der DFG finanziert (100 Mio. €). Können zum Teil von der breiten Bevölkerung genutzt werden (nicht nur über Bibliotheken). Projekt ISTEX in Frankreich stellt vier Produkte als Backfiles zur Verfügung, die auch von öffentlichen Bibliotheken genutzt werden können. In Grossbritannien besteht mit dem „UK National Academic Archive" von JISC Collections ebenfalls eine Sammlung ausgewählter Ressourcen, die dauerhaft für Hochschul-, Weiterbildungs- und Forschungsinstitutionen des Vereinigten Königreichs erworben wurden. Allianz-Lizenzen für Current Content werden als nationale Opt-in-Konsortien für aktuelle Literatur in Deutschland von der DFG mit 25 % unterstützt.

Das Projekt SCOAP3 ist ein weltweites Konsortium im Bereich Hochenergiephysik, das in Zusammenarbeit mit Verlagen die wichtigsten Zeitschriften in Open-Access-Zeitschriften umwandelt.

B. Im Bereich Open Access gibt es zahlreiche internationale Referenzprojekte. So werden in Grossbritannien, Deutschland oder in Österreich Open-Access-Publikationen durch die nationalen Förderorganisationen finanziell und mit zusätzlichen Budgets unterstützt. Renommierte Studien zeigen, dass die Kosten rund um wissenschaftliches Publizieren insgesamt steigen, solange Lizenz- und Open-Access-Modelle koexistieren, und dass weltweit vollständiger umgesetzter Open Access kosteneffizienter wird. Geldgeber wie der European Research Council (EU-Projekte) verlangen von ihren Beitragsempfängern zunehmend Open Access, auch im Bereich gewisser Forschungsdaten (Open Data). Repositorien sind oft in nationale Policies eingebettet (z.B. USA mit PubMed Central). In skandinavischen Ländern und UK sind institutionelle Repositorien manchmal Teil von CRIS (Current Research Information System) und liefern automatisiert standardisierte Daten über Publikationen, Personen, Projekte an zentrale nationale Plattformen. Die Initiative ORCID bietet eine breit abgestützte kommende Plattform für Autorenidentifizierung. OA-Kompetenzzentren gibt es in vielen Ländern, z.B. national in Österreich (OANA) oder mit der Informationsplattform open-access.net in Deutschland. Viele Hochschulbibliotheken bieten ihren Forschenden professionelle Plattformen für die Veröffentlichung von Open-Access-Zeitschriften und Monografien sowie Unterstützung im Bereich Forschungsdaten-Management und Open Data.

C. Im Bereich Digitalisierung können viele internationale Referenzprojekte aufgelistet werden. Neben den grossen nationalen Portalen (z.B. gallica.fr) gibt es Plattformen für Alte Drucke (VD16, VD17 in Deutschland), für Zeitschriften (DigiZeitschriften in D, aber mit beschränktem Zugang), für Zeitungen (Historische Kranten in NL) oder auch übergeordnete Portale, die via geharvestete Metadaten auf die Digitalisate in anderen Plattformen verlinken (Europeana, Deutsche Digitale Bibliothek).

D. Metadatenhubs und wissenschaftliche Suchmaschinen gibt es im internationalen Rahmen einige: www.europeana.eu (M/S), www.narcis.nl (Suchmaschine für wiss. Lit. in NL), http://trove.nla.gov.au/ (M/S), National Digital Library of Finland (www.finna.fi, M/S) usw.

- Austauschformate/Protokolle: OAI-PMH (Datenaustausch), LOD, SRU, SPARQL

- Metadatenstandards: DC - Dublin Core, MODS - Metadata Object Description Standard, CERIF - Common European Research Information Format, METS - Metadata Encoding and Transmission Standard, OAIS - Open Archival Information System, MARC21 (demnächst: bibframe), RDA
- ID-Standards und -Initiativen: DOI, URN, ORCID, ISNI, ODIN. Normdaten: GND, Rameau

2.4. Required innovation

Gänzlich neue technische Lösungen scheinen in diesem Handlungsfeld oftmals nicht nötig. Es geht vielmehr darum, die bestehenden, eher lokal ausgerichteten Services über offene Schnittstellen und standardisierte Metadaten zu vernetzen und für weitere Services zu öffnen (u.a. für ein nationales Portal, aber auch für Anwendungen in der Forschung direkt). Die Innovation bezieht sich in diesem Handlungsfeld eher auf neue Organisationsformen, Geschäftsmodelle und Implementierung von neuen Funktionen, Standards (standardisiertes Metadaten-Austauschformat) und Schnittstellen. Ein zentraler Metadatenhub soll die einzelnen Datenlieferanten (Repositorien, Online-Plattformen) entlasten und durch Bündelung der Daten die Nachnutzung erleichtern. Organisationsformen, Policies, Evaluationsmodelle, aber auch die Verhandlung von Lizenzen mit Open Access u.a. bedingen einen Dialog und die Unterstützung – ev. Einsitz – weiterer wichtiger forschungspolitischer Stakeholder wie SUK, CRUS, SNF, Akademien Schweiz etc.

2.5. Action items

A. Nationallizenzen → Action Item eP-1
   1. **Lizenzierung von Backfile-Archiven** abgeschlossener Jahrgänge bibliographischer Datenbanken, elektronischer Sammlungen, elektronischer Zeitschriften, E-Books etc. mit Zugriff für alle schweizerischen Hochschuleinrichtungen, Forschungsanstalten und allenfalls private Einzelnutzer. Inklusive Pflege der Inhalte, Aufbereitung der Metadaten, Bereitstellung des Zugangs, Zugriffs- und Rechteverwaltung und Support. Hosting und Langzeitarchivierung. Mandat an das Konsortium. Hosting (in zweiter Phase) ausschreiben.
      → Action Item eP-1-1
   2. **Lizenzierung aktueller elektronischer Informationsprodukte für E-Journals, Datenbanken und E-Books unter Berücksichtigung von Open Access.**[5] Verhandlung von Open-Access-Rechten: für Publikationen von AutorInnen (aus Institutionen, die dem Konsortium angeschlossen sind) in lizenzierten Werken: Hinterlegung in Repositorien (Green Road) mit Fokus auf möglichst klaren und einfach zu handhabenden Rechten; Verrechnung von OA-Publikations- mit Lizenzkosten zur Vermeidung doppelter Bezahlung ("double-dipping" im Hybridmodell); Kommunikation der erzielten Vereinbarungen. Zudem Koppelung der aktuell lizenzierten Jahrgänge an die Backfiles mit einer Moving Wall. Mandat an das Konsortium.
      → Action Item eP-1-2
   3. **Abklärung des zusätzlichen Bedarfs** von Forschenden an elektronischen Informationsressourcen, insbesondere in kleineren Hochschulen. Ausarbeitung einer Handlungsempfehlung zu Handen des Konsortiums, bzw. der zu schaffenden nationalen Organisation. Ausschreibung einer Studie.
      → Action Item eP-1-3

B. Open Access (OA) → Action Item eP-2

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[5] Die bisherige Aufgabe des Konsortiums, die Lizenzierung aktueller Inhalte für die Hochschulen, wird als existierender Service und nicht als Action Item aufgeführt. Diese Aufgabe ist aber von höchster Priorität und muss weitergeführt werden.

1. **OA-Publikationskosten:** Gründung eines Fonds und Erarbeitung von Kriterien zur Vergabe von Geldern für OA-Publikationskosten in reinen OA-Zeitschriften und Gebühren für OA-Monografien. Wichtig ist, dass die Forschenden selber einen Teil (50 %) der Open-Access-Publikationskosten tragen, damit sie als zentrale Stakeholder die Kosten im Auge behalten. Beteiligung an SCOAP3. Mandat an CRUS: Gründung eines Fonds zur Förderung von OA-Publikationen.
→ Action Item eP-2-1

2. **Swiss Open Academic Publisher**: Gründung eines „Swiss Open Academic Publishers", welcher es Schweizer Forschenden sowie akademischen und Non-Profit-Herausgebern (z.B. wiss. Gesellschaften, Instituten, Universitäten) ermöglicht, OA-Zeitschriften und -Monografien zu veröffentlichen. Technisch wird ein zentraler Betrieb von Open Journal Systems und Open Monograph Press empfohlen.
Vorgehen: Ausschreibung.
→ Action Item eP-2-2

3. **OA-Repositorien**: Gründung eines nationalen Repositories (als Ergänzung zu den bestehenden Hochschulrepositorien) als Ausbau bestehender (Rero.doc, Zenodo o.a.) oder als neues Repository für alle Forschenden an öffentlichen Forschungsinstitutionen der Schweiz, inkl. Fachhochschulen, Spitälern, nichtakademischen Stellen. Neue Formate wie E-Books sollten unterstützt (EPUB2, EPUB3, MOBI) und die Institutionen entsprechend dargestellt werden. Studien und Pilotprojekte, ob und wie bestehende Repositorien auch für Speicherung und (kontrollierten sowie offenen) Zugang zu Forschungsdaten verwendet werden können.
Vorgehen: Ausschreibung.
→ Action Item eP-2-3

4. **Autorenrechte**: Klärung der Rechte für die Hinterlegung von Publikationen in Repositorien pro Journal; Darstellung dieser Rechte in einer Datenbank sowie automatisiert beim Eintragen einer Publikation in einem Repository. Denn die AutorInnen und Repository-Manager sind oft unsicher, welche Rechte bei der Hinterlegung ihrer Werke in Repositorien gelten. Dies betrifft speziell schweizerische Verlage, aber auch die Ebene der individuellen Journals bei internationalen Verlagen. Ausschreibung, Pilotprojekt.
→ Action Item eP-2-4

5. **Evaluationsmodelle:** Studien zu OA-freundlicher Forschungsevaluation und Zitationskennzahlen sowie konkrete Handlungsempfehlungen (für Policy vgl. B7) erarbeiten. Forschungsevaluationen, welche nicht nur Publikationen, sondern Forschungsdaten mit einbeziehen (z.B. Altmetrics), erhöhen den Anreiz für Forschende, ihre Daten strukturiert zu pflegen. Ausschreibung von entsprechenden Studien.
→ Action Item eP-2-5

6. **Rechtsgutachten**: Zu Umgang und Wiederverwertungsrechten bei Open Access, E-Books, Forschungsdaten, Langzeitarchivierung. Für Forschende sowie ihre Supporter (Repository-Manager, Bibliotheken, Rechtsdienste etc.) bestehen in diesen Bereichen viele rechtliche Unsicherheiten. Rechtsgutachten zu Lizenzen für OA (z.B. Digitalisate, verwaiste Werke etc.), Lizenzen und Wiederverwertungsrechte bei Inhalten von E-Books, Lizenzen und Rechte bei Forschungsdaten (u.a. Urheberrecht, Datenschutz, Intellectual Property Rights), sowie für Langzeitarchivierung gekaufter Objekte werden Klarheit schaffen. Dies schafft eine Basis zur konkreten Umsetzung von Strategien. Ausschreibung von Rechtsgutachten.
→ Action Item eP-2-6

7. **Policies**: Zu Open Access, Open Data und Forschungsdaten-Management. Übersicht über aktuelle und geplante Anforderungen wichtiger Stakeholder, v.a. Funders wie die EU. Auf schweizweiter Ebene sollten Policies mit Unterstützung der in 2.4. erwähnten Stakeholder und in Abstimmung mit internationalen Organisationen (EU, DFG etc.) zu Datenmanagement und Open Data erstellt werden. Auf Hochschulebene können bereits existierende Policies ausländischer Universitäten empfohlen werden. Call for Proposals (CfP).
→ Action Item eP-2-7

8. **OA-Kompetenzzentrum**/Netz: Bündelung der bestehenden, Einbezug neuer Anspruchsgruppen auch aus Forschungspolitik (SNF, CRUS, Akademien Schweiz, SBFI). Politisch-strategische Arbeit, z.B. im Bereich Urheberrecht, im Bereich

verwaiste Werke und im Bereich zwingendes Zweitpublikationsrecht. Jährlicher Überblick OA-Landschaft und -Stand in der Schweiz: Status von OA in der Schweiz transparent machen. Reservation einer URL für einen Webauftritt, z.B. www.openaccess.ch; Ausschreibung, ev. Mandat an die zu gründende nationale Bibliotheksorganisation.
→ Action Item eP-2-8

Digitalisierung → Action Item eP-3

9. **Digitalisierung wissenschaftlicher Sammlungen** (Erweiterung der bestehenden Services mit neuen Inhalten, Erweiterung der bestehenden Infrastruktur). CfP.
→ Action Item eP-3-1

10. **Nationales Koordinationsgremium für Digitalisierungsvorhaben**
In diesem Gremium sind die einzelnen Dienste zusammengeschlossen. Es werden Digitalisierungsprojekte und Anfragen neuer Partner koordiniert sowie Standards und Best Practices abgestimmt und ausgetauscht. CfP oder Mandat an die zu gründende nationale Bibliotheksorganisation.
→ Action Item eP-3-2

11. **Fonds für Digitalisierungsprojekte**. Mandat an Koordinationsstelle/nationales Gremium.
→ Action Item eP-3-3

12. **Institutionalisierung der Trägerschaften** für die bestehenden Plattformen und Ausbau zu echten nationalen Services, die allen Schweizer Hochschulen offenstehen. Dazu gehört auch die Definition von Prozessen für die Aufnahme neuer Partner und die Entwicklung eines nachhaltigen Geschäftsmodells. Mandat an die Träger der Projekte/Plattformen.
→ Action Item eP-3-4

13. **Vernetzung bereits bestehender und neuer Services** mittels offener Schnittstellen und LOD. CfP.
→ Action Item eP-3-5

14. **Weiter- und Neuentwicklung** der Online-Plattformen: Responsive Designs für z.B. mobile Anwendungen wie Apps und Tablets sowie Texterschliessung durch Integration von OCR- und Transkriptionstools. CfP.
→ Action Item eP-3-6

15. **3D-Digitalisierung**. Bedarfsanalyse und anschliessend ev. Projekt zur Einrichtung eines 3D-Digitalisierungszentrums für mobilen Einsatz.
→ Action Item eP-3-7

C.   Metadaten → Action Item eP-4

1. **Metadatenaustausch und Standards**: Standardisierter Metadatenaustausch zwischen Repositorien und Darstellung via Portal. Erarbeitung und Anwendung von gemeinsamen Standards von Schweizer Repositorien und anderen Datenlieferanten. Einrichtung einer Clearing-Stelle (in Verbindung mit Metadatenhub D3), welche die aktuelle Situation analysiert und mit den Stakeholdern einheitliche Mindestanforderungen (unter Berücksichtigung der Mehrsprachigkeit) definiert. CfP.
→ Action Item eP-4-1

2. **Einrichtung einer API** für die Nachnutzung, bzw. der Integration der Daten in z.B. Forschungsplattform P3 des SNF. Entwicklung von Schnittstellen für Repositorien.
→ Action Item eP-4-2

3. **Aufbau eines Metadatenhubs** zur Bündelung und Präsentation der weiterhin dezentral erfassten Metadaten über verschiedene Schnittstellen für Suche und Datentransfer. Der Hub ist so flexibel aufgebaut, dass bibliographische Metadaten aus verschiedenen Domänen (Bibliothek, Repository, Content-Provider, Forschungsdatenplattformen, P3-Datenbank des SNF) verarbeitet und für die Nachnutzung bereitgestellt werden können, z.B. via http://opendata.admin.ch/ als Linked Open Data. Der Metadatenhub und die Clearingstelle (D1) können der zu gründenden nationalen Bibliotheksorganisation angegliedert werden.
→ Action Item eP-4-3

4. **Aufbau einer Personennamendatei** (inkl. Körperschaften) für die mehrsprachige Schweiz: Konkordanz zwischen GND und Rameau schaffen und mit ORCID (für lebende Autoren) verbinden. Abklärung für Publikation unter CC-Lizenz. CfP.

→ Action Item eP-4-4

D.   Nationale Organisation der Hochschulbibliotheken → Action Item eP-5
1.   Die Action Items eP-2-2, eP-2-3, eP-2-8, eP-3-2, eP-3-7, eP-4-1 und eP-4-3 erfordern alle **eine nationale Koordination**. Da bisher mit dem Konsortium nur für die Lizenzierung von elektronischen Ressourcen eine nationale Stelle existiert, besteht hier Handlungsbedarf. Als übergeordnetes Action Item schlagen wir deshalb die Einrichtung einer nationalen Organisation der Hochschulbibliotheken vor. Diese soll als Trägerin der verschiedenen Koordinationsaufgaben dienen. Die einzelnen Action Items können dann als Mandat an diese Organisation übertragen werden. Mit dieser neuen Organisation sind die Einbettung in die bestehende Landschaft und eine effiziente Koordination sichergestellt. Damit wird auch das Risiko beseitigt, einzelne Institutionen könnten das Konsortium nicht mehr unterstützen.

Bestehende Services, die weitergeführt werden sollen:

1.   **Lizenzbeschaffung elektronischer Verlagsprodukte** (Current Content) durch das Konsortium.
2.   **DOI-Registrierung:** u.a. für permanente Adressierung in Repositorien (Publikationen, Forschungsdaten). Der Service der ETH Zürich soll fortgesetzt werden.
3.   **Digitalisierungszentren in div. Bibliotheken** (vgl. Action Item eP-3-1), Online-Plattformen für digitale Inhalte (Action Item eP-3-6).

3. Dependencies and Interfaces

3.1.   Prerequisites from other strategy projects

Schnittstellen

1.   **Autorenidentifizierung:** Schwerpunkt bei Identity-Management-Strategiegruppe. Unsere Anforderungen: (a) Mit ORCID = kommender Standard im Bereich Forschung/Autoren wissenschaftlicher Werke. (b) Jeder Forscher, der an einer Schweizer Forschungsinstitution arbeitet, soll eine ORCID-ID zugewiesen bekommen. Herausforderung des Abgleichs bei bereits existierender ORCID. (c) Bestehende und neue Repository-Einträge sollen mit den ORCID-IDs abgeglichen werden. Zusätzlich soll eine eindeutige Identifizierung von verstorbenen Autoren möglich sein, wie sie in Bibliothekskatalogen verzeichnet sind. Hier wäre ein Abgleich zwischen der Gemeinsamen Normdatei (GND) möglich. Das Pendant für die französischen Normdaten ist Rameau.
2.   **Konzepte zur Langzeitarchivierung (LZA):** Schwerpunkt bei der Gruppe Data Management, unsere Anforderungen sind: (a) gemeinsame Metadaten, Prinzipien und Workflows erarbeiten für die LZA in Repositorien und anderen Gefässen (Publikationen, Dokumente, Forschungsdaten). Dazu sind Expertisen und Konzepte nötig. (b) Infrastrukturen und Repositorien müssen entsprechende Formate für LZA nach OAIS ausgeben. Weitere Inhalte für LZA: Files aus Hosting der Dokumente aus Nationallizenzen; Digitalisate aus Digitalisierungsaktivitäten.
3.   **Data Management Plans:** Unsere Anforderungen sind (Schwerpunkt bei Gruppe Data Management): (a) Support für Forschende beim Erstellen von Data Management Plans. (b) Richtlinien für Institutionen beim Einrichten von Daten-Infrastrukturen: Interoperabilität, Metadatenstandards, Langzeitarchivierung, Zugangsoptionen (geschlossen bis offen). (c) Bestehende fachorientierte oder internationale Repositories und deren Praktiken und Standards sind zu berücksichtigen. (d) Betonung auf Organisation, Support für Forschende und auf Open Data: Welche Daten sollen wie und mit welchem Zugang gespeichert werden? Zu berücksichtigen sind dabei u.a. Urheberrecht, Datenschutz, Intellectual Property Rights.
4.   **Portallösung:** Harvesting der Inhalte über standardisierte Schnittstellen und Metadaten. Verknüpfung von Autorenidentifiern (ORCID) mit Objektidentifiern (DOI). Suche im Volltext und Lösungen für Data Mining, Bibliometrie etc.
5.   **Identity Management:** Für die Verwaltung und Persistierung der Personen-IDs ist entweder eine neue Infrastruktur zu implementieren oder eine der bestehenden Lösungen wie Switch

AAI, ORCID, ISNI oder GND (d) oder Rameau (fr) nachzunutzen. Der Aufbau einer nationalen Personennamendatei im Rahmen eines neuen Projekts und die Verbindung mit internationalen Standards wird als Action Item beschrieben.

3.2.   External interfaces

Offene Schnittstellen für Portal, Forschungsvorhaben (z.B. in Digital Humanities) und Informationssysteme (SNF P3-Datenbank, European Research Council (OpenAIRE), Universitäten, ArXiv, PubMed). Grundsätzlich OAI-PMH, REST-Schnittstelle, Nutzung von LOD.

API für Suchfunktionen: SRU, SPARQL.

3.3.   Further dependencies and relevant external factors

A.   Hosting und Langfristsicherung der erworbenen Backfile-Archive (Use Case 094 Hosting von Nationallizenzen). Die Lizenzbedingungen beim Abschluss von Nationallizenzen sehen in der Regel vor, dass der Zugriff auf die dauerhaften und mit Archivrechten lizenzierten Inhalte für einige Jahre über die Infrastruktur des jeweiligen Verlags oder Anbieters genutzt werden kann. Danach müssen die lizenzierenden Institutionen selbst für ein Hosting der Inhalte und deren laufenden Zugriff sorgen. Eine entsprechende Infrastruktur besteht in der Schweiz bisher nicht.

B.   Post-Cancellation-Access (Use Cases 090 CLOCKSS, 097 LOCKSS, 099 Portico). Für die langfristige Sicherung des elektronischen Zugangs ist der Post-Cancellation-Access zu berücksichtigen. Das Konsortium hat Rahmenvereinbarungen mit LOCKSS und Portico geschlossen. An diese sind derzeit aber mangels personeller und finanzieller Ressourcen nur wenige Bibliotheken angeschlossen. Im Rahmen einer Finanzierung von Nationallizenzen wäre die Einbindung und Förderung der Teilnahme weiterer Bibliotheken an den Diensten Portico und LOCKSS zu begrüssen.

C.   Metadatenkompatibilität bei Repositorien und Online-Plattformen für digitale Objekte: MARCXML, METS, MODS, OAI_DC

D.   Metadatenstandards: Semantik (OA Status, Projektinformation, Autoridentifikation); Format (Dublin CORE, CERIF, MODS, Linked Open Data); Protokoll (OAI-PMH, Web Services).

E.   Bei verwaisten Werken wäre eine Urheberrechtsänderung nach EU-Modell nötig.

F.   Für die Publikation von Metadaten aus Bibliothekskatalogen muss geprüft werden, ob und wie diese unter einer Creative-Commons-Lizenz veröffentlicht werden können.

4. Economic Efficiency / Availability of Funding

Durch die Koordination auf nationaler Ebene erhöht sich die Effizienz der Dienste durch Vermeidung von Doppelspurigkeiten. Durch die Harmonisierung der Metadaten verringert sich der Aufwand für die Eingabe durch Forschende oder anderes Personal.

Einige der Aufgaben, die im Handlungsfeld E-Publishing beschrieben werden, werden bereits heute lokal von Bibliotheken wahrgenommen. Einen Teil der Kosten werden die Bibliotheken tragen können, wobei sie jetzt mit ihren Lizenzzahlungen schon einen riesigen Beitrag leisten. Grundsätzlich hat sich ein Beteiligungsschlüssel wie in e-lib (50:50) bewährt, wobei projektspezifische Flexibilität möglich sein sollte.

4.1.   Implementation costs

A.   Nationallizenzen
    1.   Der Erwerb von ca. 8-10 Nationallizenzprodukten wird derzeit auf ca. 13.5 Mio. CHF geschätzt. Diese Zahlen basieren auf einer Umfrage, welche das Konsortium im Frühjahr bei den Bibliotheken zu den favorisierten Verlagsangeboten durchgeführt hat und den von den Verlagen dazu eingereichten Offerten. Die zehn wichtigsten

Produkte wurden vorselektiert. Es besteht keine Abhängigkeit zwischen den einzelnen Paketen. Die Gesamtkosten sind hier auf drei Jahre verteilt, da erfahrungsgemäss die Verhandlungen und Vertragsabschlüsse, Rechteverwaltung und Umsetzung der Zugriffe, Pflege der Daten etc. sehr langwierig sind. Es wird daher von einem Kauf von ca. 3 Produkten pro Jahr ausgegangen.

2. Lizenzierungsverhandlungen unter Berücksichtigung von OA: keine Kosten.
3. Bedarfsabklärung: Durchführung einer Studie. Kosten: CHF 250'000.-

B. Open Access
1. OA-Publikationskosten: CHF 1.4 Mio. im 1. Jahr (1 FTE, CHF 1.25 Mio. Sachmittel = OA-Publikationskosten). Berechnet mit 50 % Unterstützung, den Rest zahlen die Forschenden selber. 6 Monate Vorbereitung, dann fliessen Sachmittel.
2. Swiss Open Academic Publisher: 2 FTE im 1. Jahr = CHF 300'000.- für Konzept und Einrichtung.
3. OA-Repositorien: Gründung zentrales Repository: 2 FTE=CHF 300'000.- im 1. Jahr. Service Rero.doc und Zenodo nicht schätzbar, aber wahrscheinlich um einiges günstiger.
4. Autorenrechte: 0.2 FTE + CHF 50'000.- Infrastruktur / externe Programmierung im 1. Jahr.
5. Evaluationsmodelle: 2 FTE während 2 Jahren für 2 Studien. Nur Einmalaufwand.
6. Rechtsgutachten: CHF 400'000.- Einmalaufwand für Erstellung, Kommunikation und Publikation von 3 Rechtsgutachten (Erfahrungswert Universität Zürich).
7. Policies: total 0.5 FTE während 3 Jahren für Übersicht, Empfehlungen, Vernetzung.
8. OA-Kompetenzzentrum: 1 FTE/Jahr für Einrichtung und Betrieb und danach.

C. Digitalisierung
1. Investitionskosten für Services in Betrieb (gemäss Use Cases):
    i. e-manuscripta: 70 kFr.
    ii. e-rara: 157kFr.
    iii. retro-seals: 240 kFr.
    iv. Zeitungsdigitalisierung: unbekannt. Skriptorium als Service ist in Betrieb, die Plattform von rero.doc ebenfalls.
2. Digitalisierung: Fonds für Digitalisierungsprojekte: keine Einrichtungskosten
3. Institutionalisierung: 0.5 FTE
4. Einmalige Kosten für die Einrichtung der benötigten Schnittstellen. Geschätzte Kosten: Fr. 50k pro Plattform (e-lib-Projekte).
5. Weiterentwicklung Online-Plattformen: in C1. enthalten (so weit bekannt)
6. Einrichtung eines Kompetenzzentrums für 3D-Digitalisierung: 500 kFr. – Zuerst Bedarfsanalyse, Ausschreibung einer Studie. Kosten: Fr. 100'000.-

D. Metadaten
1. Harmonisierung Metadatenstruktur: Bedürfnisabklärung, Ausarbeitung von Empfehlungen: 1 FTE.
2. Einrichtung einer API für SNF und Entwicklung von Schnittstellen für Repositorien: 1 FTE.
3. Aufbau Personennamendatei: 1 FTE.

E. Nationale Organisation Hochschulbibliotheken
1. Projektleitung für 2 Jahre (Betriebskonzept, Business Plan, Realisierung): 1 FTE

4.2. Operational costs

A. Nationallizenzen:
1. Nationallizenzen: Die aktuellen Lizenzen werden derzeit von den Bibliotheken selbst getragen (Kosten: ca. 25 Mio. Fr. jährlich). Für die Nationallizenzen werden 3 FTEs

        zur Bearbeitung (Verhandlung, Aufbereitung Metadaten, Statistik, Support plus IT-Unterstützung) veranschlagt. Kosten: 600'000.- jährlich

2. Lizenzen mit Open Access: 0.8 FTE/Jahr für Einrichtung, Betrieb und danach.

B. Open Access:
1. OA-Publikationskosten: CHF 2.6 Mio./Jahr (1 FTE, CHF 2.45 Mio. OA-Publikationskosten) für 2 Jahre. Berechnet mit 50 % Unterstützung, den Rest zahlen die Forschenden selber.
2. Swiss Open Academic Publisher: 2 FTE = CHF 300'000.-/Jahr für 2 Jahre für Technik und Support. Zumindest der Techniker (mind. 0.5 FTE) muss danach permanent finanziert werden. Support kann nach Programmende von den beteiligten Hochschulen verlangt werden.
3. OA-Repositorien: 0.33 FTE = CHF 50'000.- im 2. und 3. Jahr und auch danach. Service Rero.doc und Zenodo nicht schätzbar.
4. Autorenrechte: 0.2 FTE im 2. und 3. Jahr für Koordination, danach Finanzierung durch Benutzer.
5. Evaluationsmodelle: 2 FTE während 2 Jahren für 2 Studien. Nur Einmalaufwand.
6. Rechtsgutachten: CHF 400'000.- Einmalaufwand für Erstellung, Kommunikation und Publikation von 3 Rechtsgutachten (Erfahrungswert Universität Zürich)
7. Policies: total 0.5 FTE während 3 Jahren für Übersicht, Empfehlungen, Vernetzung
8. OA Kompetenzzentrum: 1 FTE/Jahr für Einrichtung und Betrieb und danach.

C. Digitalisierung
1. Die bestehenden Services werden beim Ausbau ihrer Plattformen unterstützt. Der Kostenschlüssel soll wie bei e-lib.ch bei 50:50 liegen. Kosten gemäss Use Cases (Finanzierungsbedarf):
    i. e-manuscripta.ch: Betriebskosten 1.5 Mio. Fr. (2014-16))
    ii. e-rara.ch: Betriebskosten 2.8 Mio. Fr. (2014-16)
    iii. retro.seals.ch: Betriebskosten 870 kFr. (2014-16)
2. Fonds für Digitalisierungsprojekte: 3 Mio. Fr. (2014-16)
3. Nationales Koordinationsgremium: 1 FTE.
4. Institutionalisierung: keine Betriebskosten
5. Vernetzung: keine Betriebskosten
6. 3D-Digitalisierung: 1 FTE während 3 Jahren

D. Metadaten
1. Betrieb Metadatenhub: 0.7 Mio./Jahr (3 FTEs)
2. Metadatenaustausch und Standards für Repositorien: 0.5 FTE 2. Jahr, CHF 25'000.- für Plugin-Entwicklung = CHF 100'000.-. Ab 3. Jahr keine Kosten, getragen von lokalen Repository-Betreibern.

E. Nationale Organisation Hochschulbibliotheken
1. Für den Betrieb wird ein Businessplan erarbeitet.

4.3. Customer benefit

Erleichterter und dauerhaft gesicherter Zugang zu Information für Forschende und Studierende aller Hochschulen in der Schweiz, auch bei Hochschulwechsel. Verbesserter Zugang zu wissenschaftlicher Information für Forschende und Studierende kleinerer Hochschulen. Dadurch dauerhafte Sicherung des Zugangs zu wissenschaftlicher Information für den internationalen Spitzenforschungsplatz Schweiz. Bessere Unterstützung von Open Access, dadurch erleichtertes Einhalten von Vorgaben von Geldgebern, Anschluss an internationale Standards und optimale Sichtbarkeit der Forschungsresultate.

Durch die Verlinkung und Öffnung bestehender Services werden die Inhalte auch über andere Plattformen, z.B. virtuelle Forschungsumgebungen, und für übergeordnete Portale nutzbar.

Mehrfaches Eintragen eigener Publikationen entfällt. Die Digitalisierungsprojekte und -plattformen bieten vor allem für die Digital Humanities wertvolles Forschungsmaterial.

5. Implementation Plan and Risks

Die Frage Mandat oder CfP wurde bei den Action Items bereits angegeben.

Um das Ziel der Sicherung einer langfristigen nationalen Versorgung mit wissenschaftlicher Information weiter zu verfolgen, wird die Weiterführung des Konsortiums der Schweizer Hochschulbibliotheken empfohlen. Der neu aufzubauende Bereich „Erwerbung von Nationallizenzen" soll im Konsortium angesiedelt werden. Eine neue Trägerschaft und Organisationsstruktur, z.B. einer nationalen Bibliotheksorganisation angegliedert, würde die Akzeptanz des Konsortiums verbessern.

6. Conclusions and Priorities

Action Item	Impor-tance	Alignment with program goals	Availability of funding / business case	Implemen-tation risks	National benefit	Implemen-tation effort	Operational effort
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
A1. Nationallizenzen für Backfiles	1	1	3	1	1	4	>6
A2. Lizenzen mit OA	1	1	3	4	2	1	1
A3. Bedarfsabklärung	2	2	1	1	3	1	1
B1. OA-Publikationskosten	1	1	4	1	1	>6	>6
B2. Swiss Open Academic Publisher	2	1	4	3	2	2	2
B3. OA-Repositorien	2	1	4	2	2	2	1
B4. Autorenrechte	1	1	1	4	1	1	1
B5. Evaluationsmodelle	1	1	1	2	2	2	0
B6. Rechtsgutachten	1	1	1	1	1	3	0
B7. Policies	1	1	1	2	2	2	0
B8. OA-Kompetenzzentrum	1	1	4	1	1	1	1
C1. Digitalisierung	1	1	3	1	2	1	>6
C2. Nationales Koordinationsgremium	1	1	2	3	2	1	1

Action Item	Impor-tance	Alignment with program goals	Availability of funding / business case	Implemen-tation risks	National benefit	Implemen-tation effort	Operational effort
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
C3. Fonds für Digitalisierungsprojekte	1	1	2	3	2	1	6
C4. Institutionalisierung	2	1	1	2	2	1	1
C5. Vernetzung	1	1	1	2	1	3	2
C6. Weiterentwicklung	2	2	2	2	2	3	1
C7. 3D-Digitalisierung	2	2	2	2	3	3	2
D1. Koordination Metadatenstandards	1	2	1	3	1	4	1
D3. Infrastructure (API)	2	2	1	4	1	2	1
D4. Infrastructure (meta data hub)	1	2	4	1	1	3	3
D5. Personennamen-datei	2	2	1	3	2	3	1
E1. Organisation	1	1	1	3	1	2	2

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for e-learning

Version 1.0: 11.10.2013
Contact: isci@crus.ch

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1. National services within the field of action

- S-2: e-Portfolio
- S-15: Exams with electronic support (e-assessment)
- S-16: Knowledge transfer with electronic support
- S-17: Management and delivery of electronic educational content

2. Foundations, key functions and services

2.1. Overview

Higher education institutions face fundamental changes in the area of technology-enhanced learning. Advances in cloud services, personalization approaches and mobile technologies open up new opportunities for creating complex, large-scale learning environments that were not feasible with conventional approaches before (see MOOCs). This has implications for all areas of educational activities in higher education institutions and similarly affects course organization and management, the production and distribution of learning material, didactics, and assessment. Such technology-enhanced learning has major implications for the Swiss Higher Education Institutions (HEI) because courses, books, textbooks, exams and other didactical content (including the open educational resources - OER) plus personalized data have to be adapted. There are also many challenging issues to deal with, such as data privacy, copyright clearance, plagiarism, obsolescence of formats, interoperability between applications etc.

To face these challenges, we propose concentrating our efforts on four national services (closely matched to S-2, S-15, S-16, and S-17):

1. e-portfolio;
2. e-assessment;
3. Learning and teaching with new tools for a more efficient knowledge transfer;
4. Management and delivery of electronic educational content.

Such national services should contribute to lowering the costs given. Complex learning environments are expensive to develop and difficult to maintain for a single organization and many educational functions and tools are of shared interest to all institutions.

Besides costs, these national services will enhance the learning and teaching experience and in some cases bridge the existing gap between research and education (for instance through case-based learning, inquiry-based learning, project-based learning, etc.). Furthermore, current approaches do not allow the reuse and repurposing of solutions in different contexts, and in many cases suffer from usability issues. This is why we must at national level:

- Promote learning from anywhere at any time;
- Improve teaching interactivity;
- Provide tools to manage all digital learning resources collected during and after the students' studies, which include students' learning outcomes and reflections, semester projects and Master theses, e-certificates, OER, links to MOOC courses, eBooks, self-assessments, virtual labs, simulation results, etc.;
- Promote active and collaborative learning through peer-coaching, interactive content and technology-enhanced learning spaces with respect to students' identified needs, based on efficient authoring tools;
- Further develop e-assessment (formative and summative) to improve the quality of exams through innovative, competence-oriented e-assessment formats, better objectivity and control of confounding factors in e-assessments and greater efficiency in exam administration and correction (automatic and manual) in the face of growing student numbers.
- Help to cope with the increased diversification of technologies and tools so as to provide the e-learning platforms running in Switzerland (Moodle, Olat, ILIAS, Mahara, Chamilo, docendo, etc.) with enhanced functionalities (e.g., e-assessment-tools, e-portfolio-systems, mobile OS platforms, etc.).

2.2.   Existing services and ongoing projects

Since 2000, e-learning in Switzerland has been able to benefit from several programs: the Swiss Virtual Campus (2000-2008), the "AAA/SWITCH e-Infrastructure of e-Science" (2008-2013), and the "Learning Infrastructure" (2013).

Within the SUC cooperation and innovation project AAA/SWITCH, 68 out of 116 projects were carried out in the domain "e-learning" (http://www.switch.ch/projects), making it the domain with the largest number of projects. Furthermore, it turned out that this domain also had the largest number of institutions involved in the Swiss higher education sector: all cantonal universities (except the University of Lucerne), both Swiss Federal Institutes of Technology and all seven universities of applied sciences. This can be taken as a clear sign that e-learning today is vital for the entire academic sector and is of essential interest to all institutions.

The AAA/SWITCH e-learning projects were followed in 2013 by the transitional one-year project "Learning Infrastructure", which is part of the CRUS P-2 cooperation project. The two main thrusts of "Learning Infrastructure" (due by the end of 2013) are:

- "New learning environments", devoted to analyzing the student lifecycle plus the concept of personalized working and learning environments using e-portfolios and PLEs;
- "e-assessment" for creating a portal to establish an e-assessment culture and practice at the institutions, the improvement of solutions, deployment of products, field tests, dissemination, common concepts (e.g. Virtual Desktop Infrastructure, VDI), and best practice scenarios for lecturers and other stakeholders.

The organizational outcomes of these three programs (Swiss Virtual Campus, AAA/SWITCH, and learning infrastructure) were on the one hand the setting-up of e-learning centers (CCSPs, one for each institution) with the ETWG assembly serving as the CCSP board, and on the other hand the launch of the eduhub community. This community, coordinated by SWITCH, encourages the sharing of best practices through:

- Regular webinars;
- The distribution of a newsletter and other information on a blog (http://www.eduhub.ch);
- An annual meeting (regrouping over 100 participants);
- Setting up Special Interest Groups (SIG), bringing together specialists of a specific e-learning topic to allow in-depth discussions and developments on an expert level;
- Sharing resources;
- Partnerships to launch new projects;
- The promotion of national and foreign events;
- etc.

From these programs and communities a set of services progressively emerged, for instance:

- Some e-assessment tools (SEB, SIOUX, e-OSCE, etc.) along with a community of practice;
- e-voting tools for improving interactivity in auditoriums;
- Self- and peer-assessment tools;
- Lecture recording and video management systems (SWITCHCast, Matterhorn, and other homemade systems) along with video annotation tools;
- The DICE community for copyright in e-learning;
- Swiss LMS (Moodle, OLAT, ILIAS, etc.) and e-portfolio (Mahara) communities.

2.3.   International references and standards

The above-mentioned e-learning areas are of concern beyond Switzerland and have been extensively discussed, for instance, within the EDUCAUSE U.S. association (which includes over 260 non-U.S. institutions) during regular annual events and in journals. At the European level, in addition to the JISC association and SURF foundation, which are both very active in e-learning, there are the LERU and

COIMBRA e-learning task forces in which all these areas are actively discussed and best practices shared. The Gesellschaft für Medien in der Wissenschaft (GMW) offers roughly the same for all German-speaking countries. In Germany there is e-teaching.org, an e-learning community (platform) and in Austria there is the Forum Neue Medien (FNM) that both play a similar role in the national academic sector.

As for standards: some exist for making e-learning objects interoperable (i.e., SCORM, QTI, IMS, LTI, and more recently "Experience API", EPUB3, etc.), and they should be applied as much as possible in future national services for importing and exporting content so as to maximize the exchange and sharing of e-learning material as well as the interoperability between tools and services. However, standards that are usually a lowest common denominator in e-learning topics should not be used to stifle innovative services.

2.4. Innovation required

The first area in need of action is **e-assessment** (S-15). Indeed, the practical use of e-assessment tools is far from easy if there is no well-established local service and faculty members have to implement and operate e-exams on their own. On the other hand, e-assessment offers a large potential for improving the quality of exams, and in some assessment scenarios substantial cost savings could be realized due to automation in distribution, correction and grading of examinations.

Today, the e-assessment solutions that are already in place at various Swiss institutions need to be consolidated at the national level so that they are easier to deploy and can become more robust to various environments (less prone to errors). With this action, two main avenues should be pursued:

(1)   A well-focused mix of centralized and local services should be made available that allow the institutions to adapt them to their needs. These vary not only due to the existing local IT infrastructure but also due to the different requirements from the various departments (e.g. "Staatsexamen" for medical students, multiple choice examinations for biology students or the written discourse in essay questions). So the services offered need to be flexible enough to cope with the huge variety of curricula, disciplines and courses at Swiss HEIs, each with its own, unique requirements for the implementation of exam tasks. In addition, these services must not only support the examinations themselves, but also their preparation and post-processing.

(2)   A national e-assessment consultancy service (like the DICE project for copyright in education and research, see below) should be established for a certain period of time in order to support the establishment of common, standardized solutions as well as to support local adaptations. This service can be provided either in a decentralized model or through a service broker.

With the rapid development of the cloud there is now a plethora of websites where students can find tools, apps, MOOCs, multimedia content, simulation tools, etc. that are ready for use. Such resources contribute to autonomous, reflective learning strategies, transferable and showcasing skills development, professional identity building, etc. These are buzzwords representative of what civil society expects from learners tomorrow. The European community is currently investing massively in lifelong learning, which is believed to be the key to ensuring a healthy economy. At the HEI level, those ideas can be fostered through the **e-portfolio** (S-2). Before it can become a tool, it must be a process that students, accompanied/coached by lecturers, are trained to apply during their studies and beyond. Consequently, the Swiss HEI urgently need to be able to offer official services through a national e-portfolio to bridge the informal and formal student's knowledge and offer the student a mean to host portfolio documents in one place throughout their educational, life-long career.

The large-scale adoption of smart **mobile technologies** (S-16) marks a major change in creating, using, and sharing information in all areas of life. Mobile technologies have significantly influenced and empowered new forms of information services. However, up to this point many solutions in the higher education sector are vendor-specific or custom-tailored, which challenges the wider adoption of new mobile practices through high costs and limited interoperability. It is therefore necessary to reduce the

need for custom-tailored vendor-specific solutions and provide interoperable solutions. Two strategic action points should be pursued: First, greater flexibility and better integration of mobile applications with LMS is required for creating composite learning and working environments. Secondly, better production facilities must be provided for high-quality knowledge resources that are accessible to the academic community on a wide range of devices.

"Access to remote labs, scientific data, and simulation and game tools for educational purposes" (S-16) will offer added-value services to students, lecturers and researchers and bridge the existing gap between research and education. This is still an emerging field, but coupled with the OER trend it has great promise, and could greatly benefit from the actions proposed by the other groups (cloud computing, data management, working environments and e-publishing).

New solutions for **producing educational content** (S-17) in a more user-friendly and collaborative way, be it for regular courses or MOOCs to enhance the attractiveness of the educational resources and complement existing OER (in collaboration with librarians who can promote e-books and other pertinent electronic resources needed by students). For instance, there is a real need for annotation tools (textual and video) and for integrating authoring tools with existing e-book producing environments to serve lecturers, students and researchers in their everyday work.

Because the web is transnational, it has never before been as vital to address **copyright issues** (S-17). Fortunately, within the previous AAA program the Digital Copyright in Education (DICE) project developed all the necessary tools to sensitize teaching staff to these issues. Yet this is clearly not enough, because it has so far been of limited scope and has involved only a few Swiss institutions. Therefore, increased efforts are necessary to further develop DICE through setting up a national-level competence center on legal issues in both e-learning **and** e-research (the latter, central to the CUS-P2 program, will deal with specific copyright issues).

MOOCs have attracted the attention of many institutions as an important vector of delivery of electronic educational content. Because they involve several thousands of students per course, there are new needs in the way students are tutored (besides e-assessment techniques). This is referred to as the "**self-service tutoring engine**" (S-17), a tool related to data analytics and intelligent agents. With the development of **lifelong learning**, this kind of technology will increasingly be in demand, along with access to OER and other educational resources.

Last but not least: e-learning is a very dynamic field and is in constant evolution. Thus, for all the proposed new national services, the community of practice must stay tuned and reactive to the current and next innovation waves in learning and teaching methods. To that end, we have included an action concerned with the **consolidation of the existing eduhub community** (S-17). This is to ensure that the realization of all actions remains in line with the needs identified on a long-term basis.

2.5. Action items

A. An e-Portfolio service with the following features
   1. Lifelong identity building (linked with e-identity services) and learning certification solutions to manage informal learning;
   2. A national instance for e-portfolio with import and export functionalities to work with separate HEI local instance platforms (including LMS) and professional and social platforms;
   3. Tutoring materials and guidelines for promoting the e-portfolio in the academic community;
   4. Advanced functionalities to support reflexive practices (through, for instance, visualization tools, annotation tools, templates and wizards).
B. e-assessment services providing a well-focused mix of centralized and local services and an e-assessment consultancy service / national competence center
   1. Centralized and local services that will

     i. Enable a fully digital, end-to-end e-assessment workflow, with a national, public key infrastructure for digital signing of an exam before submission (student) and after grading (faculty) and for archiving (faculty, HEI);

     ii. Propose tools supporting peer-assessments in different scenarios (scaling for groups, classes and MOOCs);

     iii. Support e-assessment client-side tools such as lockdown browsers and their mass-deployment, as well as tablet-based e-assessment solutions to deliver exams to students and/or support examiners (e.g. in oral exams);

     iv. Support standardized, well-documented interfaces (APIs) for importing data between different services;

     v. Improve existing export functionality (e.g. csv-export) in e-assessment tools for storing assessment results for future analysis;

     vi. Improve existing e-assessment possibilities in LMS and build connectors to extend their e-assessment functionalities in a more flexible way;

     vii. Implement or improve didactical and/or psychometric best-practice standards of LMS e-assessment functionalities;

     viii. Propose tools supporting the preparation of e-assessments;

     ix. Propose tools supporting the post-processing, analysis and presentation of e-assessments.

  2. An e-assessment consultancy service providing

     i. Identification and implementation of common needs;

     ii. Technical and procedural recommendations and advice to the institutions on the organization and execution of e-assessments;

     iii. Clarification on legal and security issues for e-assessments.

C. Knowledge transfer with electronic support

  1. Support for mobile services through

     i. Development of a mobile app clearing house for a mobile learning app certification across organizations (currently, no commercial solutions for inter-organizational app-certification exist on any platform);

     ii. Provisioning of frameworks, guidelines and recommendations for integrating mobile apps in the learning environments and campus information system of the Swiss higher educational sector;

     iii. Identification of interface requirements between LMS and mobile applications based on a review of the current situation;

     iv. Development of educational guidelines for creating integrated multi-device learning environments.

  2. Access to remote labs, scientific data, and simulation and game tools for educational purposes;

  3. Integration of video, textual and rich media annotation development tools supporting interaction and knowledge-building processes, including (among others):

     i. The possibility for teachers to use these tools to mark students' production (e.g. in medical clinical exams to document students' performance);

     ii. Assessment of students' competences based on an analysis of various types of media;

     iii. Students' self-evaluations to identify their own weaknesses in oral production in autonomous learning contexts;

     iv. Annotations of students' and researchers' readings to highlight important knowledge.

D. Management and delivery of electronic educational content

  1. e-Book publication pipeline support and authoring educational/research content, featuring:

i.   Peer-reviews, collaborative work, quantitative evaluation, and transcription mode;

ii. Better integration of learner interaction with LMS;

iii. Repository integration for storing, organizing and sharing digital publications; interoperable widgets for interactive multimedia content for e-books (potential synergies with S-8 "e-publishing");

iv. Integration with existing e-book authoring environments and production pipelines for platform-independent, interactive e-books;

v.   Development of educational guidelines for using e-books in higher education, and recommendations of state-of-the-art e-book readers on the different mobile platforms.

2. A competence center on legal issues in both e-learning and e-research, featuring:

i.   Free access to online resources and tools to allow lecturers, researchers and staff of Swiss HEI to quickly and easily find specific information on legal aspects and to apply this information in their everyday teaching and research contexts;

ii. Delivery of training activities (online and on the spot);

iii. First-level help-desk support to all Swiss HEI staff to solve legal issues.

3. Self-service tutoring engine featuring:

i.   A decision tree to help students follow an adequate learning path with the right ICT tools;

ii. A "tutoring profiler" to support students in their development of ICT competences needed to succeed in their studies.

4. Consolidation of the Swiss eduhub community to allow:

i.   Techno-pedagogical best practices to be capitalized upon and shared within the academic community through the Swiss CCSP e-learning centers and international collaborations ("techno-pedagogical watch", "expertise in setting MOOCs", etc.);

ii. Promoting special interest groups (SIG) to address key topics at a national level (e.g. e-assessment, MOOCs, e-portfolio, OER, student voice, game-based learning, etc.).

3. Dependencies and interfaces

3.1.   Prerequisites from other strategy projects

- **e-identity platform** for ensuring lifelong identity for the e-portfolio service;
- **data management** for preserving on the long-term learning objects and for accessing scientific data for educative purposes;
- **cloud computing** to provide an environment based on virtual machines for simulation and game environments for educative purposes;
- **e-publishing tools** for authoring teaching content, e-books, etc., and a coordinated legal approach to copyright issues between e-learning and publishing;
- **working environments** for:
  - a coordinated effort between personal learning environments (PLE) in the e-learning domain and the action item "WE-2: personalized environment";
  - a joint effort to support mobile functionality between e-learning and the action item "WE-4: Functions for mobility".

3.2.   External interfaces

APIs when necessary.

3.3.   Further dependencies and relevant external factors

Learning objects deposited into a repository should use standard metadata.

Legal questions will be dealt with by service eL-4-2 ("A competence center on legal issues"); other legal questions related to e-assessment will appear but should be coordinated through the legal departments of each institution (cantonal laws as well as local institutional rules apply).

4. Economic efficiency/availability of funding

4.1.   Implementation costs

See Table in Section 6

4.2.   Operational costs

See Table in Section 6

4.3.   Customer benefit

For the university:
- S2: Possibilities for establishing a network for alumni and associated services through e-Portfolio;
- S15:
  - ○ Improved quality of exams: in many cases e-assessments can help make exams more objective, reliable and valid;
  - ○ Improved efficiency and time savings for the examiners.
- S2, S16 and S17:
  - ○ More efficient use of the e-learning resources available at the institutions, reduced costs for individual institutions in apps development (first mover potential for next-generation apps integration on a Swiss scale), improved collaboration between different universities and between different types of universities in particular, including improvement in the dissemination of concepts, standards, and tools;
  - ○ Mitigation of the risk of having to pay fines for illegal use of digital resources by teachers, lecturers and staff.

For the lecturer:
- S15:
  - ○ Decrease in manpower needed for examinations through the use of a well-established (local) e-assessment service;
  - ○ Quality improvement in exams.
- S2, S16 and S17:
  - ○ Replacing the large number of e-learning tools and services, which do not have proper maintenance, with established, well-maintained and standard e-learning services at a national level, adapted to lecturers;
  - ○ Reducing fears and raising confidence about permitted behavior in the use of copyrighted digital material for teaching activities.

For the researcher:
- S16 and S17:
  - ○ Putting research-based teaching and learning into practice (e.g., case-based learning, inquiry-based learning, project-based learning, etc.);
  - ○ Applying research skills in teaching and vice versa (e.g. visualization and presentation of new findings, working with students' groups in virtual environments, etc.);
  - ○ Quick and easy transfer between research and teaching through the use of digital media;
  - ○ Enlarging scientific digital collections with student input;
  - ○ Getting inspiration for further research from students' pertinent questions;

○ Reducing fears and raising confidence about permitted behavior in the use of copyrighted digital material for research activities.

For the student:

The role of students is essential in the success or failure of any tool, and whichever tool that is developed we should include students (for example a student committee) for its conception, testing and implementation (be it for the student of the future or the student of today). Also,

- S2:
  ○ Availability of a modern personal learning and working environments adapted to the interests and needs of each student;
  ○ Support for an e-portfolio that remains available beyond the university studies and allows students to keep their certificates, work results and personal information in one place if desired.
- S15:
  ○ Benefit of well-aligned, competence-oriented e-examinations;
  ○ Improved objectivity and thus exams that are fairer.
- S16 and S17:
  ○ Well-maintained e-learning tools accessible to students, with the same credentials for all universities;
  ○ Ease of mobility between institutions.

For the IT services **departments and e-learning support facilities of the Swiss universities (CCSP)**:

- S15: Support in setting up a robust and scalable e-assessment service at the institutions;
- S2, S16 and S17:
  ○ The advantage of being able to concentrate on the services that have to be offered locally, referring to the national services for non-local tasks;
  ○ Pooling services and reinforcing the community (eduhub).

5. Implementation plan and risks

S2: Action A2:
- The main e-portfolio service is developed and maintained by the SWITCH e-portfolio service already planned. Functionalities that would be developed for local instances must be designed so as to be easily integrated/interoperable with the national instance.

S15: Exams with electronic support (centralized and local e-assessment services):
- With a call for proposals, existing e-assessment tools (e.g. e-OSCE, SIOUX, SEB, etc.) should be consolidated and new functionalities and tools developed (e.g. peer-assessment tools, SEB-Server, digitally signed submission and marking of exams, etc.).
- From the third year of the program onwards (consolidation), one institution should be mandated to provide the central services (e.g. VDI-Infrastructure for exams, SIOUX, SEB-Server, peer-exams toolbox etc.) and the HEIs would be invoiced using a subscription model. Costs may vary considerably, depending on the type of e-assessment service implemented (a decision on which services should be offered centrally should be made collegially between the relevant stakeholders (i.e. the institutions using the service, the SIG e-assessment, ETWG, etc.).
- Further development of the central services as well as of the local tools (e.g., SEB, e-OSCE, peer-assessment tools) should be geared by the SIG e-assessment and the provider of the central services and would be financed by cooperative innovation projects of the HEIs.
- Risks:
  a. Establishing local services at HEIs that do not yet operate e-assessment services is a delicate undertaking. Exams are typically high-stakes situations for all people involved and there is very little tolerance for failure. Thus the implementation of new e-assessment services should produce results as early as possible, with a basic, easy-to-manage e-assessment service in order to secure local support for e-assessments at HEIs. More ambitious exam environments and scenarios should

only be implemented after a basic local e-assessment service has been established successfully.

b. Risks may be taken into account on the side of commercial providers for proctored exams, as we have observed overseas and in Germany. These services could compete against central services offered on the level of basic exams (multiple-choice questions and regular questions). On the side of advanced examination formats (peer-assessment, competence-oriented exams), it seems hard to imagine a business case for this for a commercial company.

S15: Exams with electronic support (e-assessment consultancy service):
- Mandate to an institution to be selected to act as service broker, ETHZ (Online Examinations with LMS/SEB, SEB-Server and competence-oriented exams with VDI), UniBe (e-OSCE, MEASURED) and UNIGE (peer-assessments), which are the leading houses in the specific subjects.
- After a period of 3 years, either all HEIs have an e-assessment service or there are enough HEIs with a regular service, which could help on a peer-to-peer level. Further coordination of e-assessment subjects is part of the regular work of the SIG e-assessment and the eduhub community. Further operational costs are not expected.
- Risks:
    a. An essential prerequisite is that a HEI is willing to initiate and finance an "e-assessment" project. So the decision of the institution's board is necessary. Without this, the project risks failing due to missing internal support.
    b. There exist no commercial solutions for such a consultancy service and it is hard to believe that such would be a future business case for a consultant company to offer this.

S16: Action C1:
- Developing frameworks for interoperable mobile apps that can be used in different organizational settings without considering the specific system architecture (for instance by engaging the educational technology industry to provide interoperable solutions that are available to all Swiss organizations – e .g. through certification).

S17: Actions D2, D4:
- Competence center for legal issues: a service centrally provided by a competence center or an association to be constituted (e.g. by the partners of the DICE project, together with SWITCH and other interested institutions, such as other Swiss HEIs or collecting societies). Note: there is no risk that international solutions are superior, as the center will necessarily focus mainly on Swiss regulation.
- **eduhub** is the forum of the e-Learning community in Switzerland and is coordinated by SWITCH. Each institution contributes manpower to the joint activities such as the SIGs. SWITCH offers its coordination effort as part of the "SWITCH basic services", covered by the institutional contributions to SWITCH as approved by the Foundation Council.

6. Conclusions and Priorities

Action Item	Impor-tance	Alignment with program goals	Availability of funding / business case	Implement ation risks	National benefit	Implement ation effort 1 <= 1 FTE 2 = 2 FTE … 6 >= 6 FTE	Operationa l effort 1 <= 1 FTE 2 = 2 FTE … 6 >= 6 FTE
Scale	**1 (high) – 6 (low)**	**1 (high) – 6 (low)**	**1 (easy) – 6 (difficult)**	**1 (low) – 6 (high)**	**1 (high) – 6 (low)**	**1 (low) – 6 (high)**	**1 (low) – 6 (high)**
A1. Lifelong Learning	1	1	N/A	2	1	2	1
A2. National e-portfolio	1	1	3	3	1	3	1
A3. Tutoring material and guidelines	2	2	N/A	1	2	1	1
A4. Reflective practices	1	2	N/A	1	2	2	1
B1. Centralized and local services	1	2	4	1	1	6	3
B2. e-assessment consultancy	1	2	3	2	1	2	1
C1. Mobile services	1	1	3	3	1	5	3
C2. Access to remote labs, scientific data, and simulation and game tools for educational purposes	1	1	N/A	4	2	6	1
C3. Annotation tools	1	2	N/A	1	2	2	1
D1. E-book publication pipeline support and authoring educational/ research content	1	1	N/A	2	2	5	1
D2. Competence center for legal issues	1	1	1	3	1	3	2
D3. Self-service tutoring engine	2	2	N/A	3	2	2	1
D4. Consolidation of the Swiss eduhub	1	2	1	1	1	1	1

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for data management

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1. National services within the field of action

This field of action has a strong focus on supporting research activities. These tend to have diverse requirements that are in a state of constant evolution. A national strategy on data management needs to take this into account when delivering services useful to the Swiss research community, in particular when defining national services. Given the diversity of needs we are facing, we are convinced that the best approach to a national service in data management is to strengthen the existing, local service providers and enable them to interoperate on a level and to a technical depth that is not possible today. To this end, we emphasize the need of sound technical and organizational interfaces that will enable this level of collaboration and interoperability, also taking into account the international context.

S-10 Maintaining digital collections (publications, images, videos, maps, cultural heritage etc.)

S-11 Archiving data (primary, secondary, projects etc.)

The group struggles with the concept of predefined national services, which in our opinion should rather be the outcome of work on the strategy. National services that have been assigned to other fields of action are strongly connected to the two services in data management mentioned above. It is very likely that the national services cannot be implemented as they are proposed now. For successful implementation it is important to identify and understand the overlap with those other services. This mainly, but not exclusively, concerns the following national services:

S-4 Personal repository (personal data)

S-5 Repository and use of shared data (papers, projects, etc.)

S-12 Access to digital collections (publications, images, videos maps, cultural heritage, etc.)

In the following we will try to achieve an overall perspective over the predefined national services with regard to what needs to be done. We try to highlight perceived overlaps and dependencies.

We consider the development of concepts (processes and role definitions), and programming interfaces for interoperability in services and software systems that already exist, to be an important part of this strategy. The deliverables of these action points can be a set of interface definitions, reference implementations and role and process descriptions that enable the interaction of data management services provided by different institutions, where data management services can include metadata search functions, data access, data provenance tracking and data lifecycle management functions.

2. Foundations, key functions and services

2.1.   Overview

2.1.1.   Definitions and clarifications

The assignment of use cases to functional blocks clearly shows a need for some definitions to ensure that all participants in the discussion share a common understanding. In the description of functional blocks the ambiguous term "e-archive" comprises different functions. We try to avoid the term "e-archive" and decompose the functional blocks into the following functions. It is worth noting that throughout all processes involved between these functions, and with respect both to data and metadata, it will be crucial to ensure integrity through all activities. It is therefore important that any harvesters and other tools involved must be able to handle conflicts.

- **Storage:**
  Mere storage of digital data is the smallest common denominator for a number of functional blocks. Provision of storage is an aim in itself in F-CC-2 (access to temporary storage resources), but for all functional blocks in data management (F-DM-1 to F-DM-6) and, e.g., for F-WE-7 and F-

WE-8, different qualities of storage are required to enable other, usually more complex functions. Characteristics to consider are: writing/reading performance, scalability, cost per TB and cost per unit, online, nearline, offline use, life expectancy etc.

Currently, restrictions apply due to the fact that SWITCHaai cannot work with files systems and the server level (see also 3.1, prerequisites).

- **Access:**
  Preserving or just storing data is questionable if it is not intended to provide reasonable access to such data. That is why methods for access need to be considered at the same time as questions of creating, preserving and managing digital collections.
  Wherever possible, access should be facilitated by meaningful metadata that is indexed and searchable for interested parties.
  Access is of major relevance in functional blocks F-DM-2 to F-DM-5 and this therefore relates strongly, for example, to F-WE-9 (search functionality) and F-eP-4 (functions for national publication catalogues).

- **Metadata:**
  Metadata in the broadest sense of the term is information about data. While it is usually intended to collect and manage metadata in defined structures according to established standards, e.g. in the library community, this will not always be feasible. Where more specific and less easily structured information must be provided and should accompany data, the most straightforward way might be to add a document containing the relevant information as a kind of "Readme". The integrity of such "Readme"-files must be controlled; therefore a specific application should help to generate them (LIMS, DICOM images, or ad-hoc solutions which might be part of the researchers' working environment. Such applications could, e.g., instantiate DataCite forms, which would be triggered when the files are imported to a new directory for the first time.
  For the purposes of data management, and with a view to digital preservation, the following types of metadata should be considered:
  - descriptive metadata (semantic and context information)
  - technical metadata (properties relevant for using or preserving data)
  - administrative (including legal information and access rights information)
  - preservation metadata (logging "events", i.e. actions performed on data).

- **Data management:**
  For the purposes of the strategy, the term data management will be applied to functions for handling "living" data that is subject to current analysis and processing in the research process. Apart from just handling the data, a data management platform should ideally support research by providing the required tools for analysis and processing. These might be very discipline-specific. Data management in this sense is at the core of functional blocks F-DM-1 (data life cycle functions) and according to the mentioned projects and services it is also of major importance in F-DM-4 (e-archive research).

  Once analysis and processing are completed, such data might be
  - Partly deleted (e.g. with easily reproducible intermediate results);
  - Shared with others for further analysis and processing on a suitable platform;
  - Transferred to a digital archive (i.e. to a long-term preservation facility). There, data can be accessed and inspected, but in order to re-use it for further analysis and processing, data will usually need to be exported again to a researcher's working environment.

- **Digital long-term preservation (LTP) and digital curation:**
  The functions of LTP can be well described in terms of the reference model for an Open Archival Information System (OAIS). As a prerequisite, data need to be described and documented in order to remain retrievable, accessible and usable in the long term. The model comprises the whole workflow from the ingest into a long-term preservation solution to data being accessed again from, and delivered to, a user.
  In principle, the concepts of LTP and of the OAIS do not make any assumptions regarding the kind of digital content which needs to be preserved.
  LTP systems are intended to provide access to archived content, but they are not optimized to support frequent modifications of data which is part of ongoing analyses. For this purpose, data will usually need to be exported to a researcher's working environment.

The term "digital curation" is sometimes used as a synonym for "digital preservation", but in fact digital curation goes beyond the more technical aspect of preservation and is concerned with maintaining the value and, if possible, adding to the value, of data which is preserved. It is about ensuring that data remains meaningful with respect to its content and context.

LTP is at the core of F-DM-3 (functions for an open archival information system, OAIS), F-DM-5 (e-archive teaching data) and F-DM-6 (e-archive library/publications). F-DM-5 and F-DM-6 are in fact considered as two different use cases for an OAIS and it might be advisable to treat them as one functional block.

The exact role of LTP in F-DM-4 (e-archive research) is not fully clear: there needs to be at least a well-defined interface to continue the data lifecycle after data analysis and processing are completed, and data needs to be preserved for re-use or other purposes. This coincides with requirements from F-DM-1 (data lifecycle functions), as the management of the lifecycle must include, but must not be limited to, LTP.

2.1.2. Outline of national services

Service focus: research data

Research data passes through different phases of processing and management during its lifecycle. The following description tries to reflect this.

A first group of services covers the needs of researchers to have research data available in various software environments (e.g. scientific workflow systems) and computer environments (e.g. clusters and clouds). The data needs to be made available not only for analysis by the group who created it, but also to other researchers for further analysis before and after scientific publication of the data. Here we are talking about large amounts of data which are expensive to store. We expect that the underlying data storage will be operated by the scientific institutions themselves, rather than being operated in one or a few Swiss national nodes. The institutions may offer the storage as providers to other institutions (see below, *Advanced storage provision*).

The value of the data stored in an electronic research repository is not yet established at the time of ingestion, so retention times may vary between 3 years and over 50 years, based on later findings. However, we do not see these repositories as a suitable place for long-term storage, but believe that a long-term storage archive like that described in F-DM-3 is the better solution here.

In contrast to services related to functional block F-DM-3 (OAIS), where the focus is on long-term data preservation, the focus here is on system-to-system integration for research data, including data provenance tracking. As an aside: data stored in a F-DM-4 repository will in general be well prepared for ingestion into a F-DM-3 archive due to attention to proper metadata recording. DM4 repositories for different research areas will be very different in their detail, but will share some common, generic features:

- Unique and persistent identifiers for access to known data sets.
- Supports multiple binary objects for each data set, accessible by keys unique to the data set.
- Maintains connections between data sets based on data provenance (should support many-to-many relationships).
- Type system for data sets for tagging different result categories, using non-ambiguous descriptors as well as narratives.
- Manages essential metadata for data sets which can be used to find a data set in the context of data analysis.
- Provides programmatic access to individual binary objects of data sets.
- Provides flexible data ingestion procedures for new data sets.
- Exploits remote library contents when available (e.g. PMID (PubMed ID for life sciences) to acquire metadata automatically.

Data management systems which fulfil these requirements exist today and should not be reinvented. Examples from the life sciences are openBIS and SEEK. It is unrealistic to expect all Swiss researchers to agree on one system, even within one research domain. The goal of this functional

block is rather to improve interoperability between existing systems and applications such as workflow managers and data analysis, mining or staging tools that will use data in F-DM-4 repositories. To this end, a model needs to be developed (and existing data management systems need to be adapted) to select data by metadata, and to access and ingest data.

In addition, it must be ensured that international, discipline-specific repositories are taken into account beyond institutional and subject-specific repositories in Switzerland itself. Any solution which is expected to be used by active researchers in Switzerland must at least be interoperable with relevant international services.

Service focus: metadata

This section of services covers the need of researchers to find their colleagues' research data based on metadata and also to manage (i.e. share/keep/retrieve) their own research data. Today, we have generic standards like the Dublin Core (http://dublincore.org, see below) and specific standards for various fields, e.g. MIBBI (http://www.biosharing.org/standards/mibbi, see below) for biological and life science data. Most of these standardization efforts are works in progress. We should not aim to reinvent or compete with these efforts, but support and complement them. Furthermore, many data management systems exist that support the ingestion and input of metadata and searching for data by metadata. We deem it to be unrealistic that researchers in Switzerland will settle on any single such system for the purpose of data management (and thus metadata querying) and believe that the strategy needs to focus on the pragmatic goal of leveraging existing metadata standards and data management systems and allowing these systems to interoperate and upload their metadata into a metadata search service as described below.

Metadata search service

A national metadata search service should be set up and sustainably operated for research data from (usually, but not exclusively) publicly funded research by Swiss (and international) research groups. It is envisaged as a portal-like service based on decentralized source servers. A metadata record on the server refers to a data set and allows one to locate this data set in a data management system. Multiple instances of this system will be operated by different parties, e.g. by large universities and institutes, and will serve the whole scientific community when it comes to searching for data. Note that there is an intrinsic connection to F-DM4 "Electronic Research Repository" in that data using applications can use this service to find and locate relevant data sets, and the interfaces described in F-DM-4 to access the actual data in there.

The metadata search service should have the following features:

- The system needs to follow open standards and needs to be available as open-source software in a commonly used programming language. This is to avoid vendor lock-in and to support a community that will maintain it in the long term. At the same time, the framework must be well defined and robust enough so that the system is always kept "compatible" over time.
- The system needs to be flexible with respect to metadata schemas and semantic descriptions, both with respect to supporting different schemas for different areas of research and with respect to evolving metadata standards for each of the fields. It should support semantic integration of metadata, but not enforce it. The rationale of not being restrictive is to enable one to harvest as many of the available research data repositories as possible.
- Based on open web standards, an application programming interface for metadata import and maintenance is defined which allows data management systems to feed their metadata into the server, fix erroneous information and delete records when the data set is no longer retained.
- Based on open web standards, an application programming interface for metadata search operations is defined which allows data using applications to find data sets relevant for a particular use case.
- Any individual metadata search server should be able to operate as master and slave server at the same time (for different data sets). Each server is authoritative ("master mode") for

metadata records from its home institution and institutions which have an agreement with the home institution to publish metadata on the server (these are expected to be smaller institutions that cannot afford to run their own server). At regular intervals, e.g. once every night, the server harvests the metadata from all other metadata search servers in this p2p network ("slave mode" or "cache mode").

Service focus: Advanced storage provision

The strategy should consider all layers of data management including the physical storage hardware. Provision of standardized storage hardware could deliver major advantages in the context of data management:

- Software solutions for data management addressing functional blocks F-DM-4, -5, -6 and CC can access and move data via one standardized interface, without reinventing the wheel four times for different storage systems or *n* times for different sites.
- All three functional blocks F-DM-4, -5, -6 require underlying hardware to store data for its lifecycle without any real reason to require different storage systems. One multifunctional system (e.g. big, but slower disk + tape) can provide infrastructure for all these services as well as for cloud computing. For cloud computing, a fast disk system could be added as additional tier.
- Geographic data redundancy/availability/remote sites need no longer be provided within one institution but can be provided by the different storage partners in different towns.
- If some big providers provide standardized storage infrastructure (in line with the requirements of a well-defined service level agreement, "SLA"), the software for F-DM-4, -5, -6 and CC could manage multiple copies over multiple sites. In this scenario, the different providers would not have to build redundant systems over multiple locations themselves. The data would be in at least two and up to *n* copies, depending on user/data owner demands and the financial situation.
- To reduce the necessity for moving data around Switzerland, the software might even be aware, or users can input preferences for the location where data might be needed for post- or reprocessing, i.e. Clusters like Brutus, Schrödinger, big SMP machines @ CSCS. One such infrastructure providing partner could be CSCS.
- The national strategy should also address the requirements of smaller institutions. It cannot be a national strategy that every institution builds and maintains its own data repository infrastructure including required redundant sites for multiple copies in case of disasters or downtimes. When a standardized infrastructure is used, smaller institutions do not have to build and maintain their own infrastructure, but can participate in a network with larger partners.
- Moving data between institutions frequently ends in problems with the different local identity management systems of the institutions (user mapping etc.). If overlying software manages data, no user mapping is necessary. But any such software MUST be rock steady and highly redundant, as it is the only instance that knows to whom the data belongs!
- Any institution can participate as storage provider if it can fulfil the SLAs (e.g. regarding price, capacity, maybe maximum time to double capacity, bandwidth, speed of different storage media – fast + slow disk systems, tape infrastructure for cheap storage – or other criteria).
- A fixed price per TB/medium/year should be guaranteed to the providers for budgeting purposes and will also benefit users' budgets. Users of services according to F-DM-4, -5, -6 and CC will also be charged per TB/medium/year.
- Ideally, there may be synergies and volume effects if the procurement of storage infrastructure could be synchronized among (a number of) participating institutions.
- Data will be managed by software in services for F-DM-4, -5, -6 and CC. No local data owners are needed and identity management over several institutions can be avoided.

This scenario for a far-reaching decoupling of software and hardware layers calls for a number of challenging activities:

- SLAs need to be defined and agreed by potential participants (storage providers and data management providers). *(Mandated activity)*
- A technical concept needs to be defined for the collaboration of storage providers and data management providers, including technical interfaces. *(Mandated activity)*

- Existing data management solutions need to be adapted to support the technical interfaces and to support *n* copies on different storage providers. *(Call for proposals)*
- Compliance of partners and storage environments with SLAs needs to be verified. *(Ongoing activity of the storage providers and customers, steering board?)*

Points to be considered are:

- Partners need to be found who can, and are willing to, fulfil the SLAs.
- Costs for users and long-term payments need to be defined.
- Different budgeting cycles and legal regulations for procurement among cantons and the federation.
- The data-management software would be the only instance that knows to whom data belongs, making it a lump risk.

These issues make it unlikely that a quick success can be achieved, but the prerequisites should be explored.

Service focus: Functions for an open archival information system (OAIS)

The OAIS is a reference model describing the functions of a digital long-term preservation solution. In spite of its origins with NASA and other space agencies, the basic concept of the OAIS is agnostic to an archive's content. It has become an ISO Standard and as such serves as a common reference for almost any concrete implementation of a digital preservation solution. This is facilitated by the model's organization in six functional areas (ingest, administration, data management, archival storage, preservation planning, access) which can be implemented largely independently, at least in theory.

It should be possible to provide technical components and generic guidelines for OAIS-compliant solutions centrally, but experience shows that the implementation of workflows in practice requires an intensive interaction with local stakeholders. Whatever the technical implementation, a layer is required that can address local stakeholders' needs directly and is available for support on site. As with other stages of the data lifecycle, the question of how to manage data ownership and its changes or transfers over time needs to be investigated in more depth.

The concept of an OAIS clearly has a role in the lifecycle of research data when data enters into a state of "inactivity" (cf. F-DM-1, data lifecycle functions) where it needs to be preserved up to a point where it is retrieved for new uses. Care must therefore be taken to define interfaces with functional blocks F-DM-1 and F-DM-4 (e-archive research) to enable the seamless integration with those approaches aimed at managing the lifecycle and providing scientific data management services or working environments. In particular, well-defined interfaces are required for the export of research data out of active data management platforms and for the import to the ingest module of an OAIS. These interfaces should facilitate the integration of one or more OAIS-compliant implementations in the overarching concept of a distributed scientific object repository (SOR) as outlined in the program proposal.

While the OAIS should cover the functions of delivery of preserved content, it is worth noting that it will not usually include discovery functions. An OAIS should therefore provide metadata about its content to metadata search services as required. These will usually include both local metadata platforms (e.g. catalogues and portals) and common services on the national level and/or within specific scientific domains.

In addition to possible complete implementations of OAIS-compliant systems, the creation and maintenance of re-usable key components supporting preservation workflows should also be considered. The registration and support of persistent identifiers is just one example that has been operational for several years now; another example is tools for format identification, metadata extraction and other tasks in preservation workflows. Institutions can build up expertise in specific areas, maintain and enhance existing tools, or contribute to existing open-source components and support other institutions in using them.

Particular attention should be paid to mechanisms which monitor possible obsolescence of file formats over time and alert the responsible persons to investigate and act.

The OAIS is also underlying, but not identical to the functional blocks F-DM-5 (e-archive teaching data) and F-DM-6 (e-archive library/publications), as long-term preservation is included in most of the use cases of these two blocks. However, there are other requirements reaching beyond the scope of an OAIS. The types of data in question are more static than "active" research data (see above) and usually meant to remain available from the beginning. Therefore the distinction between approaches for online repositories and those focusing on long-term preservation is less clear and will require more work on those functional blocks.

Service focus: data lifecycle management

General

Today, there are legal requirements on data retention, and there is pressure to keep in check the ever-growing storage costs for research data. To this end, research data need to go through a lifecycle: on production, data start as "active data". "Active data" are processed, quality-controlled, analyzed, cross-checked, visualized and eventually either dismissed (when they are found faulty) or kept for publication or further reference. Many scratch copies of active data sets may be kept in parallel due to the needs of processing systems like visualization workstations or compute clusters. When a data set is fully analyzed and it is decided to keep the data, it changes from "active" to "inactive", which means that scratch copies can be purged and the data set can go to cheaper (and slower) storage with possibly only a small result data set kept "active". The data set is now in state "inactive" until one of three conditions is met:

1. There is renewed interest in it by a researcher, so it is made "active" again (data sets can go back and forth between "active" and "inactive" many times if needed),
2. The data is considered worthy to be ingested into a data archive for long-term preservation (and set to the "archived" state),
3. The data set is at end-of-life and finally purged from storage.

The ability to perform data lifecycle management is based on a well-thought, disciplined approach to research data. There are preconditions which need to be met for data lifecycle management to work out. Defining the full set of prerequisites should be an action point. Here is a set of prerequisites that we found to be helpful when producing large amounts of potentially heterogeneous data:

- Data sets generated in one measurement or analysis step are treated as "immutable" and are given a unique identifier,
- Data provenance is properly tracked, ideally in an automated manner to avoid human errors using existing standards (e.g. nanopublications),
- Data sets are grouped logically, e.g. by experiment or any relevant semantic annotation,
- Metadata that are needed for lifecycle decisions are recorded and made available for access and querying.

These prerequisites can best be fulfilled by using some sort of data management system. In addition, roles and processes for research data lifecycle management need to be defined. The processes need to take into account the fact that only the researchers generating the data have the necessary information for lifecycle decisions, but they hardly ever have the time and determination to perform this task. A possible escape from this dilemma is to give researchers the responsibility to provide the required information, let a data lifecycle management system suggest changes to the lifecycle status of data sets (based on policies which may be different for different institutions), and give a data lifecycle engineer responsibility to take the final decision, in coordination with the original researchers.

Data ownership

Legal frameworks rule data ownership. Any data management system has to be in accordance with

applicable law. In long term data and archival management systems data ownership, data access rights, inheritance or transfer of ownership and other issues have to be defined and implemented. Rules have to be agreed upon and implemented that comply with applicable law regarding intellectual properties rights. Questions have to be answered such as: what happens to data if the data owner cannot or does not want to take responsibility or pay for his data. Applicable rules have to be investigated by legal specialists and translated into a legal rule set for the data management system.

Classification

Data have to be classified according to their importance for the researcher, for the institution that finances the research, for the research community, and also according to security requirements like high-level encryption for (for example) non-anonymized medical data. The speed of data retrieval or the frequency of use of data are factors that influence the storage medium (e.g. disk or tape). In the end, each requirement has its price.

Service focus: publications, e-learning and other content

Publications and other content from libraries

This part of services related to the functional block F-DM-6 (e-archive library / publications) comprises at least two different lines of action which can, but need not be, addressed by a unified approach. On the one hand, digital content of various characters needs to be deposited, hosted, managed and delivered to users online. This includes user-produced content uploaded to open access repositories, digitized content on dedicated presentation platforms, and might in future include publications under a national license that need to be hosted after provision of the content via the publisher's servers has expired according to the original agreement (note: in its effects this use case is similar to post-cancellation access, but here the expiry of online access is agreed from the very beginning). Increasingly, research data sets might also be referenced by and added to publications as supplementary material. This publication of research data is a different task from managing data which is still "active" in the research process (cf. F-DM-1 and F-DM-4) and it also differs from the deposit of data to a digital long-term preservation system where data might be publicly accessible but can also be subject to conditions of restricted or closed access (cf. F-DM-3). On the other hand, the online content from the repository together with more data not regularly exposed to users (e.g. master files from digitization in a "dark archive") needs to be preserved for longer periods of time in an accessible form. This requirement of digital long-term preservation is typically addressed with functions and systems complying to the OAIS (cf. F-DM-3).

Numerous repositories already exist today with the drawback that some of them do not attract a critical mass of content, while a local installation nevertheless needs to be maintained. In a broader perspective, resources should be focused on providing services locally around the publication process (cf. also F-eP-2), whereas the option should be considered of operating the applications for two or more institutions together, either sharing one installation or at least hosting more than one instance in the same environment. The viability of this approach depends on the need for major adaptations to each institution's processes and systems. Such restrictions would be even more difficult to accommodate in a fully centralized approach, which is why this is not encouraged.

Two user perspectives on this kind of service must be considered: Users who want to upload content to an online repository need to be supported locally – usually by staff on site – within the framework of their institution's policies and infrastructure. For these contributors it might also be relevant that their publication is hosted in a trusted environment (i.e. within their own institution), but beyond that they usually want to make their contribution as visible as possible by spreading its metadata. For users who want to retrieve and access a publication, the actual location where the content is stored is not relevant as long as they obtain access in an easy way that works. If meaningful metadata that is suitable for identifying and retrieving content is exposed to relevant metadata search services (local catalogues, national and international services), users should be able to find publications they need. For open access publications in particular, making metadata available for harvesting services

worldwide is an established, standardized practice according to the OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting). Increasingly, metadata from library catalogues and metadata of digital publications on publishers' websites are also provided as Open Data. In many cases, users are then directed towards copies of the content they have access to, often by using automatic link resolvers with OpenURL that are usually hosted by libraries or library service providers.

An increasing challenge is to maintain bidirectional relations between publications and their supporting research data sets, which might not necessarily reside in the same location. The digital object identifier (DOI) has proven useful as a pointer from publications to datasets cited in the paper, and the international DataCite Consortium is dedicated to registering DOIs for research data sets. DataCite requires a minimum set of five metadata to be provided when registering a DOI, but as long as they can be mapped to DataCite's metadata schema (in Dublin Core), any metadata can be submitted and published for harvesting via DataCite. In Switzerland, the DOI service has been implemented as part of e-lib.ch and is operational.

DOIs are of course also used for publications, but for them URN in the national libraries' namespace can be considered as an alternative to DOI-registration.

e-Learning and assessment results

The services envisaged in the original functional block F-DM-5 (e-archive teaching data) are not well backed by the use cases cited in its favor. Those use cases include references to materials *used* in teaching and learning and not to assessment results, diplomas or other certificates. Both from a technical and a conceptual point of view there seems to be no convincing reason to treat this functional block separately from F-DM-6 (e-archive library / publications), supported if necessary by the functions for an OAIS (F-DM-3). Additional requirements could result from the need to interface with further applications, including e-learning platforms as far as they produce data which needs to be retained for some time or preserved for longer periods. Further requirements in some use cases point to archiving project-related information which during the active phase of its lifecycle is managed in some kind of research information system (RIS); these are increasingly used in universities, sometimes closely integrated with bibliographic and other reporting tools. As far as public data is concerned, such a use case can be considered as an extension to F-DM-6. If data may not be opened to the public, it might not even be suitable for integration in a national approach.

There are other reasons why this block in the described form is not considered a vital part of a national infrastructure: The description of F-DM-5 implies that its purpose is to archive assessment results, diplomas and other certificates or relevant materials. Even if this should really be the materials to focus on, there is a serious concern that this functional block is not suited for being treated as part of a national infrastructure: As the envisaged e-archive would contain personal data such as examination results and diplomas, the standards of data protection need to be those of an official administrative archive and further restrictions would apply. If the data should only be available to the teaching institution's authorized staff, there seems to be no benefit in administering such materials on a national level. Data protection also implies that under most legislation *the institutions* managing such personal data must not store it outside their institution or at least not outside their canton. However, if *the individuals to whom the documents refer* decide to store such data elsewhere, this is of course possible and is in fact what is described in F-WE-3 (functions for providing the personal portfolios). This seems to be a much more promising approach, with real benefits.

It could also be considered an option to create such personal portfolios virtually for alumni of Swiss universities based on locally archived data. It might be an attractive service to be able to access relevant diplomas throughout one's professional life and beyond as part of a virtual personal portfolio. But this calls for even more sophisticated access rights management and could only be administered efficiently with a life-long identity in place. To enable reasonable use of such a portfolio, the dispersed documents, diplomas and certificates from all institutions to which a person was once affiliated would have to become part of a virtual portfolio: each document resides in its original institution, but is connected to a virtual layer which calls up on demand all the documents which are part of the portfolio.

It is doubtful that the benefit of this approach would justify the major effort to achieve a viable and legally sustainable solution.

For the time being it is therefore advisable that a national service should focus on requirements related to e-learning materials rather than diplomas.

2.2.   Existing services and ongoing projects

Many Swiss universities are currently setting up units for providing scientific IT services: ETH Zurich has created the division "Scientific IT Services" of IT Services and the University of Zurich is in the process of setting up such a unit (see note on **IT Science Services** in UC 050 and below). We know that EPF Lausanne and University of Basel are also currently investigating how to provide such services to their researchers. In addition to this, there are established groups who provide scientific IT services to certain communities like Vital IT for life sciences. We suggest that these groups act as a national layer of coordination for national services in the area of data management.

2.2.1.   Existing services and projects being realized

Please note: The comments below do not refer to the submitted use cases, but to projects and services mentioned in them*. No prejudice is intended with respect to the use cases themselves.*

IT Science Services (UC 050): Focusing on essential requirements to foster foundations for data-driven science and innovation including policies and standards complying with international standards. Pilot service at Univ. of Zurich. General objectives in line with strategy.

Gestion des données de recherche (UC 166): Introduction of electronic lab journals and a Laboratory Information Management System (LIMS; system Slims (Genohm)) in Life Sciences faculty. Project being realized at EPFL. Possible local building block if implemented in line with strategy.

ScienceWISE (UC 168): Platform for crowdsourcing of scientific knowledge and (meta)data providing infrastructure for collaborative editing of scientific ontology (thesaurus) and services of semantic annotation, semantic bookmarking and semantic recommendation of scientific resources. Current service centered on physics (www.sciencewise.info), extension for other domains suggested in UC by EPFL. Semantic services have relevance with respect to metadata management, service otherwise more closely related to working environment. Extension to other disciplines and institutions is in line with overall objectives of the program.

openBIS (Scientific IT Services, ETH Zurich): An open, distributed system for managing biological information. Supports research data workflows from the source (i.e. the measurement instruments) to facilitate the procedure of answering questions by means of cross-domain queries against raw data, processed data, knowledge resources and its corresponding metadata. The software framework can easily be extended and customized for specific technologies and use cases (http://www.cisd.ethz.ch/software/openBIS). It has been customized for high-content screening, sequencing, proteomics, metabolomics and is used as an electronic lab notebook (ELN) and a laboratory management information system (LIMS) and integrated with workflow and analysis systems such as iPortal, iBRAIN2, screeningBee, KNIME and Genedata Screener.

B-Fabric (Functional Genomics Center Zurich, ETHZ/UZH): B-Fabric is a productive open infrastructure for managing projects and data in life sciences. It allows storage of and access to experimental **data** together with its scientific context. The platform connects the data from scientific instruments with data analysis tools, including workflow, annotation, and data visualization support (http://www.fgcz.ch/research/bfabric). A workflow-driven interface enforces entry of scientifically and analytically required data.

Subject-specific system as an example of local research tools which should be made interoperable

within the program if **this** has not already been done. Already shared between affiliates of more than one institution, and includes the billing of certain services.

The **SEEK** is a web-based resource for sharing and exchanging systems biology data and models that is underpinned by the JERM ontology (Just Enough Results Model), which describes the relationships between data, models, protocols and experiments. The SEEK was originally developed for SysMO, a large European systems biology consortium studying micro-organisms, but it has since enjoyed widespread adoption across European systems biology. (https://erasysbio.sysmo-db.org/)

Swiss Light Source (SLS) (UC 081): Ongoing service for online and offline analysis at current data rates and volumes for users of the SLS at the Paul Scherrer Institute. As users come from virtually all Swiss universities, this can already be considered as a national service. Building on this, PSI suggests adding preservation functionality and massively enhancing capacity to meet the foreseeable demand at SLS and later at SwissFEL (Free Electron Laser).

SWITCH BCC (Building Cloud Competence)(UC 198): In order to acquire competence in building and operating "cloud-like" infrastructure, SWITCH has built a proof-of-concept cluster based on commodity servers, high-performance networking and open-source software for VM provisioning (OpenStack, KVM) and scalable storage (Ceph). This small-scale system has been opened to several internal and external pilot users.

Experiences to be re-used in national (distributed) approach to storage as a basis for data management.

myNAS (UC 167): Productive service at EPFL offering individual storage for all accredited users within EPFL. This storage can be accessed as a remotely mounted drive from Windows, Linux and Mac using CIFS, SMB and NFSv4 protocols.

Could form part of a global approach to storage and data management.

PolyBox: There is a growing demand at ETH for a storage medium similar to Dropbox. This stems from the rising need to simplify internal data exchange for all ETH members and the wish to avoid the use of (uncontrollable) storage media external to ETH. It can be used as a cloud-based logical memory stick.

Medienarchiv der Zürcher Hochschule der Künste (ZHdK) (UC 249): Media server as a productive service using purpose-built software. Currently, e.g., serving research projects in building common media pools and as a platform for other kinds of image and media documentation (http://medienarchiv.zhdk.ch). It handles different scenarios of usage from individual to collaborative or public and includes technical and subject-specific metadata. As it is a working platform, usability for targeted users is important.

Considered as both a subject-specific building block in a more global approach and a potentially re-usable application for other institutions (other universities of applied sciences in particular).

HSG Forschungsplattform Alexandria (UC 250): Open-source application and productive service for the open access publication, administration and evaluation of publications, projects and profiles of researchers at Univ. of St. Gall (http://www.alexandria.unisg.ch).

Potentially transferable solution for publication management for other institutions currently without such services?

HSR Longterm Backup (UC 143): Project being realized at HSR (Hochschule für Technik Rapperswil) to provide digital long-term preservation of project-related data on an institutional level. Possible local building block within a more global approach of the program? Transferable to other universities of applied sciences?

Digital Curation (UC 096, 098, 100, 101): Project being realized at the ETH Library, in operation from 2014. Services for long-term preservation (LTP) of research data, administrative records and library documents of ETH Zurich including counselling on data management issues to facilitate LTP. An

open-source tool is provided to structure and describe data locally in preparation for transfer to the ETH Data Archive, which itself is a commercial OAIS-compliant preservation system (Rosetta, Ex Libris).

Possible local building block or hub for digital preservation within a more global approach of the program? Open source tools to be made available for re-use.

Archivage long-terme (Univ. of Geneva) (UC 075): Service based on the technical infrastructure of Fedora Commons for the preservation of data according to international archival standards. Data include administrative archives, cultural heritage and research data.

Possible local building block or hub within more global approach of the program? Transferable to other institutions or possible host for others?

Zentrale Geodateninfrastruktur (GDI) / **HSR GDI** (UC 144): Currently local productive service at HSR (Hochschule für Technik Rapperswil). Opening up an existing Geodata infrastructure for other universities of applied sciences and other interested parties as a payable and self-sustained service (examples on national level see www.e-geo.ch). Possible subject-specific service if implemented in line with strategy.

HELI-DEM (UC 187): Helvetia Italy Digital Elevation Model, an EU-funded project aimed at creating a unified digital model of the height of the alpine and subalpine zones along the border between Italy and Switzerland. This model should be properly geo-referenced and produced, combining in a single model all the available information which in the past has been acquired in different reference frames, with different resolutions and accuracy.

Can be considered as a subject-specific example for the scientific benefit of common standards and collecting/sharing data.

PERNAT (UC 187): Data visualization and sharing of risk zones. No details available. Considered as a subject-specific example of local services which could form part of a global data management network.

Garden Memory goes Public (UC 202): Finished KTI project which enabled searches on existing objects in various Swiss archives using semi-automatic enhancements to an ontology and ontology-based search components. Created an expert system to support monument conservation and optimized research and workflows in the conservation of gardening monuments. Possible subject-specific building block within a more global approach. Might still be more closely related to e-publishing and working environment.

Archives FPSE (Faculté de psychologie et des sciences de l'éducation) (UC 075): Project in the concept and realization phase at Univ. of Geneva. Implementation of an electronic management for archival collections (text, audiovisual, iconographic, instruments). The system complies with international standards in the description and conservation of materials in archives and museums. The local project seems to focus on metadata management for heterogeneous and hybrid collections from faculty archives and museums. Probably to be considered in conjunction with the existing long-term archive (see above).

Possible local node within the more global approach of metadata management and exchange.

2.2.2. Projects not yet in the realization phase

Bern University Library workflow for archiving digital objects in the institutional repository (UC 061, 062): Project in the concept phase. The workflow aims at archiving content from the (new) institutional repository BORIS (Bern Open Repository and Information System). The repository will accept publications and accompanying research data and will also handle bibliographic information that researchers need to provide for evaluation purposes.

The need for archiving local repositories is a common one, and should be addressed within data

management. Advanced local implementation could serve as references.

RERO-DLM (UC 116): Project to establish a digital, long-term archive as part of a national approach. Archive should be able to interact and provide services for other parties on a national level. Project of the Réseau des bibliothèques de Suisse occidentale, in the specification phase. Realization depends on funding within the CUS-program. Needs to be implemented in line with the overall strategy.

Project DDZ of the SAGW (Swiss Academy of Humanities and Social Sciences): Pilot project to explore the feasibility of a data and service center for research data in the humanities (DDZ) has recently been awarded (http://www.sagw.ch/sagw/laufende-projekte/ddz.html). The pilot is to investigate technical, organizational, procedural and economic concepts and models for the realization of a DDZ. Overall aims of such a center are the creation of a platform for primary research data in the humanities, ensuring access to the data in the long term, and facilitating links with other data collections (Linked Open Data) as well as comprehensive support for the community with respect to norms, standards and information technology for safeguarding and maintaining data (data curation). A possible domain-specific hub within a more global approach? Needs to be implemented in line with the overall strategy.

2.2.3.   Services and projects that might profit from data management as understood in this strategy, but have different main objectives themselves

Introduction of LOCKSS (UC 097): "Lots of Copies Keep Stuff Safe" – international initiative and service with a highly distributed approach in bitstream preservation of content licensed from publishers (e-journals, e-books) (www.lockss.org). For technical reasons, each participating institution needs to set up its own small-scale server to participate. Most university libraries are about to start implementation.

While the issues that LOCKSS addresses are valid concerns within data management, there is no immediate gain from a national approach: libraries are already collaborating within the *Consortium of Swiss Academic Libraries* to negotiate participation with the international network and they must set up individual servers anyway.

The specific technical concept of bitstream preservation through a voting process between participating sites might nevertheless be of interest for other use cases and is in principle open for re-use. It is possible, for example, to form "Private LOCKSS Networks"" between dedicated partners.

retro.seals.ch (UC 084): Digitized Swiss scholarly journals, productive service (http://retro.seals.ch). This digitization service, in collaboration with a number of Swiss journal publishers and editors, is not considered as part of data management itself, but of e-publishing. However, the digital content (including quality-controlled metadata), which is created with a large investment of time and money, needs to be preserved in the long term. As the service is hosted by the ETH Library, the library's digital curation service is planning to take care of this.

Multivio (UC 115): Both open-source viewer software and a (limited) productive service (http://multivio.org).

Useful in e-publishing, e-learning and Working Environment, but not directly related to data management.

SWITCHtoolbox (UC154): Collaborative environment combining simple-to-use tools via common group management and AAI Access. Project being realized at SWITCH, already available as a service. https://toolbox.switch.ch:

More closely related to Working Environment. No close relation with data management as understood in this strategy.

infoclio.ch (UC 055): Professional portal of the historical sciences in Switzerland as a productive

service (http://www.infoclio.ch/). It is not considered as part of data management, but rather of working environment and possibly e-publishing.

2.3. International references and standards

2.3.1. Data repository registries

re3data.org – Registry of research data repositories: The registry is collecting information *about* research data repositories to enable researchers to identify suitable repositories for their data. *The content of these* repositories *cannot be accessed from here and their metadata is not available* (http://www.re3data.org/).

Databib: A tool for helping people identify and locate online repositories of research data. *The content of these repositories cannot be accessed from here and their metadata is not available* (http://databib.org/).

2.3.2. Institutional research repository

PURR – Purdue University **Research Repository**: "Online, collaborative working space and data-sharing platform to support the data management needs of Purdue researchers and their collaborators" (https://purr.purdue.edu/).

2.3.3. Metadata and identifiers

EPIC – European Persistent Identifier Consortium: Identifier system using the Handle infrastructure. Its focus is the registration of data in an early state of the scientific process, where lots of data is generated and has to become referable in order to facilitate collaboration with other scientific groups or communities; however, it is still unclear what small part of the data should be available for a longer time period. This is somehow complementary to what DataCite does with respect to data to be preserved. EPIC PIDs can be registered to become DOIs as necessary, as the technology is the same (CNRI Handle). (http://www.pidconsortium.eu/).

MIBBI - Minimum Information for Biological and Biomedical Investigations: A common portal to a group of nearly 40 checklists of minimum information for various biological disciplines. The MIBBI Foundry is developing a cross-analysis of these guidelines to create an inter-compatible, extensible community of standards (http://mibbi.sourceforge.net/about.shtml).

Data Documentation Initiative (DDI): A metadata specification for data in the social and behavioral sciences throughout its lifecycle. Broadly used when there is a need for data exchange or when data is to be preserved (http://www.ddialliance.org/).

Text Encoding Initiative (TEI): A standard for the representation of texts in digital form, consisting of a set of guidelines which specify encoding methods for machine-readable texts, chiefly in the humanities, social sciences and linguistics. It is in use by scholars and in institutions such as libraries (http://www.tei-c.org/index.xml).

ISO 19115 for Geographic Information – Metadata: Standard defining the schema required for describing geographic information and services including identification, extent, quality, spatial and temporal schema, spatial reference, and distribution of digital geographic data (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26020).

General International Standard Archival Description (ISAD(G)): Standard for registering archival documents, defining a list of 26 data elements (including 6 mandatory elements). This standard is considered a framework rather than a rigid format. It is widely adopted in archives (http://www.icacds.org.uk/eng/ISAD%28G%29.pdf).

Qualitative Data Exchange Format QuDEx V3: A software-neutral format for qualitative data that preserves annotations of, and relationships between, data and other related objects (http://dext.data-archive.ac.uk/schema/schema.asp).

SDMX (Statistical Data and Metadata eXchange): An initiative to foster standards for the exchange of statistical information, sponsored among others by EUROSTAT, OECD and UN. Deliverables include a technical specification (e.g. XML formats for describing structure, data, reference metadata and interfaces), guidelines on creating interoperable data and metadata sets and a tool repository (http://sdmx.org/?page_id=13).

DataCite Metadata Schema for the publication and citation of research data: Metadata schema developed by the DataCite consortium in DOI-Registration (http://schema.datacite.org/). List of core metadata properties for the identification of a resource (typically a "dataset", i.e. numerical or any other research data or digital object). This schema is also used by OpenAIRE.

Dublin Core (DC) - Originally basic and generic metadata vocabulary, later enhanced by metadata terms and often used together with more application-specific vocabularies; popular also in Linked/Open Data activities (http://dublincore.org/). Broadly used in scientific and library applications.

METS – **Metadata Encoding and Transmission Standard**: XML-Container, broadly accepted in libraries, but open to other uses (http://www.loc.gov/standards/mets/).

OAI-PMH – Open Archives Initiative Protocol for Metadata Harvesting: A low-barrier mechanism for repository interoperability. *Data Providers* are repositories that expose structured metadata via OAI-PMH. *Service Providers* then make OAI-PMH service requests to harvest that metadata. OAI-PMH is a set of six verbs or services that are invoked within HTTP. The protocol is widely used in scientific and library applications (www.openarchives.org/pmh/); Please note: OAI has nothing to do with OAIS!

OAI-ORE – Open Archives Initiative Object Reuse and Exchange: Defines standards for the description and exchange of *aggregations* of web resources. These aggregations, sometimes called compound digital objects, may combine distributed resources with multiple media types including text, images, data, and video (http://www.openarchives.org/ore/).

2.3.4. Preservation

PREMIS – Preservation Metadata: Implementation Strategies: The PREMIS Data Dictionary for Preservation Metadata is the international standard for metadata to support the preservation of digital objects and ensure *their* long-term usability. There might and should be other (non-preservation) metadata than those defined by PREMIS, e.g. to describe a resource's content. It also comprises an XML-schema (http://www.loc.gov/standards/premis/).

OAIS – Open Archival Information System: The most broadly accepted standard in digital preservation is the OAIS reference model. It originated in the 1990s with international space agencies under the auspices of *NASA* and has become an ISO-standard in 2003. ISO 14721:2012 Space data and information transfer systems -- Open archival information system (OAIS) -- Reference model. The current version of the ISO-standard is based on the "Magenta Book"-version (June 2012) by The Consultative   Committee   for   Space   Data   Systems: http://public.ccsds.org/publications/archive/650x0m2.pdf

2.4. Innovation required

The overall impression is that many solutions exist and that no major development is required to start with. However, solutions so far were often implemented on the local level and sometimes as more or less "stand-alone" systems. In data management and processing in particular, some powerful approaches exist within certain scientific communities (e.g. the life sciences) but barriers exist, both

perceived and real, to a more widely spread acceptance. Such barriers should be addressed within the program.

Development efforts should therefore focus on the definition of clear interfaces to bridge gaps between existing solutions:

- An interface between (subject-specific) data management and processing platforms on the one hand and digital preservation systems on the other, to transfer both digital objects and their metadata between systems.
- An interface between any local or central object repository (i.e. data management system, digital preservation system, institutional repository) to facilitate the collection of metadata for a centralized search. Thus distributed data can still be retrieved in one place. This also requires agreement on metadata standards and transfer protocols as they already exist within the library community. Ideally, library-specific approaches and those more adapted to the scientific data of specific disciplines should be compatible to allow for unified treatment on a technical level.
- An interface to allow access to distributed data from a central search's results list. If metadata contains a persistent pointer (e.g. a Digital Object Identifier, DOI), this is not a problem in principle.

International projects and services such as OpenAIRE have had to address some of these issues from the beginning. So there is hope that re-usable approaches and standards exist and can be adopted, or at least adapted as required.

It is important to understand that interfacing is not limited to technical questions. To enable metadata, data exchange and close collaboration, common policies, guidelines and in some cases well-defined service level agreements will be needed. They can, and in some cases must, change current practices before the services envisaged can actually become fully functional. As mentioned elsewhere, this requires the willingness of participating parties to question and change their own routines.

A major development issue exists when it comes to handling access restrictions and differentiated authorizations. These can apply to the use of resources during data processing or when access to certain data is requested and needs to be granted on a user's identification. Existing authentication and authorization mechanisms like SWITCHaai might not work, e.g. on the UNIX level. While the major part of the development will be on identity management solutions themselves, some development will also be needed on the part of applications and services adapting to such a solution.

2.5.   Action items

Action item ID	Description	Comment	Call for proposal or mandated activity
Lifecycle-01	Define a process, roles, software interfaces (UI and API) and tools in order to best perform data lifecycle management of research data from raw to fully processed and analyzed data. It needs to be generic enough to be customizable to different areas of research and to the peculiarities of different institutions. The process needs to be described well from the point of view of each role. This needs to include interfaces that data management systems must offer to play well with data lifecycle management systems. The list of software systems to be implemented is a deliverable of this action item.		Mandated activity: expert group

Action item ID	Description	Comment	Call for proposal or mandated activity
	Establish guidelines concerning data ownership: Who is in charge of the data, who decides to finally delete them? Data ownership, data access rights, inheritance and transfer of ownership and other issues have to be defined and implemented. Rules have to be agreed upon and implemented that are according to applicable law regarding intellectual properties rights.		
Lifecycle-02	Based on the list of tools compiled in Lifecycle-01, develop the necessary tools for data lifecycle management.		Call for proposals, one proposal per tool will be picked
Lifecycle-03	Projects should be funded to adapt existing data management systems to the needs of data lifecycle management by providing the necessary interfaces.		Call for proposals
Lifecycle-04	Provide methodological help for researchers to sort out what data to keep (i.e. define decision criteria and guidelines centrally and enable on-site support through all stages of the lifecycle)		Initial mandated activity expert group with a need for ongoing maintenance which should be funded by the institutions and put into 3.3, Further dependencies and relevant external factors.
Metadata-01	Define an operating model for the metadata search service (see also the concept of a metadata hub in e-publishing) providing the following functionalities: harvesting of metadata (push or pull mode?), indexing, querying and display of retrieved results in a user-friendly environment (see Working Environment). Consider: Establish guidelines on what functional metadata is needed to enable lifecycle management and data stewardship and how it can be provided, updated and maintained over time. The concept should contain a business model describing how smaller institutions can use the metadata servers operated by larger ones to make available their research metadata.		Mandated activity: expert group
Metadata-02	Define and thoroughly document APIs for data providers, data using services which can be used for ingesting, searching, harvesting metadata. In detail, we foresee APIs for these activities: • Data ingestion from research data repositories into the metadata engines • Querying the metadata engine Harvesting the metadata, also incrementally for use by other metadata engines or applications (enable federation)		Mandated activity: expert group
DM-2-3	Design and implement a search service (technically)		Call for proposals:

Action item ID	Description	Comment	Call for proposal or mandated activity
Metadata-03	which implements the interfaces defined above, is flexible with respect to metadata schemas, and can be operated as a web of peers updating each other. Deliverable: software and documentation.		only one can be selected
Metadata-04	Projects should be funded to extract metadata from existing research repository / data management systems and ingest it into the metadata search service.		Call for proposals
Metadata-05	Set up methodological help to define appropriate metadata schemas and ensure adequate metadata provision in local data repositories and platforms. E.g. preparation and maintenance of lists of generic and discipline-specific standards, discipline-specific formats and available international frameworks. This information can be provided centrally on the national level, but local helpdesks or support services need to be set up to ensure coherence in practice.		This support should be provided (and funded) locally by the university libraries (should go to 3.3, Further dependencies and relevant external factors)
OAIS-01	Clarify and describe the process of how researchers can prepare their data for long-term preservation and how to ingest into the OAIS archive, write down "best practices" and guidelines. This includes shaping the boundaries between core tasks of digital preservation on the one hand and data management (research data from raw to processed and analyzed) or digital asset management (libraries, collections, publications) of "active" data expected to be available online on the other hand. Another aspect is the compilation of additional workflow components and interfaces needed for the OAIS process.		Mandated activity: expert group
OAIS-02	In addition to possible complete implementation of OAIS compliant systems, re-usable key components supporting preservation workflows should also be identified and made fit for re-use. This includes both existing services and tools that are lacking.		Call for proposals
OAIS-03	Quantify the need for an OAIS solution in different institutions. Establish whether there exists a current need for a centralized implementation of an OAIS. (Centralization can also mean the concentration of services in a few larger institutions providing services to other partners, e.g. as regional or discipline-specific services.) Determine if and which functions of an OAIS can be centralized from a technical point of view. Consider acceptance for those functions being provided centrally for non-public or otherwise sensitive data.		Mandated activity: expert group
OAIS-04	Define possible technical interfaces with existing data management or online publication platforms. The interfaces should be as generic as possible and not target one specific implementation of an OAIS.		Mandated activity: expert group
OAIS-05	Support existing and upcoming data management / repository services in adapting/creating workable interfaces with an OAIS according to the previously established definitions and standards.		Call for proposals: maybe should be merged with Publication-03
OAIS-06	Depending on results of OAIS-03: Implementation of		Call for proposals

Action item ID	Description	Comment	Call for proposal or mandated activity
	OAIS-services by a number of service hubs, possibly with central components, or a more centralized solution.		
Research-01	Define a data access model, supporting user authentication for end-user tools and s2s integration ("data provider model"), an API for how applications can access data in a DM4 repository ("data access API") and an API for how applications can upload data to a DM4 repository ("data ingest API"). The APIs need to be based on open web technologies and need to be independent of a particular research area. Domain-specific details should be represented by configurations of both the data repository and the data user.		Mandated activity: expert group
Research-02	Adapt existing research data repositories (from any research area) to the defined data provider model by making it implement the data access and data ingest APIs.		Call for proposals
Research-03	Develop a model (for a specific research domain) which allows data user tools to auto-configure themselves for accessing DM4 data repositories hosting data for the domain at hand. It should be based on generally accepted, domain-specific ontologies. The project has to deliver a reference implementation of an adaption of a tool from this research domain, which allows the tool to use the auto-configuration mechanism. Any such model must also include an access API for accessing data in the repositories.	This includes two aspects: the technical means to express compatibility and the subject-specific implementation	Call for proposals
General remark	*With regard to F-DM-5: F-DM-6 is to include teaching and learning materials if requested.*		
Publication-01	Support concrete projects for opening up existing institutional repositories for use by partnering institutions, including defining a business model for operation. This might not only be an option for smaller institutions, for sharing common repositories between more equally sized partners should also be encouraged. In this case, the partners would be well able to run their own repositories, but they would decide not to do so in order to share operational efforts, expense and expertise.		Call for proposals. Ensure that reviewers request synergies from applications where appropriate.
Publication-02	Investigate if open access and other (existing) repositories can take over basic functions of OAIS-compliant, long-term archives and deliver recommendations on how these can be implemented. To this end, perform a reference project to enhance one or more existing repositories with OAIS-functions or modules.		Mandated activity: technical working group
Publication-03	Reference project: Support existing institutional repositories in implementing workflows and tools to prepare and facilitate a later transfer of data to an existing or planned OAIS-compliant system.		Call for proposals: maybe should be included in OAIS-06
Publication-04	*Depending on progress with the agreement on national licenses with publishers (F-eP-3):*		Mandated activity in the future: expert group (maybe too late for

Action item ID	Description	Comment	Call for proposal or mandated activity
	Evaluate options for hosting licensed content for ongoing access (list not claiming completeness): • Agreements on prolonged access through publishers. • Cooperation with partners with a similar need, e.g. in Germany, the Netherlands or Denmark. • Evaluation of existing international solutions such as LOCKSS and Portico for this particular purpose. • Hosting operational services in Switzerland (e.g. existing repositories or – in spite of the different use case – an OAIS). • Implementation of a new dedicated solution for the purpose. Support implementation of the chosen approach.		P-2)
Publication-05	Examine where interfaces from e-learning or teaching tools to institutional repositories or OAIS systems are absent and define the requirements for such interfaces.		Mandated activity: expert group
Publication-06	Support the implementation of such interfaces between existing and newly created solutions.		Call for proposals
Storage-01	SLAs need to be defined and agreed by potential participants.		Mandated: storage providers and data management providers
Storage-02	A technical concept for the collaboration of storage providers and data management providers, including technical interfaces, needs to be defined.		Mandated: storage providers and data management providers
Storage-03	Existing data management solutions need to be adapted to support the technical interfaces and to support *n* copies on different storage providers.		*Call for proposals*
Storage-04	Compliance of partners and storage environments with SLAs needs to be verified.		Ongoing activity: steering board?

3. Dependencies and interfaces

3.1. Prerequisites from other strategy projects

3.1.1. Identity management

The current identity management through SWITCHaai has certain restrictions. Several services that might be developed during phase 2 (and many more which can be envisaged beyond that) will rely on a more sophisticated identity management being implemented. In particular, there is a need to make individuals' IDs consistent during changes in affiliation within Switzerland, and to integrate a Swiss identity management solution compatible with those used in other countries. This is a prerequisite for easy cooperation in international projects. ORCID ID for scientific authors should be included as an attribute of growing importance. This could enable an easy link between individuals and their published output, and in the medium term also to performance assessments that are based on this

output.

In addition, identity management must support system-to-system communication (whereas SWITCHaai has focused on individuals) and identity management must be able to make use of information provided on group membership by an institution which has been recognized as "trusted".

3.1.2. Coordination and monitoring

Even in the case of an intensive, successful cooperation it must not be forgotten that overall coordination is required not only during the program itself, but also when new services and partnerships are up and running. As described earlier, the approach for most services will be to build upon existing projects and services instead of creating major new infrastructures which would be difficult to maintain. With such a federated or decentralized structure, a coordinating and monitoring instance is required which provides and enforces common guidelines and standards and which is actually capable of acting in case of trouble. This role is expected to be one function of the national organization.

3.1.3. E-publishing

While data management issues are closely related to technical challenges and implementations, it is expected that the *Open Access* subgroup of e-publishing will complement this by focusing on issues of policies and guidelines for open access. The experience is that even comfortable repositories will only see limited adoption if awareness, incentives and mandates are lacking.

If national licenses will be acquired as part of the program, the parties concerned must define the requirements for nationally hosting the acquired content and for its long-term preservation. Only afterwards can reasonable solutions be implemented.

There is already a need to preserve content from digitization projects, and where this has not yet happened, such projects should include a perspective for preservation right from the start, building on existing and emerging long-term preservation solutions.

3.1.4. Working environment

In connection with F-WE-3 (Personal Portfolio), an analysis of requirements and possible consequences for institutional repositories is suggested, e.g. in cases where those repositories should serve as sources to be harvested, for example to compile personal publication lists. Subsequently, the implementation of interfaces between existing publication, e-learning, teaching and administrative tools according to requirements from F-WE-3 (personal portfolio) should be supported.

3.2. External interfaces

Data management solutions will usually not support the scientific processing, analysis and interpretation of data, but rather its handling throughout the lifecycle, which enables specific scientific processes to be applied. Processing itself is too discipline-specific to be handled in generic environments. This calls for the implementation of processing pipelines from processing tools to data management solutions and back. The integration of processing tools which are used in specific communities with a more generic data management framework should thus be facilitated.

To achieve immediate added value for researchers and to enable recognition of efforts in data management as part of researchers' academic achievements, it is important to link data management applications with tools used in the management of research projects by funding agencies and research institutions. The major focus is of course on metadata documenting the research output, in the form of both publications and research data. An example of such an external tool to connect to is

the Swiss National Science Foundation's (SNF) P[3]-database of projects, people and publications (http://p3.snf.ch/). This is of course of particular importance with respect to the leading role the SNF is expected to play in formulating policies and requirements for data management plans (DMP) in project proposals and the resulting need to verify and document compliance in data management in practice. Finally, by connecting research data management to such databases, efforts in this area can more easily be made part of the evaluation of the overall quality of research projects.

3.3. Further dependencies and relevant external factors

3.3.1. Support

There is a need to provide methodological advice and support for researchers in the creation of data management plans for project proposals, in making decisions about what data to keep in what form and in what repository, and how to manage it. For this purpose, decision criteria and guidelines, for example, can be defined in a common approach. But on-site support through all stages of the lifecycle should be available. In many cases, libraries plan to provide this kind of service. In spite of the relevance of this kind of service, it will probably not be possible to fund such ongoing activities as part of the national program. Therefore a continued effort is required in each institution.

Given the huge importance of metadata for the interoperability of systems for research data and publications alike, methodological help should be available for researchers. They should be supported in the selection or definition of appropriate metadata schemas and adequate metadata provision should be ensured in any local data repositories and platforms. Part of these activities could involve the preparation and maintenance of lists of generic and discipline-specific standards, discipline-specific formats and available international frameworks. This information can be elaborated and updated jointly by several institutions on the national level, but local helpdesks or support services need to be set up and maintained to ensure coherence in practice.

3.3.2. Encouragement versus funding

There are activities or services in the field of data management which are either desirable enhancements on the level of individual institutions, or ongoing operations which need to be maintained in future. In both cases, these activities cannot be fully integrated as part of a national approach. We suggest that institutions should at least be encouraged to address such issues on their own without relying on funding within the program.

An example for this approach is the documentation, collection and exchange of best practices, workflows and guidelines in connection with the implementation and management of a local repository including the acquisition of content from users. Basically, the required information is available on the local level anyway and the exchange would benefit all institutions in one way or another.
In cases where this requires a major effort for some reason and it is justified by the expected benefit on the national level, supporting such work could be considered.

3.3.3. Cooperation and exchange

To exploit the opportunities of the program and go even beyond the scope of it, a close, open cooperation between institutions and individuals with different backgrounds is inevitable. While there has been long standing cooperation on certain issues between institutions with similar tasks, a change in culture might be necessary to encourage cross-sector cooperation and to maintain it beyond the end of any such program. From earlier programs such as e-lib.ch it is known that they have actually brought about new collaborations and inspired common projects that would otherwise not have advanced – or at least not until much later.

It would therefore be a good idea to encourage and offer practical support for cooperation wherever

possible. This cannot be left to the national organization, but must be supported by local hierarchies.

3.3.4. Metadata

The program offers a great opportunity to build on existing experience based on research and in the institutions managing the scientific information, e.g. libraries. With metadata in particular there is a chance to incorporate existing and emerging subject-specific metadata schemas into existing metadata frameworks which are well established in libraries, data repositories and digital preservation initiatives. The interoperability of all components dealing with and relying on metadata throughout the data lifecycle is an essential prerequisite for a powerful national data management landscape that offers added value to researchers. Metadata is at the core of interoperability, both when it comes to keeping data scientifically meaningful over time with possible changes in ownership or stewardship, and in enabling its preservation from a more technical point of view. Experiences from all sectors should therefore be taken into account in order to avoid duplication of efforts.

One example is the practice of metadata publication via the OAI-PMH (see above). Virtually all institutional repositories and many other library-operated applications provide metadata via this protocol. Other service providers address http-requests to these data providers and receive an xml-package of metadata in response, which they can integrate into their own metadata pool. Institutions should be encouraged to implement and maintain additional mechanisms for metadata publishing as is required, e.g. as linked open data. Where appropriate, support for the implementation of more sophisticated publishing functions might be considered.

3.3.5. Persistent identifiers

Given the fluidity of digital content, persistent identifiers have been an important asset in managing any kind of digital objects over prolonged periods of time. Several systems exist which support the registration, maintenance and resolution of persistent identifiers, such as DOI, EPIC (both based on the Handle system), URN, PURL, ARC and others. Several institutional repositories and data repositories are already registering persistent identifiers. Both in the library context and in the wider research data community, service providers should be encouraged to introduce persistent identifiers as an important contribution to the sustainable operation of a highly interconnected research data management infrastructure. Where appropriate, support for such implementation might be considered. However, in most cases no major effort is required because established processes are already in place for the registration.

3.3.6. Evaluation of research

For several years now there has been international development, with funding agencies requiring applicants to provide data management plans with their project proposals and a mandate to deposit, document and publish their research data. Granting academic credits for researchers' efforts in complying with this would be a logical consequence. One means of technically facilitating this are interfaces to tools such as the P^3-database of the Swiss National Science Foundation (see external interfaces).

Despite its focus on social sciences and humanities, the CUS-program *Mesurer les performances de la recherche en sciences humaines et sociales* might include considerations in this direction which can be generalized.

3.3.7. Legal issues concerning data ownership

Legal frameworks determine data ownership. Any data management system has to be in accordance with applicable law. In long-term data and archival management systems, data ownership, data access rights, inheritance and transfer of ownership and other issues have to be defined and implemented. Rules have to be agreed upon and implemented that are in accordance with applicable law regarding intellectual properties rights. Questions have to be answered such as: what happens to data if the data owner cannot or does not want to take responsibility or pay for his data. Applicable rules have to be investigated by legal specialists and translated into a legal rule-set for the data management system.

4. Economic efficiency/availability of funding

4.1.   Implementation costs

Hypothetical implementation costs for the field of activity can only be stated as an accumulation of the rough estimates for the individual action items. These estimates need not correspond at all to the real costs that might be stated in concrete project proposals that are submitted.

We estimate the implementation costs for tackling all action items identified in the data management strategy to **87 person years**.

We consider all work as easily fundable that produces concept papers for enhancing existing software systems as deliverables, as this work will be finished at the end of the program. If new software is written, we assess how easy or how difficult it will be to fund the ongoing maintenance of the software written as part of the program. For the central pieces of software developed as part of this program (like the distributed metadata server), we suggest creating a non-profit foundation of which the institutional users of the software become paying members. In return, the foundation maintains the software. Essentially, this makes software maintenance a part of the operating costs of this infrastructure.

In 2014, work will focus on the definition of key standards and interfaces. While this phase will be labor-intensive, only limited implementation costs are expected during 2014, whereas the following years will see much more investment in implementation.

Storage costs will be an important factor, both in implementation and operation. While there are current estimates of costs per terabyte, it is not possible to predict the cost per terabyte reliably by the time that the implementation commences, nor can the increase in storage demand be predicted. It is currently known that the increase in data volume has already outpaced the decrease in storage cost per terabyte. That is only one reason why any economies of scale which can be achieved by sharing distributed resources are not only welcome, but also urgently needed.

4.2.   Operating costs

The strategy builds largely on existing local services which are funded by the universities as part of their base infrastructure. Internally, costs are sometimes charged to smaller entities such as institutes or research groups who cover these costs with their own funds (though usually not from research grants). Such existing procedures will need to remain in place for the time being, in order to keep the local components of the overall strategy up and running. As proposed enhancements need to be implemented in local infrastructures, it is envisaged that the related operational costs need to be covered within each institution.

For the time being, it is expected that universities need to cover at least their local operational costs and part of the operational costs of any central component, while another part of funding in the longer run could be envisaged under the conditions of the new HFKG ("Hochschulförderungs- und

koordinationsgesetz") which is being drafted to include the possibility of co-funding essential common infrastructure. Nevertheless, it is hoped that in resource-intensive and fast-growing areas as storage provision, economies can be realized by integrating local and common resources. In these areas it will actually be the institutions that gain a benefit from certain bilateral or multilateral approaches, e.g. when they manage to provide redundancy in storage for each other, when the business model is inter-institutional and reflects actual consumption to avoid imbalances that exceed a certain degree of goodwill.

Whether or not individual research groups can actually be charged for using more comprehensive and powerful data management services will depend very much on the position of the funding agencies. If they are willing to dedicate part of their funding to the necessary tasks of data management which they themselves increasingly mandate, then a "user pays" principle can be envisaged. The discussion between funders and universities about what is considered as basic infrastructure to be provided by universities, and about what is research-related effort, is a recurring one and can probably not be resolved once and for all.

4.3.   Customer benefit

The proposed strategy focuses on the central implementation of only those components which cannot be provided locally, e.g. a central metadata search service. As this service cannot be offered locally, it will not offer economies, but instead an immediate benefit for users: given the number of existing and emerging repositories for research data and publications, such a service would be of immediate benefit for gaining awareness of researchers' own data and for gaining access to other researchers' data. Both tasks are surprisingly difficult if they have to be dealt with on an exclusively local level.

Other suggestions in the strategy are aimed at enabling local service providers to re-use existing experiences and tools in order to greatly improve the interoperability of their services for scientific users. While interoperability can even be seen as a benefit in itself, it facilitates concrete improvements for researchers who need to manage their data throughout the lifecycle of the data and also throughout their own professional life. Improved interoperability will enable researchers to handle their data smoothly from the time of production of raw data through the stages of processing, analysis and interpretation up to possibly publishing data and deciding to preserve selected data over time. This is currently usually a fragmented and cumbersome process and therefore very often not handled too well. As requirements in data management increase, there are time-saving economies for researchers, plus benefits in the form of services which cannot be provided at all at the moment, and cannot be provided in future by local stand-alone solutions on their own.

Parts of this lifecycle might in future be supported centrally, but it is currently not possible to decide which stage (e.g. preservation) or which layer (e.g. storage) this will be. Ideally, either solution should work in such a way that users will not have to bother which part of the service they use is centralized and which is provided locally.

One possible measure to achieve this aim could be the decoupling of software and services from the underlying hardware, with considerable economies on the infrastructure's side, thus probably benefitting the users' institutions more than each individual user at first sight. However, freeing up resources with providers enables other services to be established.

Relying on relatively small central components also benefits the sustainability of the approach. As no major infrastructure needs to be sustained, it will be easier to demonstrate a favorable cost/benefit ratio to the stakeholders who will eventually be requested to contribute to the funding of the service in future. As the proposed strategy is about interoperability and not about levelling out the specific structures and practices of each institution and each discipline, the barriers for local implementation should also be relatively low and broad acceptance easier to achieve, especially when successful reference projects can be presented.

Whether or not individual research groups can actually be charged for using data management
services will depend strongly on the position of the funding agencies. If they are willing to dedicate part

of their funding to the necessary tasks of data management which they themselves increasingly mandate, then a "user pays" principle can be envisaged. Otherwise, funders and universities will need to make arrangements to clarify what is considered as basic infrastructure to be provided by universities, and what is research-related effort.

5. Implementation plan and risks

Two phases are envisaged in the program. In a first phase, more conceptual work needs to be done and interfaces and guidelines need to be defined (see also the list of action items). This phase comprises several activities which should be carried out in the form of mandates and should be concluded in 2014. Afterwards, the defined interfaces, concrete APIs and workflows should be implemented in existing services in 2015 and 2016, and new services and workflows should be developed as needed to complete the landscape.

A general risk for the whole program and for any undertaking of this scope is the limited availability of people with the required expertise: the number of people who are deeply involved in data management issues in Switzerland is limited. Their expertise is essential for the success of any projects, but they are usually fully engaged in their ongoing work. On the other hand, time is short to find staff who can work competently at the interface of science, IT and information management in a still small marketplace; even people "only" trained in IT are difficult to find.

Related to a lack in staff is the risk that some of the action items might not be adopted by interested parties submitting their proposals.

Usability issues should be taken into account already in the early stages in order to promote acceptance. Beyond general usability, solutions must suit the community addressed: A solution welcomed by one community might just not fit smoothly into another community's way of thinking and working.

The program as a whole, and the field of activity of data management in particular, are at the interface of two fields with very high rates of innovation: scientific research (and its supporting methods and technologies) and information technology. If today's assumptions are to be more or less relevant throughout the program, they can only be rather generic. This can be a risk regarding coherent implementation, but more specific requirements bear the risk of being outdated before most projects are finished. The program must therefore allow for enough flexibility to be able to adjust later calls for proposals to current developments.

Such ongoing developments not only concern technology, but also questions of data protection and policies. For example, while general acceptance for cloud storage solutions has grown over recent years, 2013 has seen growing concern about clouds that appear to be insufficiently protected by law. This has direct consequences for the degree of acceptance which can be expected for cloud solutions in data management. This is of course less of a concern for data which is exposed to the public anyway, but it is highly relevant for sensitive or competitive data which is to be handled in data management. For the near future, international approaches are therefore not considered an alternative for data management as they will usually include a component of cloud technology. Of course, this does not prevent the sharing of metadata for accessible content.

Data protection issues apply in the clinical sciences in particular, but also in the social sciences and other fields. Concerns about data protection can on the one hand limit the possibilities of using new technical tools – networked solutions in particular. On the other hand, data protection requires the anonymization of data, which can even limit the value of the data for scientifically sound re-use. As any uncertainty regarding these issues will reduce the acceptance of services handling such data, it would be desirable to have the legal situation clarified in Switzerland so that the requirements both for individual researchers and for data management services are better understood. There might also be a need for more sophisticated technical solutions when it comes to the anonymization of data.

The reasons mentioned above limit the possible role of major international solutions as superior

alternatives. Of course there are powerful and attractive international services in operation, but they usually only serve a few disciplines really well and often ignore the vast amount of unpublished material that researchers need to cope with. In addition, there is a need for specific and even bespoke workflows and for support nearby and on-site. International services can have a role in metadata exchange and in collecting the published output in specific disciplines. Such existing and functional international services should not be ignored, but be interfaced with. This can be better facilitated if services exist on the national level which can consolidate data from various contributors and collect a critical and visible mass of data. It can also be expected that researchers in Switzerland have a stronger influence on national services than on international ones.

6. Conclusions and priorities

The range of activities outlined will advance infrastructure and practices in data management for the scholarly community in Switzerland. By re-using existing subject-specific solutions it will facilitate and speed up the establishment of professional data management in more disciplines across all higher education and research institutions and be well-integrated with parallel approaches in the library sector.

By defining technical prerequisites and formal standards on the national level and in agreement with international activities, exchange and interoperability on the national level will be advanced. At the same time, the largely distributed approach allows different disciplines to adopt solutions and practices according to their particular needs.

Likewise, the underlying storage infrastructure can be made more flexible and cost-efficient for institutions, again allowing institutions to join and contribute according to their needs and possibilities and resulting in a robust, extendable storage infrastructure on the national level of research and higher education.

The star (*) denotes implementation efforts that can be scaled up or down according to available funding.

Action item ID	Priority on time-line / phase	Impor-tance	Align-ment with program goals	Availa-bility of funding / business case	Imple-men-tation risks	National benefit	Imple-men-tation effort	Opera-tional effort
	1 (first) - 2 (second) - (3 later or as needed)	1 (high) - 6 (low)	1 (high) - 6 (low)	1 (easy) - 6 (difficult)	1 (low) - 6 (high)	1 (high) - 6 (low)	1 (low) - 6 (high)	1 (low) - 6 (high)
Lifecycle-01	1	2	2	1	2	2	2	0
Lifecycle-02	2	2	2	3	4	2	4	0
Lifecycle-03	2	2	2	1	3	3	4*	0
Lifecycle-04	3	3	3	6	2	3	2	4
Metadata-01	1	1	1	1	2	1	1	0
Metadata-02	1	1	1	1	2	1	1	0
Metadata-03	2	1	1	3	4	1	5	0
Metadata-04	2	1	1	1	3	1	4*	0

Action item ID	*Priority on time-line / phase*	Impor-tance	Align-ment with program goals	Availa-bility of funding / business case	Imple-men-tation risks	National benefit	Imple-men-tation effort	Opera-tional effort
	1 (first) - 2 (second) - (3 later or as needed)	1 (high) - 6 (low)	1 (high) - 6 (low)	1 (easy) - 6 (difficult)	1 (low) - 6 (high)	1 (high) - 6 (low)	1 (low) - 6 (high)	1 (low) - 6 (high)
Metadata-05	3	2	2	6	3	2	5	5
OAIS-01	1	1	1	1	2	3	3	0
OAIS-02	2	1	1	3	4	4	4	0
OAIS-03	2	2	1	1	2	2	3	0
OAIS-04	3	1	1	1	2	3	2	0
OAIS-05	4	2	1	1	4	3	3*	0
OAIS-06	2	2	1	2	5	2	6	5
Research-01	1	1	1	1	2	1	2	0
Research-02	2	1	1	1	2	1	5*	0
Research-03	3	2	2	5	4	2	5*	1
Publication-01	3	4	3	4	4	4	2*	1
Publication-02	3	3	3	4	2	4	4	0
Publication-03	3	4	2	3	3	4	3	0
Publication-04	4	4	2	4	4	5	5	3
Publication-05	2	4	3	4	2	4	2	0
Publication-06	3	4	3	3	4	4	3*	0
Storage-01	1	2	2	1	3	2	1<	0
Storage-02	1	2	2	1	2	2	1	0
Storage-03	2	2	2	1	4	2	4*	0
Storage-04	3	2	3	5	5	2	1<	1

Program SUC 2013-2016 P-2
Scientific information:
Access, processing and safeguarding

Strategy for cloud computing

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1. National services within the field of action

Table 1 is the list of high-level national services defined in the IBM "Foundations for Strategy"[6] document for the cloud computing strategy group, which can be found in more detail in Appendix A along with the function blocks as defined by IBM.

Table 15: Cloud services as defined by IBM's "Foundations for Strategy" document.

Code	Title
s-13	Access to temporary computer resources
s-14	Access to temporary storage resources

Like many other governments, the Swiss government is pushing for a "cloud first" strategy[7] and it is felt that Swiss academia should follow this example. The commercial world has moved en masse to cloud services because of their lower overall cost,[8] but for a variety of reasons the academic sector has been lagging behind in this, and it is critical that this is addressed. It is not possible to define precisely what specific cloud services should be used by Swiss academia besides the basic ones of computing and storage, because market forces should dictate this; so the scope of this document is to define the general characteristics of cloud services and how this ecosystem can be enabled in the Swiss academic sector.

It is unlikely that there will be any single national cloud service in Swiss academia for compute or storage, but rather that there will be categories of cloud services consumed by institutions that could be offered through a marketplace shared with other public institutions.[9] Researchers must also have the option of using international resources as required for their collaborations, or highly specialized resources that apply only to a handful of researchers. The use cases assigned to the cloud computing strategy group were examined and it was determined that several different types of service would most likely be needed to cover their specific needs (Table 2). As a result of this, one of the recommendations of the cloud computing strategy group is to go beyond merely the IaaS model (Infrastructure-as-a-Service) and define the concepts of the cloud in general, as this affects how the IaaS model is leveraged and how other services are delivered with PaaS (Platform-as-a-Service) and SaaS (Software-as-a-Service). For the attributes required to be defined in order to serve as a guide for a cloud service, we refer to the Academic Compute Cloud Project at ETH[10], which built upon the NIST definition of cloud computing[11] (see also Appendix B): self-service; on-demand; cost transparent; elastic and scalable; multi-tenant and programmable. This gives an abstraction layer for services and allows the sharing of resources which in turn gives the consumer a wider pool of resources to choose from. Another recommendation is to move away from the term "temporary" for compute and storage, as several use cases require indefinite commitments to these services. Furthermore, having the concept of cloud services in place is an important foundation for all national services.

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[6]   IBM Consulting, "Grundlagen zur Strategie" (http://goo.gl/ZlYdQd).

[7]   U.S. Cloud First Policy Progress Difficult to Assess (http://goo.gl/6AZ3Dt), UK government adopts "cloud first" policy for IT procurement (goo.gl/8qRv5X), Cloud-Computing-Strategie der Schweizer Behörden 2012 - 2020 (http://goo.gl/x07BY2).

[8]   Novartis used to demonstrate Microsoft Office365 case (http://goo.gl/DLCN5e), Roche moved over 90,000 employees to Google Apps (http://goo.gl/jPJn8L).

[9]   G-Cloud is a UK Government initiative to encourage the adoption of cloud services across the whole of the public sector and in conjunction with some higher education institutions (http://goo.gl/nj0Ls2).

[10]   Academic Cloud Project Results (http://goo.gl/XdlSRd).

[11]   The NIST definition of cloud computing (http://goo.gl/Z6oVnM).

Services could be partnerships with commercial cloud providers, similar to Internet2 NET+ services,[12] SURF[13] and Janet,[14] including negotiating contracts for preferential rates (e.g. e-mail, access to infrastructure and application services such as websites, virtual learning environments and research projects). Three large EU research institutions CERN, ESA, and EMBL are part of the Helix Nebula initiative that works with commercial IaaS providers[15] as well as PRACE and the EGI federated cloud for special capabilities.[16] These cloud services are targeted for use in either private clouds (services internal to a single institution), community clouds (services shared by multiple institutions), or public clouds (services open to all institutions). This is driven by the increasing commoditization of HPC being led by companies like IBM who are defining reference architectures for cloud-based HPC[17]. A best practice from the US comes from XSEDE, which also recently investigated what is driving cloud adoption in HPC, as well as its benefits and challenges[18].

VENUS-C[19] successfully demonstrated commodity HPC approaches based on a hybrid delivery model (MS Azure public cloud and private clouds running at two European research institutions and one private company). It helped to position cloud as an effective paradigm not only for the research community (including an "army of one" approach), but also for small companies for which HPC systems are not economically affordable. For three usage patterns (sporadic peak usage, oscillatory demand, plateau of resources), it demonstrated benefits for both applications that had previously run in grids and clusters (e.g. bioinformatics, earthquake monitoring, radiotherapy planning) and for users moving straight to the cloud (e.g. systems biology, drug discovery, social trends analysis, architectural design and analysis of energy efficiency in buildings; wildfire predictions and management). Interoperability was focused on easing the process of migrating from different target platforms with the implementation of OGF standards and protocols (BES, OCCI) and CDMI.

Harmonizing on cloud services from the broad market of providers, or converting an existing tool or resource into a cloud service, can benefit multiple organizations and researchers. The cloud is increasingly becoming the default mode of operation in national and international collaborations where resources are used or shared with others, so the move to the cloud is an absolute necessity. A national strategy should support cooperative projects to facilitate cloud adoption. To prevent projects from being fragmented or not having critical mass, a cross-institutional eScience team must be established to ensure a coordinated approach across a smaller set of harmonized services to the benefit of multiple researchers and institutions. This eScience team must be independent of the service providers and have participation from all institutions. Such an approach has been taken in the Netherlands with the establishment of the eScience Center,[20] which is a collaboration across institutions, and such eScience teams can be found in various other places throughout the world. This eScience team must be seen as complementary and beneficial to service providers in order to help ensure that the appropriate services are established and to help facilitate users adopting them.

2. Foundations, key functions and services

2.1. Overview

The use cases assigned to the cloud computing strategy group were examined and grouped into

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[12]   Net+ services from Internet2 (http://goo.gl/DWXB9y)

[13]   GreenQloud: Moving Universities and Research data from the Netherlands to Iceland (http://goo.gl/SOQlba)

[14]   Windows Azure to power Janet education cloud (http://goo.gl/MWXhdl)

[15]   Helix Nebula –The Science Cloud: A catalyst for change in Europe (http://goo.gl/IC5wsX)

[16]   Implementation of a European e-Infrastructure for the 21st Century (http://goo.gl/kSeyK1)

[17]   IBM's Guide to Cloud Based HPC (http://goo.gl/37FhRe)

[18]   XSEDE Cloud Survey Report (http://goo.gl/IbSaUA)

[19]   Website for Venus-C project (http://goo.gl/3RVvye)

[20]   The Swiss National Grid Association (SwiNG) web site (http://goo.gl/WLhEow)

subcategories of cloud services as seen in Table 2. It can be seen that multiple use cases can potentially leverage a single cloud service, which can most likely also be used for future use cases as well.

Table 16: Sub-categories of cloud services based on use cases for the cloud strategy group.

Subcategories	Associated use cases
community/cooperation (WLCG, EGI, SwissACC, SystemsX, CHIPP)	043, 021, 144
IaaS: data center sharing	117
IaaS (VPS, VM): standard VM hosting, persistent and on demand	007, 127, 177, 199
IaaS (SM): persistent, on demand, cloud bursting	005, 017, 021, 041, 117, 128, 130, 131, 199
PaaS: cluster, supercomputer, etc.	005, 013, 021, 041, 117, 128
IaaS: CIFS, NFS, Cloud, ftp, archive storage	008, 041, 144, 198, 143
SaaS: backup for servers, desktops, laptops, mobile	186
SaaS: self-provisioning of storage/archive	042, 058, 072

2.2.   Existing services and ongoing projects

Based on existing national activities including existing cloud-based services and ongoing projects, we have listed the following examples and aligned them with the subcategories defined above.

Table 17: A list of existing national services and ongoing projects organized, linked to the subcategories above.

Description
Community/cooperation: SwissACC, SMSCG, CHIPP, SystemsX, Swiss OpenStack SIG/CERN, EGI/Swiss National Grid
IaaS (VPS, VM): public clouds such as Amazon, Google, CloudSigma, Microsoft, etc.
IaaS (VPS, VM, HPC): SwissACC infrastructure with SWITCH, UZH, ETHZ, ZHAW, HES-SO and HESGE
PaaS (cluster): The Swiss Multi-Science Computing Grid infrastructure, EGI

There is a vibrant market of commercial offerings in cloud services. Internationally, the dominant suppliers are Amazon, Microsoft and Google, but many smaller regional or niche offerings were created lately. Switzerland has options for cloud hosting with established providers such as IBM and CloudSigma within its borders for organizations that have concerns about legal issues regarding storing data outside the country. However, academic institutions have been hesitant to endorse or even to allow the use of these services due to:

- Possible legal implications of outsourcing data and processing outside the institution/country;
- Local institutional policies limiting how and where data can be stored and processed;
- Concerns about loss of control including vendor lock-in;
- The perception that commercial cloud services are more expensive than their own infrastructure in the long run, or incompatible OPEX and CAPEX models.

In addition, there is a wealth of compute and storage infrastructure operated locally within academic institutions, not just centrally, but also within departments and institutes. More and more of these local installations offer virtualized machines and storage. Nevertheless, they are typically not operated for cloud-like self-service access, and usually restricted to a small set of users. Some research groups are individually exploring the adoption of cloud services for their scientific use cases at many levels. This exploration is happening in an uncoordinated manner without a clear understanding of the possible

legal implications, and models for funding infrastructure often do not take this kind of computing resource into consideration.

2.3.   International references and standards

The references are focused on relevant activities in cloud in order that this program may benefit from them, and much of the information within this document is drawn from them.

References:
- The Helix Nebula project where emphasis is placed on links with commercial cloud providers as well as specialized providers such as PRACE and EGI aligned with the European cloud strategy as part of Horizon 2020 ("Helix Nebula –The Science Cloud: A catalyst for change in Europe", 02.04.2013, http://goo.gl/wWCoHu).
- This paper is a cooperation between EGI and Helix Nebula to define interoperability requirements between commercial providers and specialized academic resources ("Helix Nebula – The Science Cloud: Interoperability Requirements Report", 21.05.2013, http://goo.gl/sLHEKk).
- The Dutch NREN SURF outlines its strategy for cloud services ("Into the cloud with SURF: Cloud computing and cloud services in higher education and research", 12.07.2011, http://goo.gl/1x90kj).
- Cloud for science and public authorities gives an overview and outlook for EU cloud activities ("Cloud for science and public authorities", 18.07.2013, http://goo.gl/kQxfOa).
- The EU Cloud Computing Infrastructure strategy document ("Unleashing the Potential of Cloud Computing in Europe", 27.09.2012, http://goo.gl/Zh7eP0).
- The Nectar project exemplifies the use of IaaS infrastructure along with a national eScience team to cloud enable research applications (website for National eResearch Collaboration Tools and Resources, 03.10.2013, http://goo.gl/Ay20IU).
- GRNET's ~okeanos service in Greece provides IaaS for compute and storage to the national academic community as well as other parts of public administration. These services are offered for free in the framework of a large funded project (~okeanos website, 03.10.2013, http://goo.gl/X90PLD).
- The University Modernization Fund Eduserv Education Cloud in the UK targets academic institutions, rather than individual researchers. It includes an elaborate pricing scheme which is integrated into the UK government cloud store (eduserv UK IaaS offering, 03.10.2013, http://goo.gl/pb6rKW).
- In 2012 the Swiss federal government began developing a cloud strategy which includes a catalogue of measures to enable public administration to benefit from cloud. These measures include raising awareness, adapting rules and regulations, and the creation of an IaaS community cloud to host security-sensitive applications ("Cloud-Computing-Strategie der Schweizer Behörden 2012 - 2020", 12.06.2013, http://goo.gl/Tnio0b).
- The "PLA Outline" has been developed within Cloud Security Alliance by an expert working group comprised of representatives of cloud service providers, local data protection authorities, and independent security and privacy professionals ("Privacy Level Agreement Outline for the Sale of Cloud Services in the European Union", 02.01.2013, http://goo.gl/tBlH8R).
- In 2012 the Swiss Federation Council created the SOWISCH working group to study security-related economic opportunities in various fields including cloud computing ("Strengthen Switzerland as a business location by data security", 20.12.2012, http://goo.gl/RgEGzl).
- CERN's use of OpenStack and collaboration with Rackspace to build large hybrid IaaS infrastructure for use with the LHC ("CERN and Rackspace Form OpenStack Partnership", 07.03.2013, http://goo.gl/6sku7w).

Standards:
Interoperability is important for broadening choice by creating fair play for providers, helping to avoid getting locked-in to a specific provider that cannot meet all needs or to one that loses competeness over time. It can also avoid technical lock-in for developers, even if a service may have a compelling business model. A goal should be to make interoperable and integrated services a requirement

whenever necessary or desirable, including commercial partnerships where appropriate.

The open Grid Forum (OGF) is the standardization body hosting the Open Cloud Computing Interface (OCCI) working group, which strives to define an open, community-driven standard for interfacing with cloud resources. The Storage Networking Industry Association (SNIA) is a non-profit organization whose work spans a wide range of topics: big data, cloud storage, storage security and topics closely related to storage. OpenStack is a community-driven effort to implement an open cloud operating system and has achieved a significant impact in the open source community, similar to many commercial companies. The Open Networking Foundation (ONF) is a standardization body dedicated to the promotion and adoption of Software-Defined Networking (SDN), which is a new approach to networking in which network control is decoupled from the data forwarding functionality using a protocol such as OpenFlow. There are others from the area of archiving such as ISO 14721 (OAIS), proposed initially by the Consultative Committee for Space Data Systems, which should be examined.

While it is true that considerable efforts are invested in defining cloud standards at all levels, it is also true that, at the moment, none is widely acknowledged, recognized and adopted. This leaves the program two possibilities:

1. A arbitrary choice of standards to comply with, and follow the strategy accordingly.
2. Recognize that the market is not yet consolidated and that the adoption of whatever standard should imply a shift to another in the near future.

The latter variant is the most flexible, but also implies extra measures that have to be taken to minimize the risks to the end users. Unless there is a heavy emphasis on interoperation, investing time and effort in standards may not result in sizeable advances and may limit choices. Instead, an emphasis should be placed on ensuring that services are indeed cloud services as outlined previously. It is also felt that the eScience team cooperating across institutions, supporting researchers in adopting and establishing cloud services, will help harmonize services across institutions. Such an approach will deliver more value than focusing solely on standards or building interfaces between similar services.

2.4.   Innovation required

The following innovations will be needed to help improve the likelihood of success of the program:

- Develop a strategy that motivates academic institutions to cooperate and use shared services. Options of re-branding, using commercial providers, implementing multi-tenant solutions etc. should be investigated.
- Innovation in the area of software defined networking (SDN) could help increase the acceptance of IaaS within academia by allowing IaaS to be more tightly integrated with local resources. Long-established technologies such as CWDM and DWDM could also be leveraged for resource sharing.
- Ensuring that activities are driven by actual needs of researchers and educators. This can be done by implementing an innovation management process to bring consumers together to find common solutions with new and/or existing cloud services.
- The creation of a cross-institutional eScience team so as to optimize coordination and cooperation as well as gradually harmonize services to meet the needs of a particular institution, researcher, or community.

2.5.   Action items

A. Launch a call for national compute and storage cloud services that address the needs of the Swiss academic community. All Swiss academic institutions should be eligible to use the service. Quality dimensions (such as authenticity, integrity, accessibility, security, etc.) should be controlled systematically with transparent tools and processes (Appendix C). Procedures need to be formalized for collecting usage statistics and enabling billing. The program's strategy for "national organization" must establish procedures that connect consumers with providers, work with funding agencies to establish business models on how users receive funding to spend on the national

services, work with user communities such SwiNG[21] and Eduhub,[22] and create incentives for providers to serve the entire Swiss research community.

B. Launch a call for cooperative integration projects. These can define and implement standards for common national access control and usage reporting infrastructure. The standards should align with solutions for federated identity management. Clarify legal and administrative aspects for use of cloud services, such as billing between institutions, data privacy, etc. The call can also investigate the integration of remote IaaS resources into academic institutions' campus ICT infrastructure. Particular attention should be paid to SDN (Software-Defined Networking) approaches. Such projects should produce realistic proofs-of-concept.

C. Launch a call for a national eScience team, leveraging the scientific IT support in various institutions and based on the experiences of inter-institutional IT cooperation from such projects as SwissACC, SystemsX and CHIPP. Proposals for the national eScience team must detail how the team will work together across all strategy areas. The team must support multiple communities from research and education to facilitate cloud adoption. The national eScience team should tap into institutional expertise and resources, as well as national and international activities.

D. Launch a call for cooperative projects to fund the adoption and development of cloud services based on use cases and community needs. Projects should provide a high and significant level of interoperability among scientific communities and should develop more connectivity between scientific activities, especially concerning resource sharing.

E. Fund projects of national importance that integrate with international e-infrastructure for research communities (e.g. EGI, Elixir, EUDAT, RDA) so that all researchers in Switzerland can benefit from such activities and resources. This should be done in cooperation with the current partners of the respective projects and be driven by requirements from researcher/community needs. In particular, there should be support for the continuing membership of Swiss partners in the EGI initiative. This should also connect the Swiss academic community with EGI's pan-European federation of private clouds.

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[21] The Swiss National Grid Association (SwiNG) web site (http://goo.gl/WLhEow).

[22] Eduhub is an Swiss academic e-learning community (http://goo.gl/AQsyzV).

3. Dependencies and interfaces

3.1. Prerequisites from other strategy projects

National organization:

The program must support the model of operation of a national eScience team. As the Nectar Project[23] from Australia has demonstrated, the IaaS portion is important in the early stages, but the longer-term benefit is in assisting researchers to leverage IaaS architectures and in helping them to develop SaaS and PaaS services to support their own communities and add them to the national services portfolio. In addition, the program must support a funding model that fosters cooperation and sharing resources between institutions. It must also work with the national funding agencies to come up with a business model to sustain the national services and the national eScience team through the program's "national organization", as well as working with the funding agencies to establish business models on how users receive funding to spend on the national services. The user communities of SwiNG and Eduhub need to be integrated into the program's national organization so that the needs of the researchers and educators are well represented in the program.

Identity management:

In order to enable easy activation of services to all members of Swiss academia, cloud computing should be able to access identities and attributes from identity management services for accounting, as and when required. The identity management area will also need to work closely with the national eScience Team and must be use case driven.

To support international and industry collaboration, the identity management service should cover loosely affiliated individuals. These include a university's affiliated individuals and international individuals through inter-federation with other national identity federations and research communities. The identity management service should link to relevant social identities (Google, ORCID, etc.). It should also support the security context at the organization, groups and group levels as provided by participating institutions. It must also be possible to use this identity management as a source for rights management and application provisioning.

For the seamless use of cloud computing services, it must be possible to use these identities for authentication and authorization in non-web contexts, such as access to REST APIs and to control access to compute and storage resources via common login and storage protocols.

Working environment, data management, e-learning, e-publishing.

These areas will need to work as part of the national eScience team. Interfaces to such cloud services will be critical, since many use cases will combine service hosting and data processing, and processed data will need to be transferred to and from the systems used for the other fields. The interfaces should be aligned as much as possible and, where possible, cloud services should be standardized across institutions. Particular care should be taken with the interfaces with data intensive services in order to ensure the good performance and smooth operation of cloud services.

3.2. External interfaces

The cloud services should provide simple web-based interfaces for users to request access to and manage compute and storage resources. They should also be accessible through APIs. These APIs should conform to accepted standards wherever possible. The services should provide accounting interfaces to report on resource provision and utilization at a level suitable for institution-based charging and cost control. Accounting should support charge-back to individual users or groups within an institution. There will be an interface to allow users to report and track issues with the services and to assess their health.

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[23]   Web site for NeCTAR: National eResearch Collaboration Tools and Resources (http://goo.gl/Ay20IU).

In addition to technical interfaces, the eScience team will work with SwiNG to form interfaces to national and international projects, in particular those supporting national and international communities (e.g. EGI, EUDAT, RDA). Since the team is distributed across several institutions, it will also help build bridges between these institutions.

3.3.   Further dependencies and relevant external factors

There must be rules and processes in place that allow participating institutions in their different roles to produce and consume cloud services as well as to receive and pay fees for them. Research funding rules may need to be adapted to allow researchers to "rent" compute and storage resources as an alternative to acquiring them. The actual flow of money from researchers to service providers may have to be channeled through a broker model. This includes adequate mechanisms of governance and accountability to foster the goals of collaboration, sustainability, customer choice and innovation-oriented competition. An important area of work is the agreement on SLAs, legal issues and monitoring. As these are topics spanning all strategy areas, it is assumed that these topics will be taken up by the program's strategy group for national organization.

4. Economic efficiency/availability of funding

4.1.   Implementation costs

The investment costs for building compute and storage capacities to the estimated levels required will be in the order of tens of millions of Swiss francs. Investments in equipment should be funded by the institutions themselves, possibly using contributions from large anchor user communities. Funding equipment purchases through the program is not recommended, both because the funds available for this area are insufficient and because experience has shown that such contributions often do not result in a sustainable service to the wider community.

The program should fund the establishment of community-wide standards for these services, of national shared systems such as common access and accounting infrastructure, and of a national eScience team to help researchers make effective use of the services. The program may fund the efforts required to integrate large and medium-scale storage and compute resources in the national services. In fact, all the action points mentioned above.

4.2.   Operational costs

Cost model/business model/business potential:

In terms of services, it is assumed that national services will work on a full cost recovery basis, and the pricing strategy will be variable between providers of the service. The costs of a service will generally be lower, the more consolidated it is, as it will gain from operational efficiencies. In addition, more users of a particular service will drive down the overall cost of a service, since the operational costs can be spread over more users. It is assumed that the program's national organization will establish the billing methods for these services. This program will have to observe a level of flexibility in billing in order to accommodate the variety of funding sources in academia. In terms of user support, information and community management these costs are highly dependent on the desired level of support.

Available funding sources/sustainability:

It may be that some institutions pay for their use of certain cloud services similar to the way they pay for the national network infrastructure today. They may or may not choose to charge the costs internally, depending on whether the services are used by a wide population, or whether their use is

dominated by a large group of users. In order to ease the transition, usage accounting should be implemented early on, with an emphasis on presentation as both appropriately detailed (initially pro-forma) bills per consuming institution, and as reports of resource contributions per providing institution. Researchers must be allowed to include infrastructure costs as part of their research grants. Similarly, they must be allowed to use the institution's infrastructure funding to cover all or some of the national service costs.

However, it is hard to justify the additional expense of working cooperatively with other institutions to establish new national services or to migrate existing tools and services to cloud services. In addition, new national and international cooperative projects may be formed and they may require new cloud services to be established to support a cooperation or to make it more effective. This will be the role of the national eScience team, which will already have established relations with researchers. The eScience team will work cooperatively with researchers and institutions to apply for additional grants for the development of new cloud services. This should have a multiplier effect on the program, especially considering the shared institutional expertise and resources brought to it. This team will need a minimum of operational funding in order to support their involvement in this program's activities as well national and international activities. As a minimum, the program should fund 5-25% of an FTE for each institution participating in the program (dependent on the number of researchers and teachers at each institution). In addition, the program will need to provide a certain amount of funding for the team's activities (e.g. travel, organizing training events, presentation), which is estimated to be in the order of 100K CHF per year. Projects should be funded or co-funded that relate to international e-infrastructure for research communities (e.g. EGI, Elixir, EUDAT) so that all researchers in Switzerland can benefit from such activities and resources. This should be done in cooperation with the current partners of the respective projects and be driven by requirements from actual use cases and communities. It is estimated that this will in the order of ~200K CHF per year. Funding should be partly allocated to small projects (~500K CHF per year) and approximately 2 million CHF per year given to larger cooperative projects.

4.3.   Customer benefit

A stable, scalable, accessible and flexible infrastructure will considerably reduce drivers for institutions to acquire their own compute and storage resources. Many research groups operate their own servers or clusters today. These resources may have low usage during low demand periods, or not be able to handle peak periods (e.g. conference submission deadlines). More importantly, they require local maintenance and support, often dependent on the spare time of graduate students. By reducing the dependence on local administrators through pooling resources and by centralizing "cloud bursting" to meet peak demand, significant savings could be achieved in labor and other costs. Such an approach would enable a large pooling of resources at higher utilization levels, while still giving users the illusion of isolation. This on-demand model will cut waiting times for resource allocation associated with local reliance, and increases autonomy; for example, getting and publishing results could be achieved in less time.

5. Implementation plan and risks

The groundwork for basic national compute and storage services will be laid through integration projects, for which a call for proposals should be issued as early as possible. The bulk of this work should be performed in the first 12-18 months of the program's realization phase, although smaller additional projects might extend to later phases if major new integration requirements are identified.

It is felt that all national services should be driven by the needs of the researchers. An inter-institutional eScience team will need to be formed to support the community of researchers and educators to apply their use cases to consume cloud services, and to ensure new services built upon them use cloud service models so that these investments are useful to others. This eScience team

should be dispersed into existing science IT teams supporting researchers, and their mandate should be to focus on projects that are co-operations between other institutions as well as national and international projects, and that lead to the creation of shared services (e.g. new tools useful to other researchers). In particular, the team should work closely with the recently formed science IT support groups formed at EPFL, ETHZ, Unibas, and UZH as well as with national initiatives such as VitalIT and PASC (Platform for Advanced Scientific Computing). Activities such as SyBIT, CHIPP, SwissACC, and SMSCG could be merged into this eScience team in order to benefit from these investments and guarantee continuity of the activities started by these projects. SwiNG should work with this eScience team to develop an architecture and roadmap for supporting the e-infrastructure needs of scientists in Switzerland, as well as helping to coordinate national and international activities.

Additional calls for proposals will be a request for cloud service providers to meet the needs of the use cases submitted to the program, as well as to form a national eScience team as a cooperation between institutions to work on these use cases. New use cases for national services will be accepted on a regular basis. A budget will be allocated to fund the eScience team to facilitate coordination and the eScience team will support the use of the national cloud services, which will serve as the incentive for the cloud providers to contribute resources into the shared pool.

Specific cloud services will not be defined or mandated, as it is up to individual institutions and companies to offer services with sufficient market interest to be viable. It is assumed that these will be a combination of commodity cloud resources as well as highly specialized cloud resources (e.g. HPC compute, archive storage). Since we are not proposing to fund the establishment of the cloud infrastructures directly, and we also encourage the use of public cloud resources as a viable option, there is no risk of the program investing in the wrong technology as the market will make the selection. We do, however, acknowledge the risk that there is not a viable pool of cloud services providers and that the cost model of cloud service providers might not be compatible with the funding available to researchers. Nevertheless, there are sufficient seed cloud infrastructures available that can be used initially (SwissACC, SWITCH).

6. Conclusions with priorities

Action item	Importance	Alignment with program goals	Availability of funding / business case	Implementation risks	National benefit	Implementation effort	Operational effort
Scale	1 (high) – 6 (low)	1 (high) – 6 (low)	1 (easy) – 6(difficult)	1 (low) – 6 (high)	1 (high) – 6 (low)	1 (low) – 6 (high)	1 (low) – 6 (high)
A. Call for compute and storage cloud service providers	1	1	2	2	1	2	1
B. Cooperative integration projects	1	1	3	3	1	5	1
C. Call for establishment of a national eScience team	1	2	4	3	1	3	3
D. Cooperative adoption projects	1	1	4	2	2	6	3
E. International and national projects	2	1	4	2	2	2	2

Appendix A: List of national services and function blocks from IBM "Foundations for the Strategy" document assigned to cloud strategy group

IBM "Foundations for Strategy" document: Table 7; National Services assigned to Cloud Computing Strategy Group	
S-13	**Access to temporary computer resources:** The "Access to temporary computer resources" service gives authorized users easy access to computer resources for a limited period of time for the purpose of preparing academic papers. At the end of the specific period, the computer resources are made available to other users.
S-14	**Access to temporary storage resources:** The "Access to temporary storage resources" service gives authorized users easy access to storage resources for a limited period of time for the purpose of preparing academic papers. At the end of the specific period, the data are deleted and the storage resources are made available to other users.

IBM "Foundations for Strategy" document: Annex D.6; Description of Cloud Computing Functions Blocks from	
F-CC-1	on-demand server infrastructure (Infrastructure as a Service)
	Description:
	With a virtual server infrastructure, processing power can be used on an ad-hoc, flexible basis in the form of virtual servers.
	Virtual servers can be configured by the user and provisioned by entering the necessary attributes (CPU capacity, storage requirements, etc.)
	When the server is no longer required, the resources can be released.
	Main functionalities:
	Portal for access to and administration of the server infrastructure
	Access management/user administration
	Infrastructure maintenance
	Training using the infrastructure
F-CC-2	On demand storage infrastructure (Infrastructure as a Service)
	Description: (similar to F-CC-1, with "servers" replaced by "storage", and without mention of the specific provisioning attributes such as CPU capacity)
	Main functionalities: (equivalent to F-CC-1)
F-CC-3	Interface to HPC resources (high-performance computing)
	Description:
	Provisioning of interfaces with high-performance computing resources
	Main functionalities:
	Portal to high-performance computing resources (without setting up your own high-performance computing hardware)

Appendix B: Attributes of a cloud service as defined by the ETH Academic Compute Cloud Project

Attributes of a cloud service as defined by ETH "Academic Compute Cloud Project"	
Self-service	A consumer can unilaterally provision computing capabilities and has immediate access, such as server time and network storage, without requiring human interaction.
On-demand	As needed, at the time when needed, with the possibility of automatic provisioning. No long-term commitments, no up-front investments needed.
Cost transparent	Paying for effective usage only. Accounting of actual usage transparent to both user and service provider, measured in corresponding terms (Hours CPU time, GB per Month, MB Transfer, etc.)
Elastic, scalable	Capabilities can be elastically provisioned and released, to scale rapidly up and down, matching demand. To the consumer the capabilities might appear unlimited and can be appropriated in any quantity at any time.
Multi-tenant	The provider's computing resources are pooled to serve multiple consumers, with resources dynamically assigned and reassigned according to consumer demand.
Programmable	The services expose a public, programmable API that can be used to drive any aspect of the service programmatically, such that automated processes can be set up on top of the services.

Appendix C: Data quality dimensions to be considered for national cloud service providers

A cloud service provider (CSP) should respect intrinsic and extrinsic quality dimensions of information assets during the whole data lifecycle. By intrinsic data qualities, we mean the natural characteristics such as data authenticity and integrity. Extrinsic quality dimensions are therefore associated with contextual characteristics such as data accessibility and security.[24][25]

Quality dimension issues should be addressed through qualitative and quantitative approaches. Qualitatively, models should offer diagnostics and reporting information based on meticulous analysis of the cloud service monitoring. Quantitatively, information qualities must be measured by known indicators with established and reproducible processes and observable variables (see table below). The "quality" of a record means that it is what it purports to be and is free from tampering or corruption. A CSP should demonstrate how the authenticity requirement is met. They must detail the specification of the elements of form and context that need to be preserved in order to maintain the authenticity of a given type of electronic record. A CSP should demonstrate the techniques, processes, tools and technologies in place to persevere and maintain the "characteristic of a record that refers to the presence within it of all the elements required by the creator and the juridical system for it to be capable of generating consequences. With primitiveness and effectiveness, a quality presented by an original record".

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[24] Basma Makhlouf Shabou, 2011. "Measuring the Quality of Records to Improve Institutional Memory (http://www.linkedin.com/redir/redirect?url=http%3A%2F%2Fieeexplore%2Eieee%2Eorg%2Fstamp%2Fstamp%2Ejsp%3Ftp%3D%26arnumber%3D6087223&urlhash=iDmp), IEEE International Professional Communication Conference – Cincinnati, 17.10.2011 (http://goo.gl/P5w8Ef).

[25] The InterPARES 2 Project Glossary, 14.10.2013 (http://goo.gl/CzTCZl).

Data Qualities	Indicators for controlling information qualities in cloud options (IaaS)
Authenticity	• The quality of a record that is what it purports to be and that is free from tampering or corruption. • A CSP should demonstrate how authenticity requirements are met. It must detail the specification of the elements of form and context that need to be preserved in order to maintain the authenticity of a given type of electronic record.
Integrity	**Completeness** • A CSP should demonstrate the techniques, processes, tools and technologies in place to preserve and maintain the "characteristic of a record that refers to the presence within it of all the elements required by the creator and the juridical system for it to be capable of generating consequences. [Together] with primitiveness and effectiveness, [completeness is] a quality presented by an original record". **Traceability** 1. A CSP should be able to provide authorized persons with accurate information about who accesses what information and at what time precisely. 2. Back-up and redundant storage should be well documented.
Accessibility	**Continuous availability:** 1. Describe how the CSP will ensure technical, logical and physically permanent access to the cloud service and data in the cloud. 2. Specify remedies in case of cloud service interruption (a detailed formula that will be scheduled per period of time). **Appropriate availability:** 1. Describe the access control and tracking tools and mechanisms. 2. Manage the communities of authorized access properly (identification and traceability).
Security	**Accountability:** 1. Provide reliable policies, processes and 2. Designate responsible persons who will ensure the monitoring of cloud services and who will receive the questions of users. 3. Specify the third appropriate third party to provide a relevant audit certificate. **Data Protection:** 1. Describe the process, tools and techniques in place to respond to local, federal, European and international rules for disclosure of personnel and sensitive data. 2. Describe measures in place to avoid and prevent risks of disruption, such as redundant storage, restore mechanism, etc. 3. Data deletion should properly be operated and attested.

Program SUC 2013-2016 P-2 „Scientific information: Access, processing and safeguarding"

Strategy for national organization

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1. Ausgangslage

Gemäss den Programmzielen sollen Forschenden, Lehrenden und Lernenden eine möglichst grosse Menge an digitalen Inhalten von wissenschaftlicher Relevanz und optimale Werkzeuge für deren Verarbeitung zur Verfügung gestellt werden. Die Menge dieser Informationen, die Metadaten, Schnittstellen und Services sowie die nötigen Richtlinien und Standards, welche die Weiterentwicklung und die Finanzierung steuern, bilden die Serviceplattform, die im Rahmen des Programmes aufgebaut werden soll.

Die Umsetzung erfolgt durch Projekte, die von den berechtigten Institutionen [vgl. Kap. xx] im Rahmen einer starken und strukturierten Programmorganisation durchgeführt werden.

Im März 2013 wurde deshalb für die Laufzeit des Programms (2013-2016) eine Programmleitung eingesetzt. Da das Programm verschiedene Fachgemeinschaften zusammenführt, entschied man sich für eine Zweierbesetzung, welche die Qualifikationen in den Schlüsselbereichen IT (Infrastruktur) und Bibliothek (Content) kombiniert. Die Programmleitung rapportiert an den Lenkungsausschuss, der aus Mitgliedern beteiligter Hochschulen und Fachbereichen zusammengesetzt ist.

Die Programmleitung hat mit dem Aufbau eines Programm-Office begonnen. Sie ist beauftragt, durch die Nutzung sich bietende Synergien Mehrspurigkeiten zu vermeiden und ein besonderes Augenmerk auf Effizienz und Effektivität zu legen. Sie sorgt für die Bekanntheit sowie die nationale und die internationale Integration des Programms und macht dessen Beitrag an die Wissenschaftsgemeinde sichtbar.

2.   Zielsetzung

2017 sollen die vom Programm geförderten Vorhaben in einen nachhaltigen, finanzierbaren Betrieb der Serviceplattform münden. Der Aufbau einer nationalen Organisation mit einer stabilen Struktur und klaren rechtlichen Rahmenbedingungen ist deshalb Teil des Programms. Der Übergang von der Programmorganisation zu einer nationalen Organisation kann wie folgt dargestellt werden:
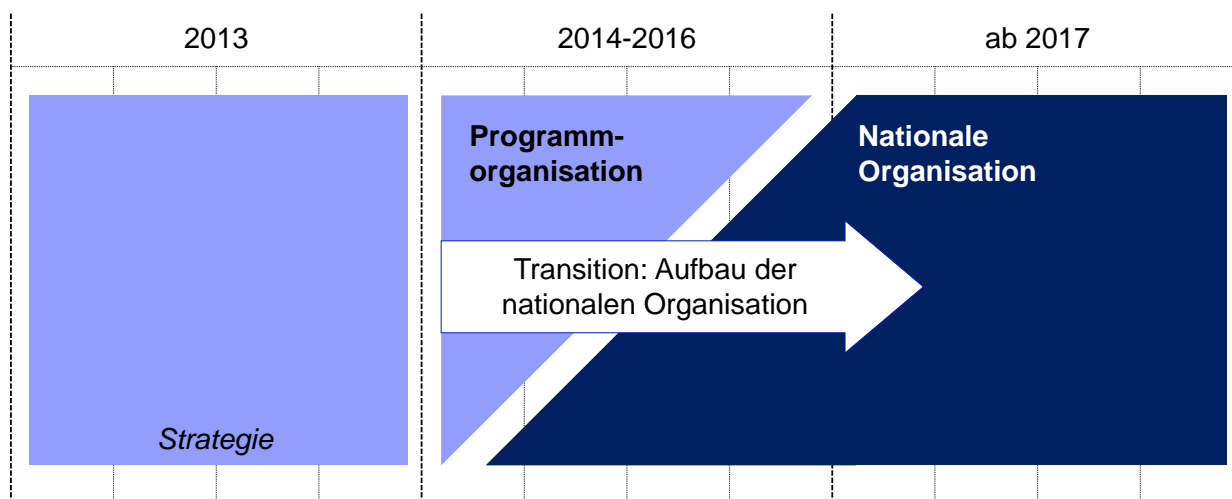

Abbildung 1

3.   Grundsätze

Die folgenden Grundsätze wurden als Voraussetzung für die Etablierung einer nationalen Organisation identifiziert:

a. In der Schweiz ist nur ein dezentrales Service-Modell erfolgreich, das sich auf freiwillige, kompetente Service-Anbieter mit hoher Akzeptanz stützt und den freiwilligen Bezug von Services erlaubt.

b. Die nationale Organisation ist eine schlanke, glaubwürdige Koordinationsstelle, die selber keine Services anbietet. Sie übernimmt nur Aufgaben, die zentral erledigt werden müssen.

c. Um den personellen Aufwand für die administrativen Aufgaben zu optimieren, sollte die nationale Organisation mit Vorteil einer bestehenden, gastgebenden Organisation angegliedert werden. Die nationale Organisation liegt im Zuständigkeitsbereich der SUK. Es liegt in der Kompetenz der SUK, sie einer Organisation anzugliedern.

d. Die nationale Organisation besteht aus einem administrativen Teil und Advisory Boards. Diese werden aus Experten der verschiedenen Stakeholder rekrutiert.

e. Ein Aufsichtsorgan steuert die Geschäfte der nationalen Organisation. Dieses kann sowohl ein eigenständiges Gremium als auch das Aufsichtsorgan der gastgebenden Organisation sein, falls es sich dabei um ein nationales Gremium handelt.

f. Die nationale Organisation ist zuständig für die Umsetzung und die Weiterentwicklung der Strategie. Dazu verfolgt sie die Entwicklungen am Markt und die internationalen Aktivitäten.

g. Die nationale Organisation definiert Grundsätze, Kriterien und Prozesse zur Bestimmung der Priorität von Services und Projekten und sorgt für deren Umsetzung.

h. Die nationale Organisation plant und koordiniert die ihr zur Verfügung gestellten Finanzmittel und teilt sie nach den Grundsätzen eines effizienten und effektiven Einsatzes zu. Sie setzt sich für die Gewährleistung einer langfristigen Finanzierungsbasis ein.

i. Die nationale Organisation definiert offene, stabile Schnittstellen und Richtlinien (Policies), die es erlauben, die Serviceplattform dynamisch weiterzuentwickeln. Sie sorgt für deren Umsetzung und Einhaltung.

j. Die nationale Organisation verwaltet den Servicekatalog der nationalen Services. Sie überprüft die Einhaltung der Dienstleistungsvereinbarungen (SLA) der Anbieter im Sinne eines Qualitätslabels.

k. Die nationale Organisation übernimmt Marketing- und Kommunikationsaktivitäten für die Serviceplattform.

l. Die nationale Organisation kann im Bereich „Wissenschaftliche Informationsversorgung" die Vertretung der Schweiz in internationalen Gremien übernehmen.

m. Projekte und Anträge für die Weiterentwicklung von Services werden von einem Expertengremium beurteilt, dessen Unabhängigkeit gewährleistet sein muss.

4.   Dezentrale Service-Organisation

4.1.   Dezentrale Service-Erbringer

Serviceerbringer können sämtliche Institutionen gemäss [Kap. xx] sein: Dienstleister, die bereits heute Aufgaben zugunsten der Hochschulen übernehmen (SWITCH, Konsortium der Schweizer Hochschulbibliotheken, u.a.m) sowie kommerzielle Anbieter. Letztere sollen nur in Ausnahmefällen (vgl. 1.3.b) von der nationalen Organisation direkt beauftragt werden. In der Regel werden Services indirekt über eine angeschlossene Institution angeboten.

4.2.   Nationale Organisation

Zentrale administrative Einheit

Um die in den Grundsätzen genannten Aufgaben zu erfüllen, müssen folgende Rollen besetzt werden:
- Geschäftsführung
- Service Management
    - Portfolio-Management
    - SLA-Management
    - Service Architekt
- Projektmanagement/Projektunterstützung

Advisory Boards

Für jeden Service resp. jede Servicegruppe wird ein Advisory Board eingesetzt, das für die strategische Entwicklung des Services resp. der Servicegruppe zuständig ist. Darin sind Experten der folgenden Anspruchsgruppen vertreten:

- Service-Erbringer
- Service-Bezüger
- Potenzielle Service-Erbringer und Kundengruppen in- und ausserhalb des Hochschulbereichs

Zusätzlich können internationale Fachleute berufen werden.

Organisatorische Verankerung

Die nationale Organisation soll einer Organisation angegliedert werden, die folgende administrative Unterstützung zur Verfügung stellen kann:

- Assistenz/Übersetzungen
- Kommunikation und Marketing/Outreach
- Finanzen und Controlling
- Rechtsdienst
- Personalwesen
- evtl. Beschaffung und Vertragswesen

Als gastgebende Organisation resp. organisatorischer Anker steht das Generalsekretariat der CRUS, resp. der zukünftigen gemeinsamen Rektorenkonferenz der Schweizer Hochschulen im Vordergrund.

4.3.   Aufsichtsorgan

Ein Aufsichtsorgan steuert die Geschäfte der nationalen Organisation. Das Aufsichtsorgan wird von der SUK eingesetzt, die den strategischen und finanziellen Rahmen verantwortet. Es ist zuständig für die Entwicklung des Programmes und entscheidet über die Finanzierung von Projekten und Services. Es kann ein eigenständiges Gremium oder das Aufsichtsorgan der gastgebenden Organisation sein, falls es sich dabei um ein nationales Gremium handelt.

Zur Laufzeit des Programms wird diese Rolle vom Lenkungsausschuss des Programmes wahrgenommen.

4.4.   Expertengremium

Das Expertengremium begutachtet Projektanträge und Anträge für den Betrieb von Services. Es erarbeitet Empfehlungen für die Bewilligung von Finanzmitteln zuhanden des Aufsichtsorgans. Zur Erweiterung des Fachspektrums und zur Vermeidung von Interessenkonflikten können zur Begutachtung zusätzliche Expertisen eingeholt werden.

5.   Internationale Referenzen

Für die erfolgreiche Verankerung einer nationalen Organisation sind die föderalistischen Strukturen der Schweiz zu berücksichtigen. Die Kenntnisnahme der Entwicklungen in anderen föderalistisch organisierten Staaten wie z.B. Deutschland ist deshalb wertvoll. Beim Vergleich von Lösungen ist Faktoren wie den unterschiedlichen Grössenverhältnissen oder der Mehrsprachigkeit in der Schweiz Rechnung zu tragen.

6.   „Action Items"

6.1.   Klassifizierung von Services

Etablierung einer Klassifizierung von Services mit dem Ziel, diese als Mittel der Priorisierung zu verwenden. Eine erste Version muss bereits für die erste Evaluation im Rahmen des Programmes zur Verfügung stehen.

6.2.   Evaluationsprozess und Expertengremium

Etablierung eines Evaluationsprozesses und von Evaluationskriterien für die Auswahl und die Finanzierung von Projekten und Services sowie den Aufbau eines Expertengremiums. Eine erste Version muss bereits für die erste Ausschreibung im Rahmen des Programmes zur Verfügung stehen.

6.3.   Regelung betreffend Eigenleistungen

Etablierung einer Regelung betreffend Eigenleistung der beteiligten Institutionen für die Finanzierung von Projekten. Eine erste Version muss bereits für die erste Ausschreibung im Rahmen des Programmes zur Verfügung stehen.

6.4.   Advisory Boards

Aufbau der Advisory Boards im Rahmen der Inbetriebnahme von Services.

6.5.   Aufbau der nationalen Organisation

Aufbau der nationalen Organisation, ausgehend vom Programm-Setup mit Programm-Office, Lenkungsausschuss und Expertengruppe. Schrittweise Klärung der allfälligen Angliederungsmöglichkeiten, Zuständigkeiten und Prozesse.

6.6.   Aufbau des Aufsichtsorgans

Festlegen der Zuständigkeiten und Prozesse und Rekrutierung der Mitglieder, falls keine Gastorganisation mit einem geeigneten Aufsichtsorgan eingesetzt werden konnte.

7.   Finanzierung

7.1.   Umsetzungskosten

Zur Laufzeit des Programmes muss der Betrieb des Programm-Office mit ca. 3 FTEs und Gesamtkosten in der Grössenordnung von 500kCHF pro Jahr finanziert werden. Dies beinhaltet Ausgaben in den Bereichen Marketing und Kommunikation, Durchführung von Veranstaltungen, Reisen, rechtliche Abklärungen, Unterstützung im Bereich Organisationsentwicklung u.ä.

7.2.   Betriebskosten

Für die Betriebsphase ab 2017 ist abhängig vom Erfolg des Programmes mit vergleichbaren, evtl. steigenden Kosten zu rechnen. Falls die nationale Organisation keiner Gastorganisation angegliedert werden kann, ist mit zusätzlichen Kosten zu rechnen.

8.   Umsetzungsplan und Risiken

Die Programmleitung setzt zuhanden des Lenkungsausschusses die Action Items laufend um. Sie bringt die Erfahrungen des Programmes ein und optimiert die Implementierung entsprechend.

Die Risiken des Aufbaus der nationalen Organisation sind dieselben wie diejenigen des Programmes: gelingt es nicht, genügend erfolgreiche Services, Kundenakzeptanz und die Serviceplattform aufzubauen, ist eine nationale Organisation obsolet.

8.   Umsetzungsplan und Risiken