

Recommendations for Data Stewardship Skills, Training and Curricula with Implementation Examples from European Countries and Universities

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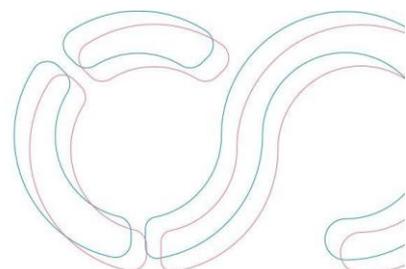
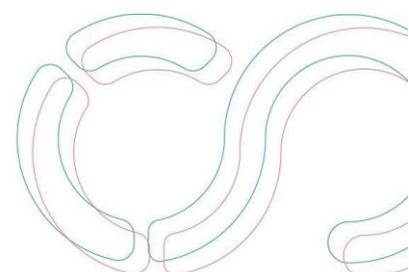


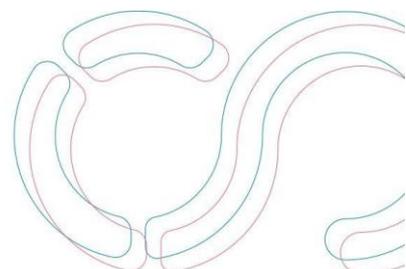
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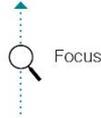


Summary

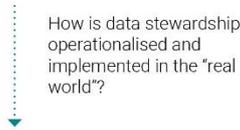
Recommendations for Data Stewardship Skills, Training and Curricula with Implementation Examples from European Countries and Universities



Data Stewards



EOSC Association Task Force
"Data stewardship, curricula and career paths"



Priority areas
(European / national / institutional)

- Skills, roles, and competencies
 - Context
- Training and curricula

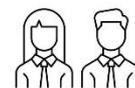


Report



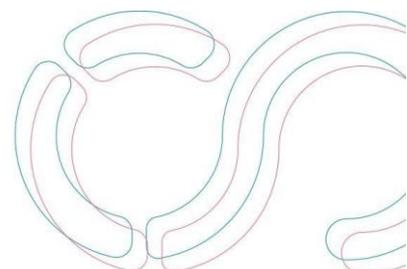
Recommendations
(Based on implementation cases)

-  • Competencies training and curricula for data stewards
-  • Curricula and training for researchers, funders and decision makers
-  • Career paths
-  • Policies, data stewardship communities and networks



17
European and national policymakers,
funders and governments

13
Research Performing Organizations



Executive summary

Data stewards, who plan, manage and maintain the data of a research unit, are skilled professionals essential in bringing about a culture change for data management, sharing research data, and developing infrastructures and data policies. At present, this essential role is not supported by validated curricula which produce individuals with the competencies, skills and capabilities the research community desperately needs to manage data.

In this report, the EOSC Association Task Force “Data stewardship, curricula and career paths” identifies how data stewardship is operationalised and implemented in the “real world”. Using implementation cases as the foundation for our recommendations, we move beyond literature and landscaping studies and build on practical experiences, including potentials, challenges and barriers to data stewardship.

Three priority areas form the major themes of this report, which are exemplified on European, national, and institutional levels are the following:

- **Skills, roles, and competencies:** How to develop a competency profile for core data stewardship activities and define training levels needed by the different data steward roles in and outside the EOSC ecosystem.
- **Context:** models and landscape: The role(s) of data stewards, their core activities, possible specialisations, or extension activities are defined in the context in which these roles operate.
- **Training and curricula:** Produce guidelines for data stewardship curricula, which could include university curricula and short training, but ultimately as a sustainable training structure that can live on after the work of the task forces has been completed.

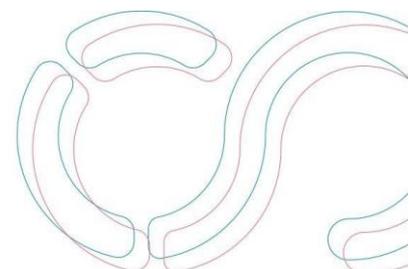
The report includes 17 Recommendations for European and national policymakers, funders and governments and 13 Recommendations for Research Performing Organizations on competencies training and curricula for data stewards; curricula and training for researchers, funders and decision makers; career paths; policies, data stewardship communities and networks.

Whilst this report recommends approaches to curriculum and profile development, there are still barriers and leverage opportunities to overcome at the local level of implementation. Therefore, our recommendations are directed at decision-makers at the managerial and administrative levels, who can consult, coordinate and nudge recommendations into action.

Recommendations for European and national policymakers, funders and governments

Competences, training and Curricula for data stewards

- Harmonize core data stewardship competencies on the European and international levels.
- Support the implementation of aligned European curricula (including certification) for data stewards.
- Commit to the education of data stewards in institutional, national and European open science and data policies and strategies.



- Promote comprehensive mainstreaming of open science skills and competencies, including training in research data management and programs for professional profiles in data stewardship.
- Recognise and invest in advanced education and the professionalisation of roles in data science and data stewardship tailored to different research and innovation domains.
- Provide accredited training of professionals to operate the EOSC and data ecosystem effectively and successfully.

Curricula and training for researchers, funders and decision-makers

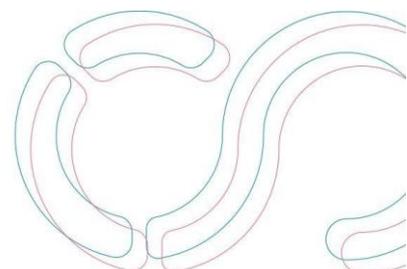
- Support the implementation of a core curriculum for data stewardship for researchers as a core element in research programmes.
- Provide parallel curricula on open science, EOSC and data lifecycle for funders and decision-makers to keep up the conversation on national open science practices, the benefits of FAIR research data management and the importance of collaborative science in the research community while highlighting the unique advantages EOSC holds for researchers.

Career paths

- Establish proper career paths for research support professionals, e.g. provide data stewardship training as an alternative career path for junior researchers to ensure the combination of high-level specialist domain knowledge and technical skills that will stimulate a dynamic research/support environment and supply much-needed skills for a research career both within and outside academia.
- Create enabling conditions for institutions and research communities to allow continuous learning on data stewardship-related topics.
- Support collaboration between Research Data Management (RDM) services, service centres and data stewards at institutions and provide clarification of the respective roles within institutions.

Policies and networks

- Strengthen European and national open science and EOSC-related policies in FAIR data literacy and data science and data management professionals, including respective skills and competencies and their recognition, training, and curricula.
- Support and promote bottom-up alliances of universities from across Europe developing data stewardship training and curricula whose objectives are empowering the education system and contributing to the international competitiveness of universities in Europe.
- Develop and promote national and European EOSC Skills and Training Ambassadors and Leadership programmes to advise decision-makers.
- Coordinate and align skills, curricula and training programmes nationally and on the European level. In the long term, create national coordination bodies that are representative of national infrastructures and can interact with national and European institutions on their behalf.
- Establish the cost of data management, data stewardship, maintenance and preservation of research outputs (including software and semantic artefacts) as eligible within European and national funding schemes.



- Fund training schemes for data stewards within research projects.

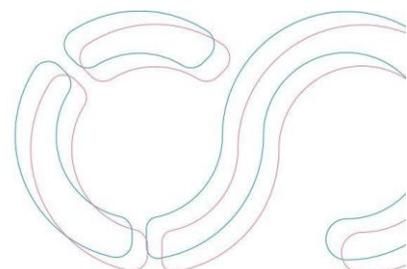
Recommendations for Research-Performing Organizations

Curricula and career paths for data stewards

- Include and commit to educating data stewards in institutional and national open science and data strategies.
- Support the continuous development of dynamic curricula that develop according to the surrounding research community. Dynamic curricula can be developed through mentoring programmes, the collaborative organisation of researcher training workshops, fostering connections with other data stewards working within and beyond the university, and the collaborative design of a project to offer domain-specific embedded data stewardship support at the university.
- Develop curricula and career paths for data steward profiles in policy, research, data and infrastructure, and as agents of change, i.e. skills to champion data stewardship across an organisation in political, technical and research contexts.
- Develop and implement curricula that address the data steward's technical and soft skills. Soft skills, such as teaching, mediation, communication and team management, are valued across stakeholders, domains, data steward profiles and service development - generic data stewards in advisory positions or data stewards embedded in research projects and other data workflows.
- Experiment with innovative teaching pedagogies, which increase the availability and effectiveness of training programmes, such as online and blended learning, cases from industrial partners, internships and on-demand learning. Provide flexible data steward training.
- There is a need for data stewards in local language communities and English-speaking industries in the labour market. We recommend that the curricula include elements anchored in disciplinary areas with either a national- or English-language conceptual world. In this way, the graduates are prepared to work as data stewards in companies and organisations, regardless of language.
- Create partnerships on data stewardship training and curricula, build on competencies and knowledge in existing communities, and establish education and training programs.

Many skills and application contexts can be included in data stewardship curricula. Examples are:

- IT competencies: data modelling, data management, automatised data collection, cleaning and storing data, infrastructure, data science and machine learning.
- Legal and ethical competencies: GDPR, FAIR, security, data ethics and ethics in Artificial Intelligence, data and cybersecurity.



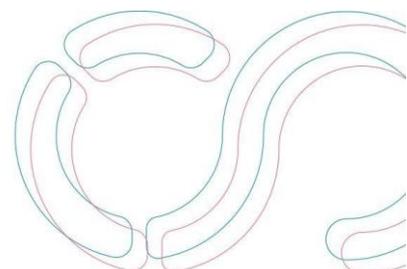
- Disciplinary-specific data competencies: knowledge about data and metadata, systems and data practice in the social sciences, health, natural and bio-sciences, law or arts and humanities. Disciplinary courses can also reflect branches of industry.
- RDM and open science, including FAIR data in the research data lifecycle (metadata for researchers; open access; OpenRefine and Tidy Data, particularly in-depth "hands-on" training on FAIR data management and its open access sharing through interaction with tutors and the respective research groups.) and RDM Support, including data stewardship in practice: project work.

Data stewardship communities and networks

- Support the development and professionalisation of research data stewardship nationally by establishing a national data stewardship network; to professionalise, embed and create sustainable career pathways for the role of the data steward within the national landscape and develop a national approach to data stewardship training informed by best practices internationally.

Implementation in the Research Performing Organizations

- Ensure skills in curating, preserving and disseminating national data assets and the continued growth and development of local research.
- Focus on domain-specific support for researchers.
- Provide peer-to-peer learning, structured onboarding, on-the-job training, training the trainer and apprenticeships on data stewardship.
- Provide the technical infrastructure, so data stewards can "practise what they preach".
- Facilitate cross-faculty discussions and provide systematic and continuous capacity building on open science concepts and practices, including broad comprehension of the open science guiding principles and core values as well as technical skills and capacities in digital literacy, digital collaboration practices, data science and stewardship, curation, long-term preservation and archiving, information and data literacy, web safety, content ownership and sharing, as well as software engineering and computer science.



1. Background and Methodology

Desk analysis and case studies approaches were used to identify the elements of best practices that can be followed by policymakers, funders and Research Performing Organizations and to formulate recommendations to that effect.

The Task Force members crowdsourced the initial list of documents ranging from reports to course descriptions. These documents were analysed using the priority themes matrix - skills, roles and competencies; context: models and landscape; and training and curricula.

The Task Force and EOSC Association members contributed ten national implementation case studies from Austria, France, Hungary, Italy, Latvia, the Netherlands, Spain, Sweden, Switzerland and the UK and seven institutional case studies from Copenhagen University, Denmark; ETH Zurich, Switzerland, Universitat de Barcelona and Universidad Pablo de Olavide, Spain; University College Cork, Ireland; University of Bologna, Italy; and University of Vienna, Austria. These diverse “real world” examples include practical experiences, potentials, challenges, and barriers to data stewardship skills building, training, and curriculum development in institutional and national contexts. Similar and related experiences and topics were grouped and summarised to formulate the recommendations.

Initially, the Task Force considered including case studies from Research Infrastructures (RIs), but with only two RIs as members it was hard to get a full picture and this angle could be taken up in the following studies.

2. European Policy Landscape

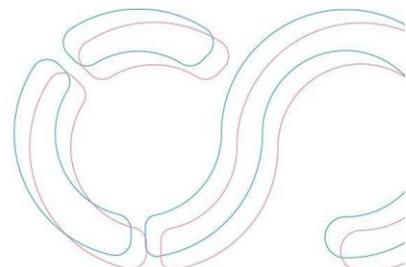
2.1 European Year of Skills and new initiatives to empower research careers and to strengthen the European Research Area

Ursula von der Leyen, the president of the European Commission, declared 2023 as the [European Year of Skills](#), putting skills at the heart of the EU policy debate. During the European Year of Skills, the Commission, the European Parliament, Member States, social partners, public and private employment services, chambers of commerce and industry, education and training providers, workers and businesses will work together to promote skills development, thereby improving professional and life opportunities for people. The European Year of Skills will help address the skills gap by leveraging national efforts and highlighting existing and new EU initiatives, including EU funding possibilities, to support their take-up and promote the organisation of skills-related activities and events across the EU.¹

In July 2023, the Commission unveiled a comprehensive set of measures targeted at strengthening the [European Research Area](#) (ERA) that includes²:

¹https://year-of-skills.europa.eu/news/commission-welcomes-political-agreement-european-year-skills-2023-03-07_en

² New initiatives to empower research careers and to strengthen the European Research Area



- A proposal for a Council Recommendation that establishes a new European framework for research careers;
- A new Charter for Researchers, replacing the 2005 Charter and Code for Researchers with new and revised principles;
- The European Competence Framework for Researchers (ResearchComp)³, to support inter-sectoral mobility of researchers.

2.2 The Strategic Research and Innovation Agenda (SRIA) of EOSC

FAIR skills and data stewardship competencies form a part of the EOSC Interoperability Framework. In 2021, the report “Digital Skills for FAIR and Open Science” from the EOSC Executive Board Skills and Training Working Group (Digital Skills for FAIR and Open Science, 2021) and provided recommendations along four priority areas:

1. Developing the next generation of FAIR and open science professionals
2. Collaborating to enhance digital skills for FAIR and open science in Europe
3. Building a trusted and long-lasting and trusted knowledge hub of learning and training resources and related tools
4. Influencing national open science policy for skills by supporting strategic leaders

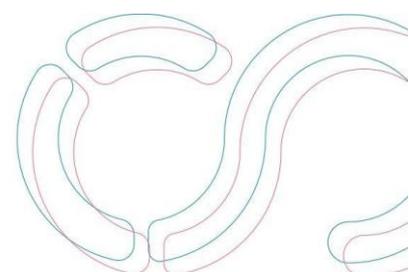
Building on this report, the Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC) Version 1.1 – 1 November 2022 defines data stewardship as “support offered at all levels to researchers and institutions by expert data stewards with respect to the management of data”. Lack of a clear definition of data professional profiles and career paths for these roles, fragmentation in training resources, and quality and FAIRness of training and learning resources were mentioned as gaps and challenges, and a coordinated and coherent approach is needed to address these gaps. (SRIA, 2022)

SRIA Priority Developing the next generation of open science and data professionals include the following actions (SRIA, 2022):

- “Enhance professional data career paths with appropriate rewards and recognition.
- Develop data skills profiles through community understanding and consensus mechanisms.
- Recognise data skills.
- Provide a quality assurance framework and certification mechanisms for trainers and trainees.
- Facilitate and simplify lifelong learning mechanisms for up-skilling.

https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3807

³ ResearchComp: The European Competence Framework for Researchers https://research-and-innovation.ec.europa.eu/jobs-research/researchcomp-european-competence-framework-researchers_en



- Establish Data Stewardship Competence Centres (DSCC) by establishing cross-disciplinary and cross-national networks of experts, leveraging existing international models.”

SRIA also calls to establish the cost of data management, data stewardship and maintenance of research outputs (including software) as eligible within national funding schemes.

The number of national education systems that recognise European curricula for data stewardship is one of the SRIA key performance indicators, to have five by 2025.

The “European Research Data Landscape” report, published by the Directorate-General for Research and Innovation (DG RTD) in November 2022 (European Research Data Landscape, 2022), highlighted that researchers expect to find professionals within their institution for managing, sharing and making their data FAIR. For this reason, the study encourages the development of “a minimum EU curriculum” and a “professional cooperation of data stewards with the relevant EC projects, Research Data Alliance working groups and EOSC task forces” to skilled staff and ensure an adequate level of expertise.

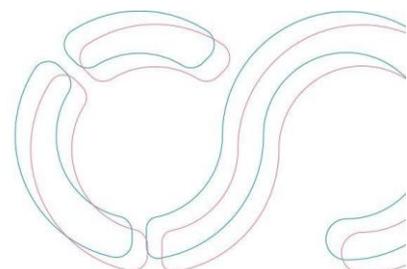
The Opinion paper on EOSC FAIR data literacy by the EOSC Steering Board expert group, published in December 2022, identified the following short-term objectives by 2024 with specific recommendations for implementation of EOSC FAIR-data literacy at the European level and recommendations for EOSC implementation on a national level and institutional level:

1. Open data skills and competence for researchers at all career stages accelerate a stable and solid increase of open research data shared in line with the FAIR principles and re-usage of existing data.
2. Sustainable support for researchers is provided in their activities by profiles of data science and data management professionals with well-defined roles and responsibilities.
3. Mutual learning is widely practised in open science across Europe by creating respective networks and platforms.
4. Awareness of FAIR data and data literacy is widespread among the European, national, and institutional decision- and policymakers by nominating, educating, and training FAIR data / EOSC Ambassadors (Champions) selected among them. (Opinion paper on EOSC FAIR data literacy, 2022)

2.3 European University Association and “European Universities”

The need for support services on research data has also been mentioned by the European University Association survey respondents conducted in July 2021 among the European higher academic institutions from 36 European countries - “research data skills were only partially available”. Consequently, the recommendation was to “expand training in the key skills needed for the transition towards open science (e.g. data skills) for researchers and staff”. (Morais, Saenen, Garbuglia, Berghmans & Gaillard, 2021).

“European Universities” support this transition - bottom-up alliances of universities from across Europe with objectives to empower the education system and contribute to the international competitiveness of universities in Europe. The ambitious mandate of the EU alliances is to become



models of good practice to increase the quality, international competitiveness and attractiveness of European higher education. In accordance with the 13th action of the European Research Agenda Policy (2022-2024), focused on the transformation and upgrading of higher education institutions, European Universities are expected to make progress towards the institutional transformation and to identify a variety of successful models for modernisation at research and innovation level.

“Comprehensive mainstreaming of open science practices” is one of the modules envisaged for such a university transformation, and a vital component of this module is the development of open science skills and competencies, including training in research data management and programs for professional profiles in the field of data stewardship.

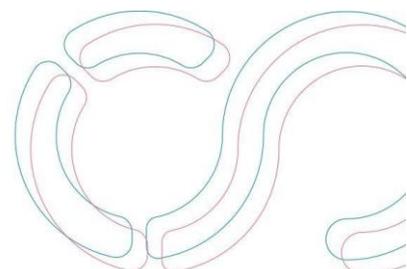
Via “European Universities”, the European Commission seeks to create a common mindset to open science expertise and capacity building in order to support the development of professionals in research data management.

2.4 UNESCO Recommendation on Open Science

On the international level, the UNESCO Recommendation on Open Science calls to provide “systematic and continuous capacity building on open science concepts and practices, including broad comprehension of the open science guiding principles and core values as well as technical skills and capacities in digital literacy, digital collaboration practices, data science and stewardship, curation, long-term preservation and archiving, information and data literacy, web safety, content ownership and sharing, as well as software engineering and computer science.” (UNESCO, 2021). It also recommends “agreeing on a framework of open science competencies aligned with specific disciplines for researchers at different career stages, as well as for actors active in the private and public sectors or in civil society, who need specific competences to include the use of open science products in their professional careers; and developing recognized skills and training programmes in support of the attainment of these competencies. A core set of data science and data stewardship skills, skills related to intellectual property law, as well as skills needed to ensure open access and engagement with society, as appropriate, should be regarded as part of the foundational expertise of all researchers and incorporated into higher education research skills curricula. And there should be investments in and promotion of advanced education and the professionalisation of roles in data science and data stewardship.” (UNESCO, 2021)

3. National Approaches

European countries are implementing policies and strategies to promote open science principles and data stewardship. These approaches include incentivising open science practices, promoting FAIR data and research integrity, providing training and support for researchers, developing data management plans, and creating roles for data stewards. However, challenges exist, including a lack of consensus on the skills, roles, and responsibilities of data stewards, insufficient funding and resources, issues related to intellectual property and data privacy, and a lack of incentives and career paths for data-related professions in academia. To address these challenges, countries are prioritising training in open science, capacity building, and human resource development, as well as



investing in resources and infrastructures. Case studies are provided in Appendix 1 to illustrate these challenges and priorities.

The text below provides a summary of all the national case studies developed by the Task Force providing high level highlights, describing challenges and priorities for the coming years. It can be viewed as an extra source of information, in addition to the country profiles and reports generated from National Tripartite Events⁴.

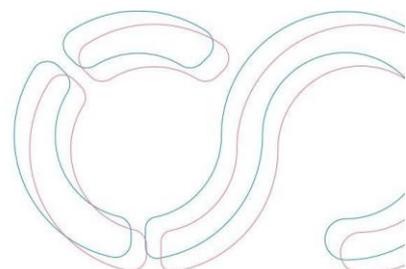
Austria has developed an open science policy⁵ that aligns with the Open Data and Public Sector Information Directive and is centred on providing incentives for the adoption of open science practices, defining implementation indicators, establishing links to EOSC, and featuring sections on FAIR data, research integrity, skills and education, and citizen science. Austria has also established a **national strategy for the development of data stewardship** solutions for the Austrian context. The strategy formalised as a toolbox presents data steward models, respective competencies, and available training to enable universities to choose the appropriate implementation strategy based on their preconditions and needs. **Challenges** to implementing data stewardship in Austrian universities include a lack of consensus on the skills, roles, and responsibilities of data stewards and funding data steward positions.

The **French** Ministry of Higher Education and Research has published the Second French Plan for Open Science (2021-2024)⁶, which aims to make research processes, publications, data, and source codes accessible to all without hindrance, delay, or payment. The Plan aims to triple the budget for open science from €5M to €15M per year, using the National Fund for Open Science and the Future Investment Programme. The plan's ambitions by 2024 include generalising open science practices, sharing research data and software, and making open science a daily practice. The implementation of these principles is expressed through the objectives and actions of the Committee for Open Science (COSO) and expert groups, which contribute to the implementation of measures set out in the National Plan for Open Science. To encourage the sharing and opening of data produced by French research, it was decided to open the national research data platform "Recherche Data Gouv. The ANR (French National Research Agency) also has an open science policy with three main components: promoting open access to scientific publications, access to and sharing of research data, and developing and promoting a concerted approach to open science. Challenges include the

⁴ The EOSC Tripartite Governance is a concept of strategic coordination between the EU represented by the Commission, the EOSC Association, and the Member States and Associated Countries involved in the EOSC Steering Board to resource and support the implementation of the EOSC environment in Europe, advancing an open science system and aligning national and EU policies to improve the production of FAIR research output: <https://eosc.eu/tripartite-collaboration>

⁵ Open Science Policy Austria <https://www.bmbwf.gv.at/dam/jcr:d0dad6b6-b94d-4e3e-8c4e-da12091be9b4/Open%20Science%20policy%20Austria%20eng..pdf>

⁶ Second National Plan for Open Science | 2021-2024 <https://www.ovvirlascience.fr/second-national-plan-for-open-science-2021-2024/>



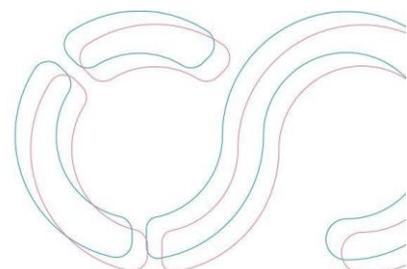
need to raise awareness of and promote training in open science, ensure compliance with data management policies, and address issues related to intellectual property and data privacy. The main priorities include promoting open access to publications and data, developing data management plans, and providing training and support for researchers.

In October 2021, **Hungary** released an official position paper on Open Science⁷, outlining its orientations towards scientific communication in the country, including open access to research outputs, research data management following FAIR and CARE principles, research integrity, next-generation metrics in research assessment, new types of rewards and initiatives, international cooperation networks, citizen science, education, and skills. The paper also specifies how signatories support the promotion of open access through various means, such as transformative agreements with publishers, gold open access journals, green route or self-archiving, and diamond open access, with CC-BY being the preferred license. The paper highlights the importance of research data management and recommends the development of a modern FAIR evaluation system for data management plans, the establishment of research data service platforms, and the launch of accredited training programs for data stewards. The paper stresses the need for capacity building and investment in human resources, training, education, and the enhancement of digital skills for new technologies to build Hungary's open scientific ecosystem. The University of Debrecen University and National Library coordinates the Hungarian Open Repositories working group and has been tasked with conducting open science training sessions within the national research institutions while also hosting online discussions to raise awareness of open science practices in Hungary. **Challenges include implementing the recommended changes, ensuring compliance with FAIR and CARE principles, and providing adequate resources and training for data stewards. Main priorities include promoting open access and research data management, capacity building, and human resource development.**

In June 2022, the **Italian** government published the "National Plan for Open Science" (PNSA)⁸, which aims to create conditions for Italy's full participation in European and international open science processes. The plan focuses on open access to publicly-funded publications, the FAIR data paradigm, research evaluation, open science and European participation, and opening research data on SARS-COV-2. The PNSA highlights the need for the development of an acquisition strategy for research data that must be "FAIR-by-design" and for the training and recruitment of qualified human resources such as "data scientists" and "data stewards." The plan also recommends the adoption of advanced research data management and services by national institutions and research infrastructures. **Challenges** include the automation of metadata acquisition, investments in resources and infrastructures, specific training, and legal management. The plan also emphasises

⁷ Position paper on Open science <https://nkfih.gov.hu/openscience/openscience-position>

⁸ Italian National Plan for Open Science https://www.mur.gov.it/sites/default/files/2023-01/PNSA_2021-27_ENG.pdf



the importance of collaboration and coordination at the national and European levels. The Italian Computing and Data Infrastructure (ICDI) and the Competence Centre (CC-ICDI) have been developed to support the implementation of the PNSA by promoting the culture and knowledge of the FAIR principles of data stewardship and open science through concrete actions, including structured training and support, consultancy, and tools and services development. The vision is to create a national coordination body that is representative of Italian infrastructures and interact with national and European institutions on their behalf.

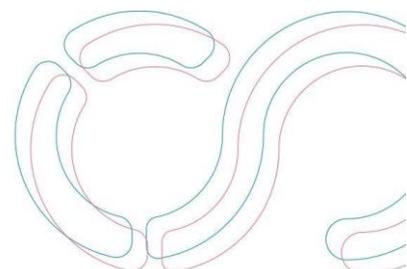
Latvia's Open Science Strategy 2021-2027⁹ aims to introduce standardised research data management practices throughout the data management cycle. The strategy emphasises improving the skills and knowledge of researchers about research data management rather than the implementation of specific digital tools. The introduction of Data Stewards, who develop general and field-specific data management skills, promote the use of e-Infrastructures and tools, help plan data management and complete data management plans (DMPs), and publish and archive research datasets, is encouraged, and dedicated funding has been allocated to build the data stewards network. The strategy envisages the implementation of mandatory requirements for researchers to develop data management plans for all projects of publicly funded research programs. Academic libraries and initiatives such as OpenAIRE National Open Access Service play an important role in improving the skills of researchers, and high-level skills competence centres are planned to be established in certain sectors. **Challenges:** The main challenge for Latvia in implementing its Open Science Strategy is the limited experience and knowledge of most researchers about research data management. The development of high-level digital skills as cross-cutting skills within the context of vocational education and higher education, including cyber security, work with big data, acquisition of digital technologies in the industry, and public administration services, is another challenge that needs to be addressed.

Priorities: To build a data stewards network and implement a Dataverse repository with funding from Latvia's Recovery and Resilience funds, aimed at making research data more accessible and reusable and offering research data management support. It is also essential to improve the researcher's skills and knowledge about research data management and promote the development of researchers' overall digital skills.

In **the Netherlands**, the development of open knowledge practice skills in the relevant scientific communities is one of the **priorities** in the National Programme Open Science [NPOS2030 Ambition document](#)¹⁰ with an overarching ambition: 'By 2030, scientific knowledge will be freely available, accessible, and reusable for everyone. Open Science in the Netherlands will be embedded as a standard practice across all scientific disciplines from basic to applied sciences, in the natural,

⁹ Latvian Open Science Strategy 2021-2027 <https://www.izm.gov.lv/en/media/17072/download>

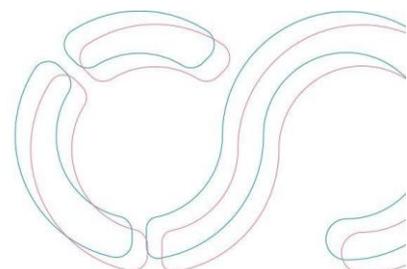
¹⁰ NPOS. 'Open Science 2030 in the Netherlands: NPOS2030 Ambition Document and Rolling Agenda'. Zenodo, 13 December 2022. <https://doi.org/10.5281/zenodo.7433767>



medical, social sciences and the humanities.’ In the Rolling Agenda of NPOS, 2030, the road to sufficient expertise and capacity in data stewardship is formulated in Objective 4.6: “In 2030, a professional community of well-trained data stewards has been established, and there is enough structural capacity (in FTEs, as well as in expertise) at Research Performing Organisations (RPOs) to facilitate making digital scientific objects FAIR. There is a nationally coordinated training programme for data stewards”. **Local and Thematic Digital Competence Centers** provide training, advice and practical support to researchers, data stewards and software engineers. [Three thematic Digital Competence Centers](#) bring together scientists in three 'domains': Life Sciences & Health, Natural and Engineering Sciences and Social Sciences and Humanities and strengthen digital competencies across Dutch science. **Professionalizing Data Stewardship**: The 2021 NPOS report [Professionalising data stewardship in the Netherlands: competences, training and education - Dutch roadmap towards national implementation of FAIR Data stewardship](#) gives tangible recommendations that help organisations with professionalising data stewardship related to job profiles for data stewards and research software engineers and to data stewardship training and education in HEIs and RPOs. As a first outcome, the data steward profile was implemented in the UFO, the Dutch job classification system for universities, in 2021. In the 2023 Workshop [Data Stewards Job Profiles: Build and Sustain Capacity for FAIR Implementation](#), stakeholders agreed that data stewards are nowadays well organised and easy to find in all RPOs. One of the **challenges** in formalising data steward job profiles is that the universities and some academic hospitals are more advanced than, for instance, the Universities of Applied Science. With regards to the availability of education and training of data stewards, there is still work to do, e.g. to set up acknowledged, certified professional education for data stewards. To attract and keep qualified data stewards, it would help to recognise data stewards’ efforts as part of the research team’s work. For the coming period, the **focus** should be on national recognition, increasing capacity and certification of data stewards training. The [Data Stewards Interest Group \(DSIG\)](#) aims to establish an **informal and inclusive community hub for data stewards** to share experiences and foster the (Dutch) national implementation of data stewardship following the distinctive hands-on and solution-oriented approach for practical matters. More recently, efforts have also been undertaken to establish job and competency profiles for **research software engineers** at RPOs in the Netherlands.

In **Spain**, “providing training to all personnel (researchers, managers, funders, evaluators) to align their professional performance with the principles of open science” is one of the objectives in the National Strategy for Open Science (ENCA) 2023 - 2027¹¹. Many open science practices are developed at an institutional and regional level. For instance, in Catalonia, the Consorci de Serveis Universitaris de Catalunya (CSUC) collaborates with universities and research systems to promote the adoption of European programs. CSUC provides research data management support services to help researchers write data management plans, make data FAIR (findable, accessible, interoperable,

¹¹ National Strategy for Open Science (ENCA) 2023 - 2027 https://www.ciencia.gob.es/dam/jcr:e5b759a4-d756-4af9-89b0-a8cf5fd28e20/ENCA_EN_acc.pdf



and reusable), and publish it in the appropriate repository. The CORA.Repository of Research Data (CORA.RDR), a federated and multidisciplinary data repository, is one of the tools provided by the CSUC. The CSUC offers practical self-learning labs for the publication of research data to the Technical Commission of CORA.RDR to help them curate the datasets published in CORA.RDR. One of the **challenges** is the need to “re-skill” library staff, as their needs regarding libraries are changing a lot based on the generalisation of digital and online information. One of the main **priorities** is to distinguish between advanced users, young researchers, and support staff from universities in open science training, following the guidelines of the European Commission Expert Group on FAIR data. Designing a program for awareness raising and continuous training is a medium-term activity in the National strategy “to educate teaching and research staff as well as institutions about the opportunities and challenges of open science, with a particular focus on members of assessment committees of major assessment agencies. The accreditation of doctoral degrees will include the assessment of transversal skills related to open science. Training in open science will be provided in the form of micro-credentials.”

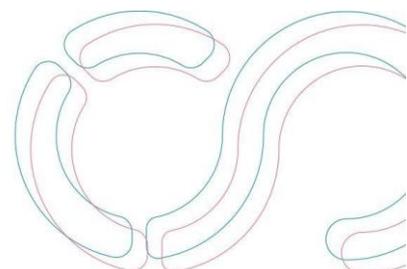
In **Sweden**, the goal of open access to research results was conveyed in the 2020 research bill stating that a transition to open access should be fully achieved by 2026 according to the principle “as open as possible, as closed as necessary”. The Swedish research council coordinates and promotes Sweden’s work on open access to research data, with a mandate implemented in consultation with bodies such as the national library of Sweden, the National Archives, the Agency for Digital Government and HEIs.

As of June 2022, the National Library has been charged by the Swedish government to produce national guidelines for open science. This includes identifying common goals and priorities, mapping out the roles that need to be included and defining the need for support and guidance. This will be accomplished in collaboration with other stakeholders, e.g. the Swedish Research Council, HEIs, governmental agencies and other relevant organisations. A report from the project will be available from January 2024. **The challenges** include unifying the national scene with regard to data stewardship, as well as raising the interest of national stakeholders and decision-makers. Most Swedish HEIs and several research-performing are members of a national network for the furthering of research data management; Swedish National Data Service. Today, a select few of the Swedish HEIs have employed Data stewards, but just recently, questions have been raised within the network, whether it would be useful to define the minimum common denominator of the tasks of a data steward and whether this network ought to coordinate a Swedish approach to the role of data steward.

Switzerland has developed a National Open Research Data (ORD) Strategy¹² that aims to make

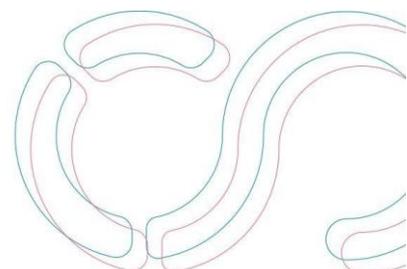
¹² Swiss National Open Research Data Strategy

https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Hochschulpolitik/ORD/Swiss_National_ORD_Strategy_en.pdf



publicly financed research data as open as possible, respecting disciplinary diversity, interoperable, internationally networked, and enabled to be sustainably financed. The strategy recognises the consolidation and strategic development of infrastructures and services, skill development, the sharing of best practices between researchers, and the development of supportive framework conditions for institutions and research communities as important objectives. An Action Plan has been developed that implements the objectives in concrete action areas and lines, covering the time period 2022 – 2028. As part of the action area focused on the development, promotion, and maintenance of sustainable ORD services and infrastructures, measures have been initiated to professionalise ORD specialists, particularly data stewards and related services. The goal is to establish professional data stewardship as a recognised career path by 2028, and a call for proposals was launched in 2022 for institutions to describe their ideas and intentions for building up data stewardship. Data stewardship implementation plans have been initiated by 25 Swiss higher education institutions in response to this call. Some of the **challenges and priorities** in implementing this strategy may include defining and establishing roles for data stewards and related ORD professionals, establishing best practices and standards, promoting collaboration between RDM services and data stewards, and sustaining financing for ORD solutions.

The **UK** Research and Innovation (UKRI) aims to lead the way in the implementation of open science, which is a core priority for the organisation. UKRI supports the adoption of open research through collaboration and alignment with national and international partners, and its ambition is to achieve an open research system that operates globally. Open access and open research data are key aspects of open research, and UKRI is taking a leading and coordinating role in overseeing the development of open research data policies, infrastructure, and services. UKRI recently published its open access policy for research articles and academic books, which aims to make published outputs of UKRI-funded research widely and freely accessible under conditions that allow maximum reuse. **However, weak incentives, practical barriers, and a lack of specialist support make the policy landscape challenging.** Variations in requirements set by different funding bodies, research organisations, and publishers also make it difficult to comprehend, and individual policies and services are not always well-attuned to disciplinary practices and cultures. Therefore, UKRI needs to develop policies, rewards, incentives, and the necessary digital research infrastructure to ensure open research and address key challenges. There is a need to increase public engagement and trust in research and promote the use of data to facilitate innovation and enhance the benefit it brings to citizens in the UK and beyond. To achieve these goals, all stakeholders must act to strengthen the incentives for researchers to create and use open research data, establish training programs for researchers in data management, analysis, and stewardship, provide specialist support services within research organisations and increase capacity in data stewardship, research software, and data science. Finally, coordinated efforts are needed to address deficits in skills and capability in data management and curation, develop capacity in data science, and establish good scholarly practice in the digital age.



4. Institutional Approaches

Universities practise different models of data stewardship education and training - from short workshops and on-demand learning, train-the-trainer activities and on-the-job training to certificate, master and postgraduate courses. All Institutional case studies are provided in detail in Appendix 2. The report includes an overview of a **one-year master's in Data Stewardship at the University of Copenhagen** that builds on three foundational competencies:

- i) IT competencies: data modelling, data management, automatised data collection, cleaning and storing data, infrastructure, data science and machine learning;
- ii) legal and ethical competencies and
- iii) disciplinary-specific data competencies.

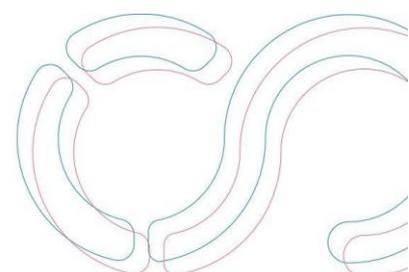
The master's programme will only be available for students with a bachelor's or candidatus degree from a university. Hence, graduates from vocational colleges cannot apply. The programme could beneficially be offered as an option for further or open university education.

Data stewardship could be an alternative job opportunity and career path for PhDs and PostDocs that will also fill the need for data support in the research team. The **Data Stewardship Network at ETH Zurich** is a service-oriented network of employees that already fulfil tasks in data stewardship and who want to extend these efforts or orient them more towards the openness of research data. In particular, this includes (1) ORD professionals and research data management specialists who are already employed at ETH Zurich specifically for those tasks and (2) ETH Zurich researchers (e.g., postdocs or senior scientists) with additional responsibilities related to research data management. Furthermore, a crucial step in professionalising data stewardship at ETH Zurich includes the tailoring of existing consulting services, training material, and guidance documents to the target group of data stewards and other ORD professionals in order to be able to implement a **"train-the-trainer" approach**.

Among other examples of **research support staff training** are the **"Open science: promotion, support and evaluation" course** taught at the Faculty of Information and Audiovisual Media of the **University of Barcelona** and the **postgraduate course on "Research support services: information, data, evaluation and scientific publication" at the Pablo Olavide University of Sevilla**.

Nationally, **data stewards in Ireland are supported by a mailing list, webinars and workshops to develop data stewardship skills** among staff in higher education institutions and other research-performing organisations. As of 2022, there is now a National Data Stewardship Network which will enable the development of data stewardship across the national landscape. **University College Cork offers self-guided units in Research Data Management and FAIR Data hosted on its online learning environment** and available university-wide, **supported by regular in-person and online classes**. Contributions to other undergraduate and postgraduate modules across a range of disciplines have also been made regularly. The "PaPOR Trall: Principles and Practices of Open Research" Open Educational Resource (OER) includes research data management and FAIR and targets undergraduate and postgraduate programmes.

Similarly, **at the University of Bologna, the training of the data stewards was conducted in the first**



month after their recruitment. The training was a **combination of a series of online courses and resources together with lectures and a train-the-trainer course.** The training plan and materials are the basis for building the training of new data stewards. Each data steward is expected to train a new colleague within a series of regular meetings.

As there was no formal training programme for data stewards available in Austria at the time, **Vienna University Library developed a formal further education program – the [certificate course “Data Steward”](#) – alongside a new network of data stewards embedded on the level of individual faculties.** The course has three main objectives: competence acquisition, peer-to-peer learning, and community building. It consists of five obligatory modules and takes two semesters part-time:

- Module 1 (2 ECTS): Basics of Research Data Management and open science
- Module 2 (3 ECTS): Basics of IT and Data Science
- Module 3 (6 ECTS): FAIR Research Data in the Research Data Lifecycle
- Module 4 (2 ECTS): RDM Support
- Module 5 (2 ECTS): Data Stewardship in Practice: Project Work.

5. Collaborations and next steps

5.1 Crowdsourced registry/directory of data stewardship training

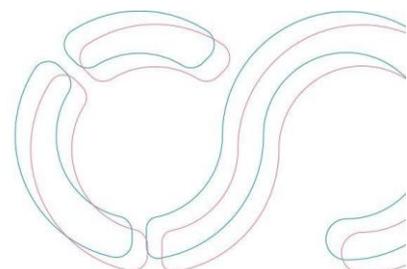
A crowdsourced registry/directory of data stewardship training (for example, following the model of the [Digital Humanities course registry](#)) would be a useful resource. Everyone will be able to submit a course, and national curators/validators will check the record and confirm the maturity state. This could be done in collaboration with the EOSC Future and Skills4EOSC. Mandated Organisations in the EOSC Association could play a national curation role, and EOSC Observatory could be the source of up-to-date information.

5.2 Professionalising Data Stewardship Interest Group, Research Data Alliance

The [Professionalising Data Stewardship Interest Group](#) is dedicated to increasing collaboration within and outside the Research Data Alliance (RDA) community around the promotion of data stewardship as a dual professionalisation concept of being both a professional (e.g. data steward, data manager, data scientist etc.) and a service (advisory/training, different repositories, competency centre etc.). It focuses on sharing good practices, initiatives, and projects that could help research organisations in professionalising data stewardship.

Collaboration and coordination with the EOSC Task Force on Data Stewardship Curricula and Career Paths:

- Some EOSC Task Force members also participate in the Interest Group, ensuring coordination and collaboration.
- This report builds on the Interest Group outputs (“RDA Professionalising Data Stewardship - Current Models of Data Stewardship” (Ayres et al., 2022) and “What gaps in training do Data



Stewards face when trying to support the needs of researchers?” (Rantasalo & Wildgaard, 2022) reports) and will feed into the future Interest Group activities.

- The Research landscape of data stewardship training and Data Steward Career Tracks Interest sub-groups could provide input to the EOSC Association’s activities.
- A shared discussion space enables an aligned approach to professionalising data stewardship in Europe and globally.

5.3 Skills4EOSC

The aim of [Skills4EOSC](#) is to unify current training for stakeholders working with data in the context of open science, EOSC and FAIR. The project intends to build and coordinate a network of competence centres or initiatives that can function as a central competency hub in partner countries. Further, the project will raise awareness for an EOSC-skilled European workforce and propose a FAIR-by-design approach to the development of teaching and learning materials, particularly curricula and syllabi for Train the Trainer programmes and sessions at competence centres.

Skills4EOSC will run between August 2022 and August 2025.

The key concepts Skills4EOSC will address are:

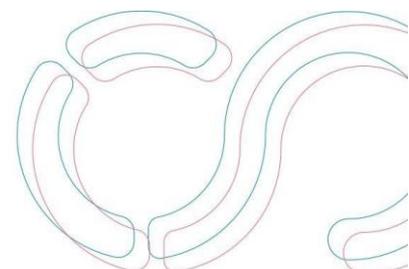
- Fair by design - fair and open approach to the creation and further development of curricula and syllabus
- Define minimal viable skill sets for stakeholders in different contexts. These stakeholders are legal experts, data stewards, policymakers, civil servants, institutions (undergrads, PhD, data stewards, data librarians, data curators, legal and ethical experts, researchers), research infrastructures & thematic communities, and professional and peer networks.
- Train the Trainer - design learning paths for trainers working in a FAIR, open science and Data Management context. The materials will be tested in pilots, but it is not an output to train a certain number of trainers an output
- Harmonise curricula and learning paths across different ESFRIs and disciplinary initiatives
- Support lifelong learning through the creation of professional networks
- Build and coordinate competence centre networks
- Recommend tools for competence centres - a training platform, a shared workplace for sharing materials and more that the competence centres can keep and develop after the Skills4EOSC project is over

The EOSC Association Task Force “Data stewardship, curricula and career paths” has topics in common with Skills4EOSC but is tackling them from different perspectives.

Skills4EOSC will provide information, share knowledge and ideas and contribute with suggestions and recommendations to the EOSC Association's work.

Collaboration and coordination with the EOSC Task Force on Data Stewardship Curricula and Career Paths:

- Skills4EOSC representatives are invited to attend Task force monthly meetings in accordance with identified topics and discussion points.



- The Taskforce has requested Skills4EOSC identify a liaison person with an overview of the status of the many tasks and deliverables in Skills4EOSC. The liaison person regularly takes part in Task force meetings, identifies high-priority topics in Skills4EOSC we need to liaise on, and further invites the Task force members to Skills4EOSC meetings/events.
- There is also an opportunity to collaborate on the crowdsourced registry/directory of data stewardship training.

5.4 RITRAIN Plus

RltrainPlus has launched [seven short pilot courses](#) (16-32 hours each plus individual work) of a brand-new management training programme for managers, operators and other professionals in a research infrastructure or core facility:

1. Managing the Lifecycle of a Research Infrastructure
2. Ethical, Legal and Social Implications in Research Infrastructure and Core Facility
3. Data management
4. Innovation, Entrepreneurship and Engagement with Industry
5. Socio-economic impact of Research Infrastructures
6. Team Building and Development
7. Coaching development program

The participant can take up either the whole programme and progress from one short course to the next or take an individual short course that best fits their needs. Courses are mostly offered as online intensive courses that take up 2-4 consecutive days. The courses are taught by experienced academics at RltrainPlus partner universities and institutions or invited international experts. The pilot short courses are offered free of charge, and the first courses start in June 2023.

Collaboration and coordination with the EOSC Task Force on Data Stewardship Curricula and Career Paths: There are Task force members involved in the RltrainPlus as well as the EOSC Association Board Member coordinating the project, so there are formats to facilitate the collaboration.

- Research Infrastructure case studies could enrich this report.

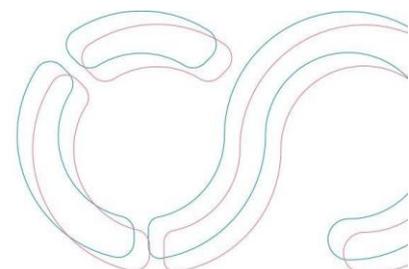
6. Next steps

This report could be supplemented with a crowdsourced curated registry/directory of data stewardship training in collaboration with Skills4EOSC and research infrastructure case studies in collaboration with RltrainPlus. Development of a European Core Curriculum and the related training initiatives would be useful resources as well. If you have comments or suggestions about the content, contact irynd.kuchma@eifl.net.

Conflict of Interest Statements:

All authors declare that they have no conflicts of interest.

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7. References

Ayres, B., Lehtsalu, L., Parton, G., Száldobágyi, Á., Warren, E., Whyte, A., & Zimmer, N. (2022). RDA Professionalising Data Stewardship - Current Models of Data Stewardship: Survey Report. Research Data Alliance. <https://doi.org/10.15497/RDA00075>

Bianchini, Federico, Fatima, Nazeefa, & Bösl, Korbinian. (2023). BioMedData Deliverable D3.3: Postgraduate curriculum for Data Stewards in Norway within the natural sciences (1.0). Zenodo. <https://doi.org/10.5281/zenodo.7689715>

European Commission, Directorate-General for Research and Innovation, (2022). European Research Data Landscape: final report, Publications Office of the European Union. <https://data.europa.eu/doi/10.2777/3648>

European Commission, Directorate-General for Research and Innovation, (2021). European Research Area Policy Agenda – Overview of actions for the period 2022-2024. https://research-and-innovation.ec.europa.eu/system/files/2021-11/ec_rtd_era-policy-agenda-2021.pdf

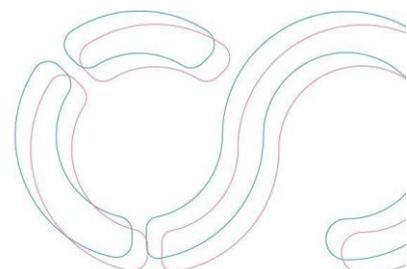
European Commission, Directorate-General for Research and Innovation, Opinion paper on EOSC FAIR data literacy, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/716842>

European Commission, Directorate-General for Research and Innovation, Manola, N., Lazzeri, E., Barker, M., et al., Digital skills for FAIR and Open Science: report from the EOSC Executive Board Skills and Training Working Group, Manola, N. (editor), Lazzeri, E. (editor), Barker, M. (editor), Kuchma, I. (editor), Gaillard, V. (editor), Stoy, L. (editor), Publications Office, 2021, <https://data.europa.eu/doi/10.2777/59065>

EOSC Association, (2022). Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC). EOSC Partnership. <https://eosc.eu/sria>

Federer., L. (2018). Defining data librarianship: a survey of competencies, skills, and training. Journal of the Medical Library Association. <https://doi.org/10.5195/jmla.2018.306>

Jetten, M., Grootveld, M., Mordant A., Jansen, M., Bloemers, M., Miedema, M., & Van Gelder, C.W.G. (2021). Professionalising data stewardship in the Netherlands. Competences, training and



education. Dutch roadmap towards national implementation of FAIR data stewardship (1.1). Zenodo. <https://doi.org/10.5281/zenodo.4623713>

Jetten M., Schoots F. (2023). [Community building via the DTL Data Stewards Interest Group \(DSIG\)](https://doi.org/10.3233/FC-230503), FAIR Connect 1, 71–74 <https://doi.org/10.3233/FC-230503>

Hasani-Mavriqi, I., Reichmann, S., Gruber, A., Jean-Quartier, C., Schranzhofer, H., & Rey Mazón, M. (2022). Data Stewardship in the Making (1.0). Graz University of Technology. <https://doi.org/10.3217/p9fvw-rke48>

Helling, P., Rau, F., Linne, M., Dierkes, J., Jetten, M., Walek, A. & Szufliita-Żurawska, M. (2022). The Importance of Demand and Environment for Defining and Establishing the Role of Data Stewards. International FAIR Convergence Symposium. Zenodo. <https://doi.org/10.5281/zenodo.6511185>

Kvale, Live, Bochynska, Agata, Ostrop, Jenny, Sundstøl, Shea Allison, Pharo, Nils, Sarre, Aili, Arnesen, Sondre Strandskog, Stangeland, Elin, Bertheussen, Lene, & Enerstvedt, Kjersti. (2023). Competency Framework for Research Data Services in Norway (1.0). Zenodo. <https://doi.org/10.5281/zenodo.7762739>

Morais, R., Saenen, B., Garbuglia, F., Berghmans, S. & Gaillard, V. (2021). From principles to practices: Open Science at Europe's universities, 2020-2021 EUA Open Science Survey results. <https://eua.eu/downloads/publications/2021%20os%20survey%20report.pdf>

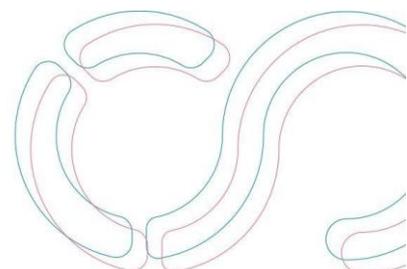
National Coordination of Data Steward Education in Denmark: Final report to the National Forum for Research Data Management: <https://zenodo.org/record/3609516>

National Open Research Forum. (2022) National Action Plan for Open Research, Digital Repository of Ireland [Distributor], Digital Repository of Ireland [Depositing Institution], <https://doi.org/10.7486/DRI.ff36jz222>

Rantasalo, J., & Wildgaard, L. (2022). What gaps in training do Data Stewards face when trying to support the needs of researchers? DOI 10.15497/RDA00076, https://www.rd-alliance.org/system/files/RDA-PDS-IG_Training_Landscape_Gaps-in-Data-Stewardship_Initial-Report_2022.pdf

Scholtens, S., Anbeek, P., Böhmer, J., Brullemans-Spansier, M., Van der Geest, M., Jetten, M. ... Van Gelder, C.W.G. (2019). Function and competencies matrices for three types of data stewards 'policy', 'research' and 'infrastructure' (Version 2.1). Zenodo. <https://doi.org/10.5281/zenodo.3239079>

Scholtens, S., Jetten, M., Böhmer, J., Staiger, Ch., Slouwerhof, I., Van der Geest, M. & Van Gelder,

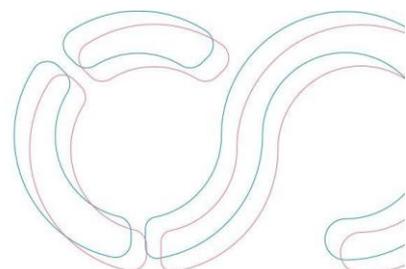


C.W.G. (2019, October 3). Final report: Towards FAIR data steward as a profession for the life sciences. Report of a ZonMw-funded collaborative approach built on existing expertise. Zenodo. <http://doi.org/10.5281/zenodo.3474789>

UNESCO, (2021). UNESCO Recommendation on Open Science. <https://unesdoc.unesco.org/ark:/48223/pf0000379949>

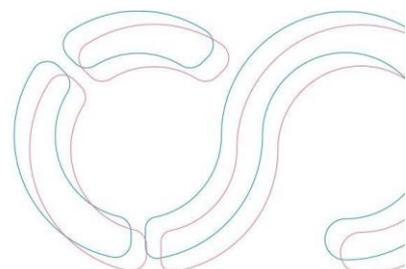
Verheul, I., Imming, M., Ringersma, J., Mordant, A., Van der Ploeg, J., Pronk, M. (2019). Data Stewardship on the map: A study of tasks and roles in Dutch research institutes <https://doi.org/10.5281/zenodo.2669150>

Whyte, A. and Ashley, K. (2017) EOSC pilot: D7.1: Skills landscape analysis and competence model. <https://eoscipilot.eu/content/d71-skills-landscape-analysis-and-competence-model>



8. Appendix 1: Task Force members

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- Chiara Basalti, Alma Mater Studiorum - Università di Bologna
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- Laetitia Bracco, Université de Lorraine
- Nathalie Claes, Katholieke Universiteit Leuven
- Constance Cournede, Université de Nantes
- Judit Fazekas-Paragh, University of Debrecen
- Monica Forni, Alma Mater Studiorum - Università di Bologna
- Francesca Frontini, CLARIN ERIC
- Joanna Janik, National Center for Scientific Research (CNRS)
- Małgorzata Galik, Jagiellonian University
- Celia van Gelder, DTL/Health-RI, co-chair
- Kim Gurwitz, European Molecular Biology Laboratory
- Illire Hasani-Mavriqi, Graz University of Technology, co-chair
- Tereza, Kalová, Vienna University Library, University of Vienna
- Iryna Kuchma, OpenAIRE, EIFL
- Dunja Legat, University of Maribor
- Hanna Lindroos, Swedish University of Agricultural Sciences
- Henry Luetcke, Eidgenössische Technische Hochschule Zürich (ETH) / Swiss Federal Institute of Technology in Zurich
- Joke Meeus, Fonds Wetenschappelijk Onderzoek Vlaanderen (Research Foundation Flanders)
- Magdalena Szuflińska-Żurawska, Gdańsk University of Technology
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9. Appendix 2: National Case Studies

9.1 Austria

Austria has established the necessary organisational structures to implement open science across all levels of its research activities. The country's major universities and research organisations have collaborated in various networks and consortia, with the EOSC Support Office Austria (EOSC SOA) as an active operational unit of the ACONET Association, the country's mandated organisation. The members of EOSC SOA work together to coordinate the development of the Austrian Open Science Policy and EOSC goals. Austrian institutions also participate in various EOSC-related Horizon Europe projects, including EOSC Focus and SKILLS4EOSC, where they contribute to the technical and organisational development of EOSC. The institutional support of the Federal Ministry for Education, Science, and Research (BMBWF) has been essential to the overall successful strategy.

After a consultation period of approximately two years with various stakeholders, including the Federal Ministries of Education, Science, and Research (BMBWF), Digitisation and Business Location (BMDW), and Climate Action, Environment, Energy, Mobility, Innovation, and Technology (BMK), Austria adopted its Open Science Policy on February 23, 2022¹³. The policy aligns with the Open Data and Public Sector Information Directive (EU 2019/1024) and is centred around providing incentives for the adoption of open science practices, defining implementation indicators, establishing links to EOSC, and featuring sections on FAIR data, research integrity, skills and education, and citizen science.

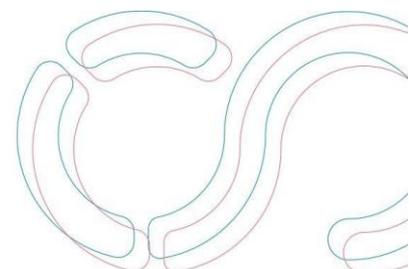
A national strategy for the Development of data stewardship solutions for the Austrian Context

An initiative within the scope of the [FAIR Data Austria](#) project (funded by the Federal Ministry for Education, Science and Research (BMBWF)) works towards streamlining data stewardship across Austrian research-performing institutions. The first case study results are based on surveys, interviews, and workshops conducted in the Austrian context.

We find that while data governance is a challenge in any institution, the challenges universities face are particularly complex. The academic community expects universities to keep data secure but, at the same time, respect privacy and academic freedom. Additionally, universities are at different stages in implementing adequate stewardship mechanisms. Prospective data stewards face challenges, including a wide range of expected competencies across institutions, which makes it difficult to develop a list of necessary and sufficient conditions related to tasks and required training that data stewards will have to fulfil.

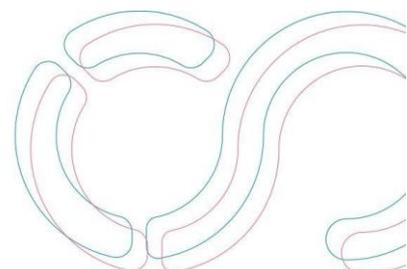
The report (Hasani-Mavriqi, Reichmann, Gruber, Jean-Quartier, Schranzhofer & Rey Mazón, 2022), formalised as a toolbox, presents data steward models, respective competencies, and available

¹³ See news: <https://open-access.network/en/services/news/article/open-science-policy-austria-as-open-as-possible>. For a version in English of the Policy please see: <https://www.bmbwf.gv.at/dam/jcr:d0dad6b6-b94d-4e3e-8c4e-da12091be9b4/Open%20Science%20policy%20Austria%20eng..pdf>



training. It allows universities to choose the appropriate implementation strategy based on their preconditions and needs. The report discusses different models for the positioning and roles of data stewards at a university, depending on factors such as size, resources, and training. The models include the data steward contact point, which serves as a point of contact for inquiries; the data steward office, which offers direct advice and more in-depth support; and the data steward network, which provides discipline-specific knowledge and support. The report highlights the importance of competencies such as communication, technical expertise, and domain expertise for data stewards and suggests that a team of data stewards is necessary to fulfil all competencies. Finally, the report stresses the significance of training in research data management and open science, technical expertise, and domain expertise.

There are several challenges evident in implementing data stewardship in Austrian universities to meet the demands of data-driven scientific research. There is a lack of consensus on the skills, roles, and responsibilities of data stewards, and different universities have different visions of data stewardship. Funding data steward positions is also a major challenge, as the source of funding and the nature of the data steward's role can vary depending on whether they are built on existing resources or newly hired. Additionally, funding data stewards out of project money can be detrimental to building a knowledge base, but there are valid reasons for implementing data stewardship at the project level. The conflicting demands of securing continuous funding and ensuring appropriate disciplinary data management pose a significant problem.



9.2 France

The French Ministry of Higher Education and Research published in July 2021 the [Second French Plan for Open Science](#) (2021-2024). This new plan is not the result of an update but rather of a new and expanded ambition. It is about opening up the entire research process, publications, of course, but also data and source codes. *«France is committed to ensuring that the results of scientific research are open to all, researchers, companies and citizens, without hindrance, without delay, without payment ».*

The Ambitions of the 2nd Plan by 2024:

- Generalising open science practices in France
- Sharing research data
- Opening up software produced by research
- Make open science the usual and daily practice
- Accelerate the circulation of information between researchers in order to increase the efficiency of science and thus the multiplication of discoveries
- Contribute to the democratisation of access to knowledge in order to bring science closer to society in the spirit of the Law on Research Programming (LPR)
- Extend the data-sharing movement, already widespread in astronomy, seismology and genetics, to other disciplines.

The 2nd Plan responds to the European Union's ambition to provide each country with a national plan for open science and is a major contribution to France's commitments to the transparency of public action within the framework of the Open Government Partnership (OGP).

On the issue of research data, the 2nd Plan considers them and the economic issues surrounding them to be very important. The situation regarding research data management is currently relatively critical. Researchers face difficulties in storing data and reproducing the results of scientific research because the data and code are not accessible or are poorly documented and not reusable. To encourage the sharing and opening of data produced by French research, the national research data platform [Recherche Data Gouv](#) has been created.

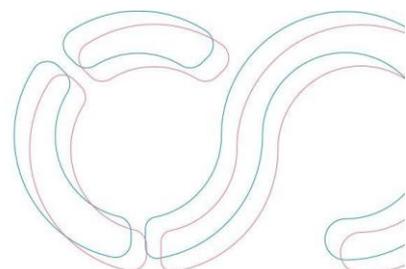
This sovereign and controlled solution is composed of three modules to support research teams on all issues linked to data:

- [Data management clusters](#)
- [Thematic reference centres](#)
- [Resources centres](#)

And two modules to deposit, publish and disseminate data:

- A repository to deposit and disseminate data
- A registry to search for data published in the repository itself or other external repositories

The implementation of principles mentioned in the Plan is particularly expressed through the objectives and actions of the colleges of the Committee for Open Science (COSO), which is permanently made up of five colleges (Publications, Research Data, Europe & International, Skills & Training and Software and Source Codes) and expert groups and major projects. These bodies



contribute to the implementation of measures set out in the National Plan for Open Science according to the theme involved.

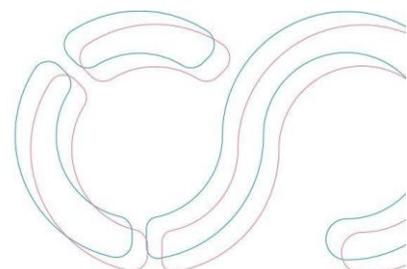
Among their achievements, the guide "For a research data policy: strategic guide" can be mentioned, in which the COSO makes seven recommendations to help formalise and implement a research data policy within institutions. The update of [the Passport to open science for doctoral students](#) of all disciplines at each stage of their research career is another achievement, as well as two complementary booklets of the Passport: the *open science - enter the Debate*, which provides answers to the main questions asked by scientists, and the *open science - codes and software*, which deals with the specific issues related to source codes and software.

Following the publication of the Passport to open science, which offers an introduction to the principles and practices of open science for PhDs, the Open Science Committee has chosen to address doctoral schools with a new guide, Train to open science, throughout the thesis ([in French](#)). The guide follows the path of PhD students, from the collection of documentary sources to the publication of the results of the thesis. It defines a series of training stages and, for each one, identifies the skills to be acquired and proposes examples of training courses already provided in several universities in the region. In this way, it aims to activate experience sharing and stimulate a collective dynamic for the development of open science training in doctoral schools.

For several years, the ANR (French main funding agency) has been multiplying initiatives in favour of open science. The latest action to date is the publication this summer by the Committee for Open Science, to which the ANR contributes, of a guide for researchers on how to implement the Rights Retention Strategy (RRS).

The ANR's open science policy has three main components. The first is to promote open access to scientific publications. The second is to generalise access to and sharing of research data. In order to prepare for the eventual sharing of research data, the ANR requests that a Data Management Plan be drawn up for all the projects it funds, which can be done through the use of [DMP OPIDoR](#), a tool to help create a data management plan. The third axis concerns the development and promotion of a concerted approach to open science, both at the French and international levels.

Recently the Skills & Training College helped to organise a series of webinars, a training course on open science for staff working in the network of French research funding agencies committed to open science. Particular emphasis was placed on data management plans and new principles for the evaluation of research and researchers' careers.



9.3 Hungary

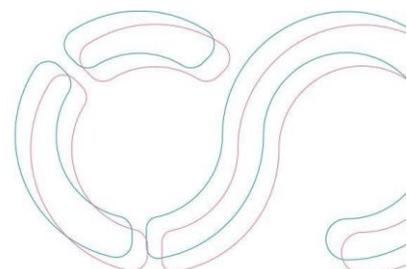
On October 18th 2021, an official [Position paper on Open Science](#) was released in Hungary, initiated by the National Research, Development and Innovation Office (NRDI Office) - the main national funder. The purpose of the paper is to articulate the orientations of scientific communication in the country, given the ongoing paradigm shift in science. This statement is the result of numerous consultations and is supported by the Association of Hungarian PhD and DLA Candidates, Association of University Libraries' Directors, Eötvös Loránd Research Network, Ministry of Innovation and Technology, Governmental Agency for IT Development, Hungarian Accreditation Committee, Hungarian Rectors' Conference, Hungarian Academy of Sciences, Hungarian Doctoral Council and National Scientific Student's Council.

The position paper defines what is considered to be open science and then identifies the key pillars of the open science ecosystem, namely

- open access to research outputs
- FAIR and CARE research data management
- research integrity
- next-generation metrics in research assessment
- new types of rewards and initiatives
- international cooperation networks
- Citizen Science
- education and skills

The document also contains an official specification of open access and how signatories support the promotion of open access. Fortunately, open access might be realised in many forms, such as through transformative agreements with publishers, via gold open access journals, through the green route or self-archiving and diamond open access. The document states that shifting to OA should result in a reduction of subscription fees, and Hungarian researchers are strongly encouraged to make their articles open-access whenever possible. The preferred license is CC-BY. The position paper highlights research data management, FAIR and CARE principles. It gives numerous specific recommendations related to the data created and collected during the research process. In addition, from the research funder's point of view, it is specified that funders are expected to develop a modern and FAIR evaluation system for data management plans. The issue of data repositories is also linked to this chapter. "Signatories support the development of research data service platforms, which will enable networking between institutional repositories while preserving the sovereignty of institutional publication and data repositories, as well as provide high-quality services to the national research community." Training of professionals is essential to operate the system effectively and successfully, so the launch of accredited training programs for data stewards is a priority.

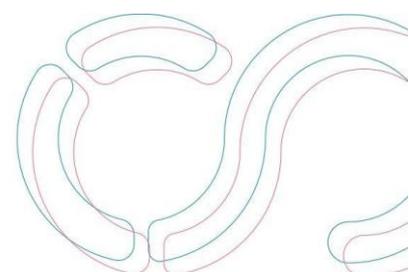
In the "Education and skills" section, the paper stresses that building Hungary's open scientific ecosystem requires thoughtful investments in capacity building with a focus on human resources, training, education and the enhancement of digital skills for new technologies. Skills development



and capacity building are expected to cover a broad range of technical skills; “archiving, long-term preservation and accessibility of publications and data, information and data literacy, secure networking, protection of the intellectual property and content sharing, software development and the provision of the necessary IT back-end systems”.

The position paper was signed by a number of universities and organisations in Hungary. The invitation to sign is still open, and more and more institutions are joining.

University of Debrecen University and National Library (UDUNL), as the coordinator of the Hungarian Open Repositories working group, was asked (by the NRDl Office) to start open science training within the national research institutions with a special focus on research data management and FAIR principles. The aim of these training sessions was to start the bottom-up approach and raise awareness of open science practices within the Hungarian research community. UDUNL and the Governmental Agency for IT Development (KIFÜ) launched in parallel with the training events from the spring of 2021 online discussions (Open Science Forum) on a regular basis to keep up the conversation on national open science practices, the benefits of FAIR research data management and the importance of collaborative science in the Hungarian research community while highlighting the unique advantages EOSC holds for researchers. Through online discussions, more than a thousand stakeholders, mostly researchers, have been reached.



9.4 Italy

In June 2022, the Ministry of Universities and Research published the “[National Plan for Open Science](#)” (PNSA) - the programmatic document through which the Italian government aims to contribute to the implementation of open science.

The document is an essential part of the National Research Program (PNR), is complementary to the PNIR, the National Plan for Research Infrastructures, and it aims to create the conditions for Italian full participation in European and international processes on open science. The PNR, covering the years 2021-2027, is a multi-year framework program that guides research policies in Italy under the coordination of the Ministry of Universities and Research and aims at strengthening the coordination of research policies at the national and European levels, with reference to the European and international dimension of research and considering regional initiatives and contributions.

The National Plan for Open Science is a document that intends to boost open access to data and research tools, support open-source software codes and ensure that all researchers have access to the necessary computing services. The goals are to develop transparent processes as well as the verifiability and integrity of results, to enhance the research activity and to develop proper scientific communication.

The National Plan for Open Science mainly focuses on the following:

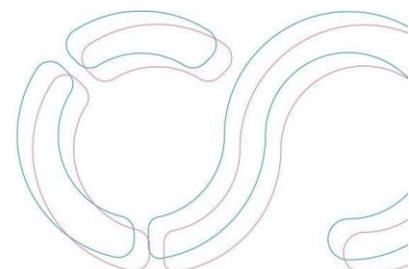
- open access to publicly-funded publications to enable a more efficient and cost-effective research process for institutions and research organisations;
- pursuit of the FAIR data paradigm, integration into EOSC, incentivising the development of ad hoc investments, promoting collaborative production processes, and initiating the training of technical figures to support research data management;
- research evaluation that should follow the principles of transparency, collaboration, open access and peer review, also equipping Italy with a national networked infrastructure to form the basis of the Research Registry;
- active participation in coordination activities at the European level;
- Opening up research data on SARS-COV-2.

Moreover, the document highlights five axes of intervention (supported by 18 macro plans of action):

- 1- Scientific publications
- 2- Scientific Research Data
- 3- Research evaluation
- 4- Open science, the scientific community and European participation
- 5- Opening research data on SARS-COV-2

Regarding research data, the PNSA states that the increasing volume of new data implies the development of an acquisition strategy of research data that must be “FAIR-by-design”. The strategy implies the automation of metadata acquisition by new technologies, investments in resources and infrastructures and specific training.

Besides that, the document highlights the researchers’ need for support from professionals and tools. Therefore, the programming document recommends training and recruitment of qualified



human resources such as “data scientists” for the development of architectures and services and “data stewards” for the curation, description, identification and archiving of data sets. Moreover, national institutions and research infrastructures are strongly recommended to adopt advanced research data management services and tools along with professionals. Besides that, support for the drafting of data management plans and monitoring their concrete implementation are required together with the management of legal aspects.

Skills

The mission of The Italian Computing and Data Infrastructure (ICDI) is to bring together existing infrastructures in Italy to collaborate and effectively participate in the infrastructural development needed to contribute to EOSC.

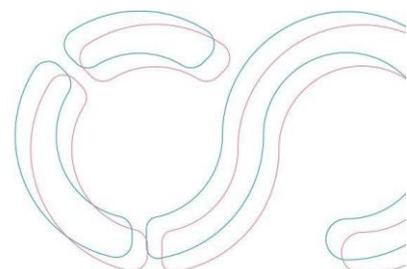
A Competence Centre (CC-ICDI) has been developed within the ICDI, whose objective is to promote the culture and knowledge of the FAIR principles of data stewardship and open science required for the evolution of research at the European level. This is being implemented through concrete actions, including

- designing and promoting structured training and consequent insertion within research institutions of the fairly new professional - data steward;
- providing and developing tools and services that enable the application of good practices of open science and FAIR by design;
- stimulating and developing good practices by making standards, resources and guides accessible;
- guaranteeing support, consultancy and training on open science, FAIR principles and EOSC; and
- fostering the integration of open science within the daily practice of the various actors through the acquisition of skills.

The CC intends to act as a single national point of reference for these activities, drawing on multiple experts who will interact with each other or with other research actors.

In the long term, the vision aims to create a national coordination body that is representative of Italian infrastructures and interacts with national and European institutions on their behalf. As of today, ICDI is regulated by a Memorandum of Understanding signed by [22 organisations](#) and open to the participation of other organisations.

The Italian Ministry of University and Research (MUR) follows this initiative as an observer.



9.5 Latvia

The Latvian [Open Science Strategy 2021 - 2027](#) outlines the following context: “Research data management practices in Latvia are gradually improving; however, the [study on open science](#) demonstrates that “the concept of publishing research data is relatively unfamiliar to most [researchers]. This is also demonstrated by answers given in interviews: in most cases, research data are stored on personal computers or personal cloud services”. Since the publication of the study on open science, the availability of research data repositories has improved – re3data lists three repositories registered in Latvia. The open science study also identified the problem that most researchers have limited experience and knowledge with regard to research data management. To address this problem, the most resource-intensive investments aimed at improving research data management are planned to address a lack of skills, information and support rather than structures or specific digital tools.

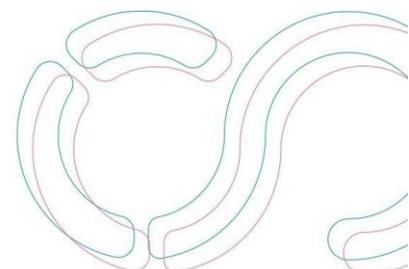
The Open Science Strategy envisages the introduction of standardised research data management practices throughout the data management cycle, introducing mandatory requirements for the researchers to create data management plans for all projects of publicly funded research programmes. The template for the data management plan shall be in an electronic, machine-readable format and as close as possible to the template used for Horizon Europe. Data management plans should minimise the administrative burden on researchers by requiring the most important information just once while maintaining the obligation to update the data management plan if there is a change in data management during the course of the research. The existence and implementation of data management plans need to be monitored by both research institutions and the funders of research.

In addition, research institutions must include a research data management criterion in assessing the performance of research personnel, by open science and related skills’ acquisition in research reports and encouraging the use of open citation, as well as by ensuring that the academic career system supports and rewards researchers who participate in the research sharing movement. The Ministry of Education and Science plans to integrate open science into the criteria “Research Infrastructure and Governance” and “Economic and Social Impact” of the International Evaluation of Scientific Institutions in 2025.

Data Stewards

In order to develop researchers’ skills and a culture of quality research data management, research institutions are encouraged to employ Data Stewards that develop general and field-specific data management skills of researchers, promote the use of e-infrastructures and tools, help plan data management and complete data management plans, and publish and archive research datasets. Data stewards require industry-specific knowledge and good knowledge of internationally available resources and best practices.

In April 2023, the Cabinet of Ministers approved a Data stewards network and a Dataverse repository project with a budget of 3.44 million EUR from Latvia’s Recovery and Resilience funds, aimed at



making research data more accessible and reusable and offering research data management support. The project will last until the middle of 2026, after which the maintenance of the Data Stewards network will be supported by research base funding.

Data champions

Research institutions are also invited to identify data champions – existing researchers who are well-versed in research data and are ready to support colleagues and share their knowledge.

High-level skills competence centres

In certain sectors (high-performance computing, language and quantum technologies), the establishment of high-level skills competence centres is planned, which is closely linked to the management of research data.

In other sectors, research institutions and policymakers are encouraged to develop high-level skills competence centres that can also be used as resources by researchers in any research institution. Data stewards and high-level centres of excellence will work primarily with researchers who possess basic research data management skills. However, there is a significant number of researchers who have little experience and/or poor skills in working with digital technologies.

Academic libraries and initiatives such as OpenAIRE National Open Access Desk (NOAD) play an important role in improving the skills of these researchers. In order to promote open science, it is important to promote the development of researchers' overall digital skills (by creating synergies with "Digital Skills and Education" and "Development of Society's digital skills in the educational process", "Guidelines of Digital Transformation of 2021-2027" programmes where high-level digital skills are developed as cross-cutting skills within the context of vocational education and higher education, including cyber security, work with big data, acquisition of digital technologies in the industry, public administration services, thus promoting the result of "Higher Education Institutions Act as Centres of Digital Innovation").

The diagram below (*Figure 1*) describes the research data management skills-building approach at different levels of researchers' competence via high-level skills competence centres, data stewards and a NOAD.

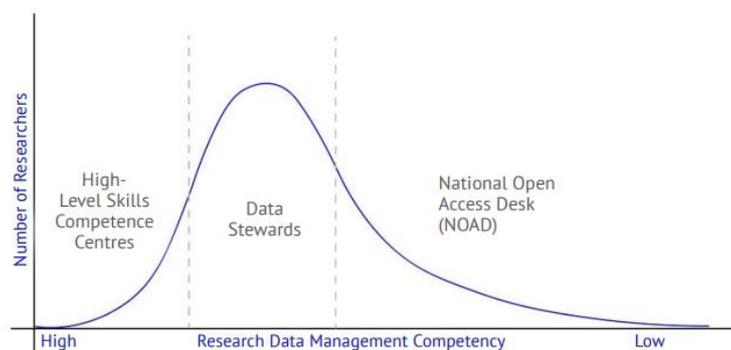
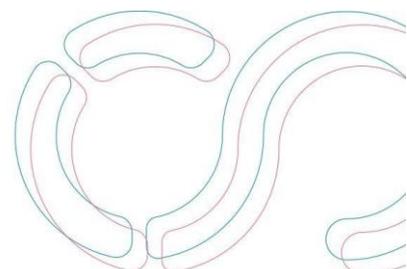


Figure 1. Strengthening research data management skills at different levels of competence. Source: [Open Science Strategy 2021 - 2027](#)



9.6 The Netherlands

Open Science in the Netherlands

The Netherlands research community has been strongly committed to Open Science principles and practices for decades. In 2017 the National Programme Open Science (NPOS) was launched to strengthen and align bottom-up and top-down initiatives and to coordinate the transition to Open Science in the Netherlands. In 2022 the NPOS delivered the [NPOS2030 Ambition document](#) with an overarching ambition: ‘By 2030, scientific knowledge will be freely available, accessible, and reusable for everyone. Open Science in the Netherlands will be embedded as a standard practice across all scientific disciplines from basic to applied sciences, in the natural, medical, social sciences and the humanities.’ This ambition is translated into four strategic goals:

- Towards societal engagement and participation.
- Towards inclusive and transparent scientific processes.
- Towards open scholarly communication.
- Towards FAIR and open research outputs.

To make progress with these strategic goals, progress is needed in five areas.

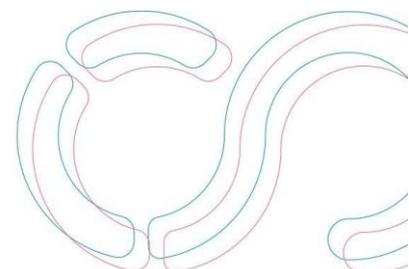
- Development of new and more effective use of already existing open research infrastructures for effective and open knowledge sharing.
- Development of open knowledge practice skills in the relevant scientific communities.
- Investment in and the spreading of best practices and inspiring strong examples of effective knowledge sharing.
- Reform the rewards and recognition system to include open knowledge practices.
- Development of new and more effective use of existing policies and regulations.
- An additional rolling agenda describes for all four strategic goals how progress in the five areas will be achieved.

In the Rolling Agenda of NPOS2030, the road to sufficient expertise and capacity in data stewardship is formulated in Objective 4.6: “In 2030, a professional community of well-trained data stewards has been established, and there is enough structural capacity (in FTEs, as well as in expertise) at Research Performing Organisations (RPOs) to facilitate making digital scientific objects FAIR. There is a nationally coordinated training programme for data stewards”.

In 2023 the [Regieorgaan Open Science](#) (Open Science NL) was established to further accelerate the transition to Open Science in the Netherlands.

Local and Thematic Digital Competence Centers

In 2020 research council NWO launched a call for the setting up or further development of local Digital Competence Centers (DCC). Research-performing organisations could use this funding to appoint data stewards and/or research software engineers for an existing DCC or the central setting up of a new DCC within the organisation. The DCC provides training, advice and practical support to researchers, data stewards and software engineers. SURF plays a role in technically facilitating and coordinating the secure, federated system that must interconnect the DCCs and in supporting the



DCCs in knowledge sharing. In 2022 the scientific field and research council NWO jointly established [three thematic Digital Competence Centers](#) (TDCC). There are three thematic DCC networks, bringing together scientists in three 'domains': Life Sciences & Health (LSH), Natural and Engineering Sciences (NES) and Social Sciences and Humanities (SSH). Each thematic DCC has developed [Roadmaps](#) together with their respective research field, in which priority bottlenecks have been identified. Researchers and institutions will work together in the TDCC network and TDCC projects to strengthen digital competencies across Dutch science. In addition, the three TDCCs are working closely together related to domain-agnostic themes (<https://tdcc.nl>).

Data stewardship competencies and skills

In the past few years, successive project teams composed of data professionals representing all major stakeholders in the Netherlands have delivered reports that took stock of data stewardship in The Netherlands, set out recommendations and made it possible to set steps on the road to professionalising data stewardship. In 2019, two complementary projects related to data stewardship were conducted in the Netherlands: *Data Stewardship on the Map* and *Towards FAIR data steward as a profession for the life sciences*.

The report “Data Stewardship on the Map” (Verheul et al., 2019) investigates the provision of data stewardship tasks, roles and needs of data stewards in Dutch research institutes. The report provides an understanding of what Dutch institutes demand of data stewards and also what has been asked for, implemented and developed by and for them. One important finding was the fact that data stewardship roles exist and are needed both at the “generic” and “embedded” levels. The project “Towards FAIR data stewardship as profession” delivered a competency framework for data stewardship (Scholtens et al., 2019). Three partly overlapping [data stewardship roles](#) were identified (policy, research and infrastructure), as well as eight competency areas. Responsibilities and tasks were formulated for each data steward role and competence area to be used for job descriptions. Knowledge, skills and abilities- and learning objectives (including Bloom levels) were described. The resulting three large matrices, one for each of the three identified data stewardship roles, together form the data stewardship competency framework ([matrices](#), also findable via [EBI Competency Hub](#)).

In the 2021 NPOS project (see further below), both lenses on data stewardship roles have been merged, combining the organisational perspective and the individual perspective on data stewardship (see Figure 2).

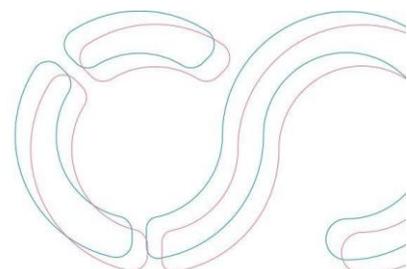


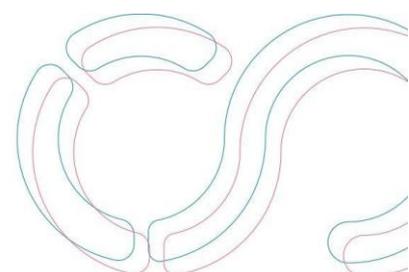


Figure 2. Basic job profile components of a data steward (Jetten et al., 2021, p.40)

Professionalizing Data Stewardship

The outcomes and recommendations of both projects are widely recognised and formulated the groundwork for the subsequent NPOS project. *Professionalising data stewardship in the Netherlands: competences, training and education - Dutch roadmap towards national implementation of FAIR data stewardship* (Jetten et al., 2021). The project team consisted of over thirty representatives of universities, university medical centres, universities of applied sciences, and service providers, complemented by representatives of the major stakeholders VSNU, VH, NFU, PNN, SURF and funder ZonMw.

The report gives an analysis of the current situation in the Netherlands with regard to data stewardship competencies, education and training and draws attention to the urgent need for nationally coordinated action by the main stakeholders. It gives tangible recommendations that help organisations with professionalising data stewardship, i.e., hire, train and educate data stewards, including career paths. Major recommendations relate to job profiles for data stewards and research software engineers and to data stewardship training and education in HEIs and RPOs. Also, it includes drafts for data stewards' job profiles for universities, university medical centres and universities of applied sciences, which already had a great impact on the professionalisation and acknowledgement of data stewardship, not only in the Netherlands but worldwide. As a first outcome, the data steward profile was implemented in the UFO, the Dutch job classification system



for universities, in 2021.

In April 2023, all stakeholders gathered for the Workshop *Data Stewards Job Profiles: Build and Sustain Capacity for FAIR Implementation* (<https://doi.org/10.5281/zenodo.8026659>) and discussed the status and lessons learnt from the adoption and implementation of official data stewards job profiles at different Research Performing Organisations in the Netherlands in the past two years. All agreed that one recommendation had been successfully adopted at all Dutch RPOs: data stewards are nowadays well organised and easy to find. As to the formalisation of the data steward job profile, the universities and some academic hospitals are more advanced than, for instance, the Universities of Applied Science, where adoption is still pending approval. More clarity on data stewards' tasks within these organisations would probably help to get the job profiles officially adopted. None of the presenters was satisfied with the current data steward capacity at their institution. To increase this capacity, it is essential to team up with all stakeholders and find senior researchers or deans who can act as ambassadors for data stewardship.

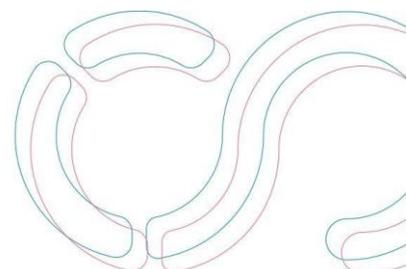
With regard to the availability of education and training of data stewards, there is still work to do. Already in 2013, the first national course on data management was set up by Research Data Netherlands: [Essentials 4 Data Support](#). Over 500 data professionals across all Dutch Research Performing Organisations have attended one of the face-to-face courses organised twice a year. Others followed the online module at their own pace. Another example of national collaboration is the '[DCC spring training days](#)': five days of workshops on topics related to RDM and Open Science. These have been organised yearly since 2021 as a joint effort for and by the data stewards at the local Digital Competence Centers under the umbrella of the [National Coordination Point RDM](#) (LCRDM). The next step would be to set up acknowledged, certified professional education for data stewards.

A final recommendation addressed career paths. To attract and keep qualified data stewards, it would help to recognise data stewards' efforts as part of the research team's work. In general, the conclusion is that, in two years' time, progress has been made with regard to the professionalisation of data stewardship in the Netherlands. For the coming period, the focus should be on national recognition, increasing capacity and certification of data stewards training.

Data Stewardship Community

Community building, knowledge exchange and peer learning are essential to support the growing community of data stewards and contribute to capacity building, career development and professionalisation of this new occupation. In the Netherlands, the [Data Stewards Interest Group \(DSIG\)](#) was initiated in 2017 in the Life Sciences and Health domain but gradually changed into a cross-domain community: it currently welcomes data stewards related to all three Dutch Thematic Digital Competence Centres (see above). The DSIG has been described as a FAIR Supporting Resource in [FAIR Connect](#).

The DSIG aims to establish an informal and inclusive community hub for data stewards and like-minded in the Netherlands (and abroad) to share experiences and foster the (Dutch) national implementation of data stewardship. Anyone interested can join the community, attend meetings

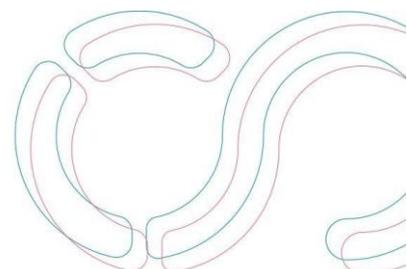


and contribute to the discussion in the communication channels. The bottom-up approach of this community has proven to be very successful in reaching out to a wider group. Over the years, templates and best practices, such as recurring agenda items and shared notes, have made it easier and more efficient to convene, chair and attend meetings. Via the [DSIG website](#), these materials are available for others who want to set up a similar community within their own country, region or discipline.

The distinctive feature of the DSIG in comparison to other initiatives regarding data stewardship is the hands-on and solution-oriented approach to practical matters. Via its meetings, the DSIG specifically facilitates and stimulates direct peer learning and knowledge sharing in a very fruitful way. This way, it is of added value in the broader landscape of, for instance, the worldwide [Research Data Alliance \(RDA\) Professionalising Data Stewardship Interest Group](#), the European topical [ELIXIR communities](#), the [Dutch National Coordination Point Research Data Management](#) (LCRDM) and local networks like the [Leiden University Data Management Network](#).

Research Software Engineers

More recently, efforts have also been undertaken to establish job and competency profiles for research software engineers (RSEs) at RPOs in the Netherlands. In June 2023, the eScience Center released [a comprehensive role description and job profile](#) to state how the eScience Center defines an RSE and to describe the tasks and skills expected of RSEs who work at the Center. These documents can serve as resources for others who are looking to define and appropriately position RSEs within their organisations. Also of interest in this context is the [FAIRsFAIR implementation story of data stewardship at MEMIC](#), the Centre for Data and information management at the Faculty of Health, Medicine and Life Sciences of Maastricht University in the Netherlands. It describes the collaboration between data stewards and RSEs as well as skills and recognition.



9.7 Spain

In recent years it has become clear that open science is taking on an increasingly important role in the Spanish national panorama. According to the Open Science Observatory of OpenAIRE, statistics on scientific publications in Spain show that 60.8% of them are open-access. In this sense, some key actions have been: the recommendations for the implementation of open dissemination, coordinated by the *Fundación Española para la Ciencia y la Tecnología* (FECYT - Spanish Foundation for Science and Technology), an institution that has also supported the "Action Plan for Diamond Open Access"; the creation of the national aggregator of open access scientific repositories RECOLECTA, managed by the REBIUN network (*Red de Bibliotecas Universitarias Españolas*) of the CRUE and, more recently, the approval of the "Spanish Strategy for Science, Technology and Innovation" (EECTI 2021-2027), which includes open science policy objectives.

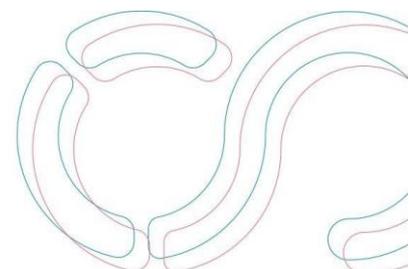
In 2022, there has been an important push for open science. On the one hand, the national law on science, technology, and innovation (Law 17/2022) has been reformed, incorporating measures to facilitate open access to scientific publications and data from publicly funded research. On the other hand, the new organic law of the university system (LOSU) incorporates a series of measures aimed at promoting open science at the service of society.

From this, it derives not only an interest but a need from researchers to, on the one hand, acquire the basic rudiments for working with data in a relatively new context (the open science) and, on the other, a concern for how to do so in such a way that their practices are not only compatible and standardised in this paradigm but also comply with the requirements of the funding organisations. In 2023, the National Strategy for Open Science (ENCA) 2023 - 2027¹⁴ has been adopted calling to provide "training to all personnel (researchers, managers, funders, evaluators) to align their professional performance with the principles of open science" and designing a program for awareness raising and continuous training as a medium-term activity "to educate teaching and research staff as well as institutions about the opportunities and challenges of open science, with a particular focus on members of assessment committees of major assessment agencies. The accreditation of doctoral degrees will include the assessment of transversal skills related to open science. Training in open science will be provided in the form of micro-credentials."

Consorti de Serveis Universitaris de Catalunya (CSUC)

The Consorci de Serveis Universitaris de Catalunya (CSUC) was created in 2013 due to the need to promote efficiency in the management of Catalan universities through cooperation and coordination. It is integrated with the *Generalitat de Catalunya* and the public Catalan universities, as well as others that participate as aggregate members. Open science collaborates with the university and research system and European programmes. Since 2016, all Catalan universities have had research data management support services to help researchers write Data Management Plans,

¹⁴ National Strategy for Open Science (ENCA) 2023 - 2027 https://www.ciencia.gob.es/dam/jcr:e5b759a4-d756-4af9-89b0-a8cf5fd28e20/ENCA_EN_acc.pdf



make data FAIR and publish data in the appropriate repository. One of the tools provided by the CSUC since 2021 is the CORA.R repository of Research Data (CORA.RDR) is a federated and multidisciplinary data repository whose objective is to increase the efficiency and transparency of research. The Technical Commission of CORA.RDR is made up of representatives from each of the institutions participating in the institutional repository, professionals who support the management of research data within their institution.

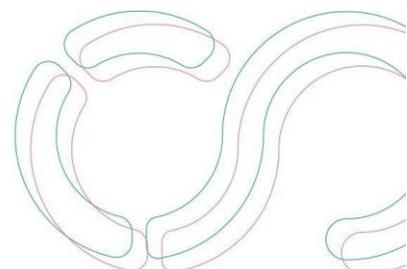
The CSUC's activities in open science and RDM began to develop based on the realisation that the needs of researchers regarding libraries were changing a lot based on the generalisation of digital and online information. Libraries began by creating and maintaining repositories with documents and continued to promote open access until reaching the need to support research data management. This evolution in services has made clear the need for "re-skilling" of library staff, especially required in relation to the RDM. Initially, theoretical training courses were organised on data management, FAIRification of research data and others, but since the launch of the data repository in 2021, it was confirmed that a different kind of training was needed. On the one hand, the training had to be practical in order to resolve the many doubts that the research support staff had in the process of curating and publishing data in the repository. On the other hand, it had to help empower the people who provided this service, as they felt insecure doing activities that were still very new, not only to them but to everyone. These two wishes redefined the training activities towards practical self-learning labs.

The working plan of the Open Science Area 2017-2019 of the CSUC had as its objective for 2018 "To elaborate a training program in open science for the people who in universities and research centres support researchers", where research data management was included. In addition, the report "FAIRxFAIR. Feasible, Affordable and Implementable Requirements for a FAIR research data repository" recommended training on open science concepts, in general, and specifically on RDM. Following the guidelines of the European Commission Expert Group on FAIR data, this training should include all members of the university community but, to be effective, should distinguish between advanced users, young researchers, and support staff from the universities.

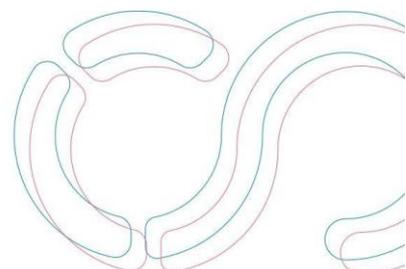
Thus, in 2021 and 2022, the institutions included in CORA.RDR participated in 11 self-learning labs for the publication of research data organised by the CSUC. The aim of these sessions was to offer a space for dialogue and debate for the people of the Technical Commission with the aim of providing them with common tools in order to curate the datasets published in CORA.RDR, taking into account the skills and abilities that a "data curator" or "data steward" must-have.

In each of the sessions, different institutions presented practical cases of real datasets and how they were resolved (relationship with researchers, licences, in-depth look at metadata, etc.), so if other institutions encountered similar cases, they could replicate the solutions provided. At first, these sessions were led by Heather Andrews, data curator of TUDelft in the Netherlands, and later by CSUC staff.

At this moment, five more sessions of self-learning labs are being prepared to take place during 2023. The main reason for continuing to carry out these workshops is to continue offering this space for dialogue and debate between the institutions. This year, a more technical part will be



incorporated into each session, where CSUC data curators will explain tools/processes to improve data curation.



9.8 Sweden

The goal of open access to research results in Sweden was conveyed in the 2020 research bill stating that a transition to open access to research publications should be completed by 2021, and that open access to research data should be fully achieved by 2026.

Open access to research data

The Swedish research council (VR) is one of the major Swedish research funders, and since 2017, VR has coordinated and promoted Sweden’s work on [open access to research data](#). VR works to make open access to research data an integrated part of the research process according to the principle “as open as possible, as closed as necessary”. However, a transition to open access requires coordination, both on a strategic level and also on a practical level for implementation.

Best practice in data management was identified early on as a prerequisite for the transition to open data. To further data management planning VR appointed a group to coordinate work with DMPs on a national level. This has led to the establishment of a common template for DMPs, and, recently, a guide to support data producers when using the template.

More recently, the focus has been to elevate knowledge about open access to research data and FAIR data. In 2021 the research council recommended that data generated through research ought to be managed according to the FAIR principles, and to support users in the implementation of this, a guiding text was also published.

Open access to research publications

The national library of Sweden was charged by the government in 2017 to support and coordinate work with the implementation of open access to publications on a national level. As previously mentioned, the goal was to make all scientific publications that result from governmentally funded research immediately open from 2021. The number of openly available publications is increasing but is not yet at 100% (fig X).

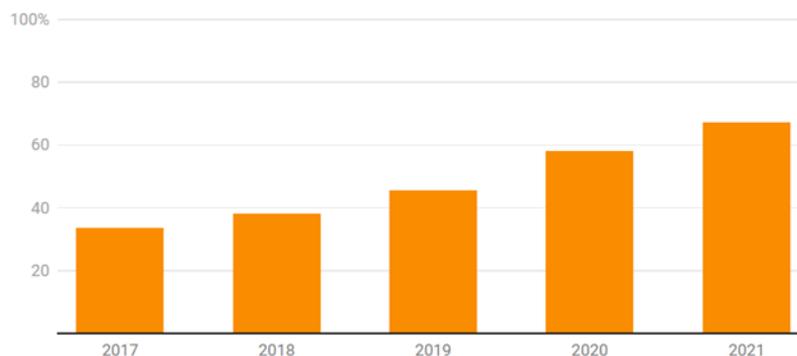
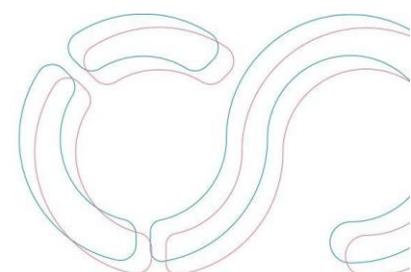


Figure 3. Publication year of the article and the percentage of immediately available articles per year.

Source: [Öppen tillgång i siffror – Kungliga biblioteket – Sveriges nationalbibliotek – kb.se](#)

National Guidelines for open science



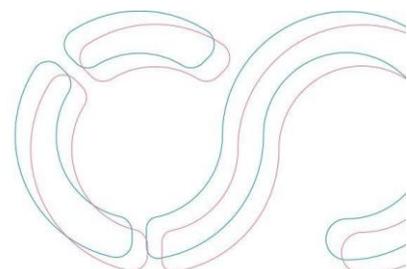
As of June 2022, the National Library has been charged by the Swedish government to produce national guidelines for open science. This includes identifying common goals and priorities, mapping out the roles that need to be included and defining the need for support and guidance. This will be accomplished in collaboration with other stakeholders, e.g. the Swedish Research Council, HEIs, governmental agencies and other relevant organisations. A report from the project will be available from January 2024.

National Roadmap for Open Science

The Association of Swedish Higher Education Institutions (SUHF) was founded in 1995 as an organisation for institutional cooperation on a voluntary basis. Thirty-eight universities and university colleges in Sweden are members. The association aims to promote sector interests to external actors to strengthen internal cooperation and provides an arena for the exchange of views and cooperation among its member institutions. A [national roadmap for open science](#) has been devised by SUHF's national working group on research data and was adopted by the SUHF general assembly in March 2021. The roadmap aims to clarify the responsibilities of HEIs and the measures needed to accelerate work on open access to research data and research results.

The roadmap contains eight recommendations directed at HEIs:

1. To create research and education environments that support, encourage, inform and educate about open science as a practice by adopting, implementing and supporting local steering documents or frameworks
2. To provide relevant research and education support services relating to open science that can meet researchers' needs for support throughout the research process, i.e. before, during and after a research project, in a resource-efficient manner
3. To aim to ensure that research data and research results are compliant with the FAIR principles as far as possible
4. To provide researchers with affordable, adequate and secure infrastructural services – compliant with the applicable regulatory framework (in particular, the Freedom of the Press Act, the Public Access to Information and Secrecy Act, the Archives Act and the GDPR) and the FAIR principles – for management, storage, publication and retention of research data and research results, archiving and deletion forming an integral part of the research process and open access work
5. To actively collaborate with other HEIs, infrastructures and funders to find resource-efficient and cost-effective joint national solutions regarding steering documents, frameworks and infrastructural services
6. To promote, participate and collaborate with international stakeholders and initiatives such as the European Open Science Cloud (EOSC) and the San Francisco Declaration on Research Assessment (DORA)
7. To develop an incentive structure that promotes and assesses open science, such as in performance assessment and performance-based allocation of funds



8. To work to ensure that copyright for the publication and re-use of research results is not transferred exclusively to commercial, scientific publishers.

In 2022 the roadmap was followed by a [guide for the implementation](#) of the eight recommendations, containing more hands-on activities.

Data stewardship on a national level

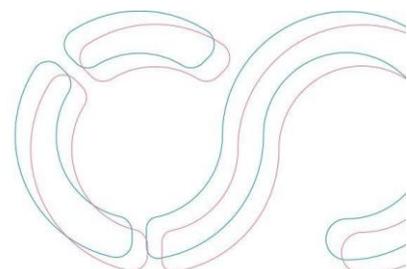
Swedish national data service (SND)

[SND](#) is a VR-funded research infrastructure that aims to make research data openly accessible. It is run by a consortium of nine of the major Swedish HEIs, and attached to it is a network of an additional 28 HEIs and research-performing organisations and governmental agencies. Each member of the SND network has a dedicated group of staff, a data access unit that acts as first-line support for data management-related issues. SND also hosts a repository for research data where all entries are manually curated by the data access unit.

The staff involved in this work are trained librarians, archivists, researchers, IT staff, etc., and all have experience in data management and can provide assistance for researchers and administrative staff in need of support.

Together with the University of Borås, SND offers a course on data stewardship aimed at university staff, i.e. librarians, research secretaries, archivists and others working with support in data management. The course contains themes such as data management during the research process, DMPs, legal issues connected with research data and the day-to-day running of a data access unit. There are other stakeholders also offering data stewardship courses; for example, National Bioinformatics Infrastructure Sweden, which hosts shorter courses on [data management practices](#) aimed mainly at researchers who feel the need for further education in this field.

To date, a select few of the Swedish HEIs have employed data stewards, but just recently, questions have been raised within the SND network, whether it would be useful to define the minimum common denominator of the tasks of a data steward and whether this network ought to coordinate a Swedish approach to the role of a data steward.



9.9 Switzerland

The [Swiss National Open Research Data \(ORD\) Strategy](#) was agreed upon by key stakeholders in the Swiss Research and Innovation landscape in July 2021. The Strategy formulates the basic principle that publicly financed research data should be as open as possible, respecting disciplinary diversity, interoperable, internationally networked, and enabled to be sustainably financed. A major objective of the strategy is the development and support of ORD solutions based on research practices in the respective research communities. In addition, the Swiss ORD Strategy also recognises the following objectives:

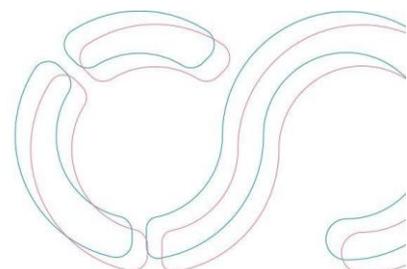
- Consolidation and strategic development of infrastructures and services
- Skill development and the sharing of best practices between researchers
- Development of supportive framework conditions for institutions and research communities

Based on the objectives formulated in the ORD Strategy, an [Action Plan](#) has been developed that implements the objectives in concrete action areas and lines. The ORD Action Plan covers the time period 2022 – 2028. As part of the action area focused on the development, promotion and maintenance of sustainable ORD services and infrastructures, implementation measures for the professionalisation of ORD specialists, in particular, data stewards and related services, have been initiated. In these measures, the roles of data stewards and related ORD professionals are to be defined, established and promoted at higher education and research institutions. Further objectives also include:

- Creation of networks of data stewards
- Supporting collaboration between RDM services, service centres and data stewards at institutions and clarification of the respective roles within institutions
- Establishing best practices and standards for various ORD consultant roles

The main actionable goal of this measure is that professional data stewardship will be established as a recognised career path by 2028. To this end, a call for proposals has been launched in 2022 for institutions to describe their ideas and intentions for building up data stewardship. In response to this call, data stewardship implementation plans have been initiated by 25 Swiss HEIs. Furthermore, a project to foster training and a national curriculum for Data Stewards has been launched by eight institutions, with the aim of creating a dedicated Certificate of Advanced Studies (CAS) for Data Stewardship¹⁵.

¹⁵ <https://www.sib.swiss/about/news/10963-towards-a-national-curriculum-for-life-science-data-stewards>



9.10 United Kingdom

UKRI Open Research and Open Access Policies

([UKRI](#), or UK Research and Innovation, is the main UK research funding body)

Open research is integral to UKRI's mission to deliver economic and social benefits. Accessible, transparent, reproducible and cooperative research:

- Underpins quality and efficiency in the research process
- Ensures research outputs are readily shared

UKRI's ambition is to lead improvements through policy, practice and technological innovations to achieve an open research system that operates internationally.

To do this, UKRI will:

- Support the adoption of open research through collaboration and alignment with national and international partners
- Support the transition towards an open and transparent research system and address key challenges - by developing policies, rewards and incentives to achieve open research and the necessary digital research infrastructure
- Ensure open access and open research data - two key aspects of open research - are core priorities.

UKRI published its new [open access policy for research articles and academic books](#) in August 2021. The policy aims to make published outputs of UKRI-funded research widely and freely accessible under conditions that allow maximum reuse.

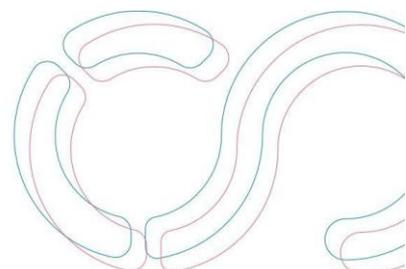
UKRI is updating its research data strategy (as of 25 November 2022). UKRI is taking a leading and coordinating role in overseeing the development of open research data policies, infrastructure and services, as outlined in UKRI's long-held research data commitments and highlighted in the [final report of the Open Research Data Task Force](#) (4 February 2019).

The report states that researchers are creating, gathering and using data in hitherto-unimagined volumes. These vast data resources dramatically increase the capacity of science to infer patterns in phenomena, whether physical, chemical, biological or human or in the complex systems that are at the heart of most global challenges. It lists the key aims of open science are:

- That published scientific results should be open access - digital, online, free of charge, and free of most copyright and licensing restrictions, and
- That the data acquired by individual scientists and scientific groups should be subject to a default position whereby it is made findable, accessible, interoperable and reusable (FAIR).

The overarching aims of the Open Research Data Task Force are:

- to enhance the quality and value of research by providing the incentives, the services, and the support researchers need as both creators and users of data;
- to facilitate the wider scrutiny and re-use of data;
- to increase public engagement and trust in research; and
- to promote the use of data to facilitate innovation and to enhance the benefit it brings to citizens in the UK and beyond



The recommendations of the Task Force include:

- All stakeholders act to strengthen the incentives for researchers to create and use open research data
- Funders and research organisations establish training programmes for researchers in data management, analysis and stewardship
- Research organisations strengthen the provision of specialist support services within research organisations and increase capacity in data stewardship, research software and data science

Weak incentives are accompanied by barriers to more widespread adoption and use of open research data.

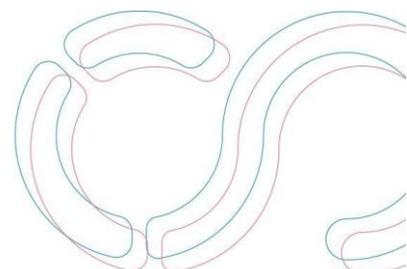
Variations in the requirements set by different funding bodies, research organisations and publishers make the policy landscape difficult to comprehend, and individual policies and services are not always well-attuned to disciplinary practices and cultures. Alongside researchers' concerns about misinterpretation or misuse of the data they have created or about 'giving away' their hard-earned research capital, there can be practical barriers. The time and effort required to make research data open and accessible in accordance with the FAIR principles (Findable, Accessible, Interoperable, Re-usable) can be considerable, and those researchers who are keen to adopt open research data practices may find themselves stymied by a lack of practical guidance and specialist support.

Calls to remedy deficits in skills and capability in data management and curation have been a repeated refrain in reports for the past decade and more. Training materials and courses have been developed by a number of bodies, including the Digital Curation Centre and the Software Sustainability Institute; and Jisc have provided support for specialists in libraries and other services in individual universities. At a more general level, the EU-funded [FOSTER](#) project has brought together training resources for open science in an online handbook.

But deficits remain all too evident:

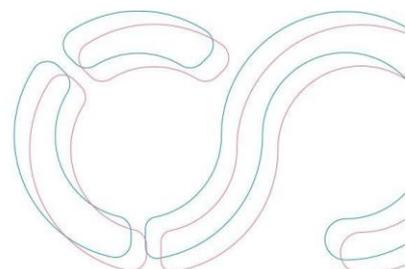
- many researchers need to develop greater understanding and skills in managing and curating the data they gather or create;
- many researchers also need to develop higher-level skills in software, data processing, analysing large and complex data sets, and the application of learning algorithms;
- there is a need for more capacity in the form of professional experts in their different subject domains in matters including data stewardship, software, data processing and analysis; and
- there is a similar need to improve the recognition and rewards for specialist staff in these areas, both in libraries and embedded in research groups, with clearer career paths less dependent on time-limited project funding.

Coordinated efforts are needed to address these issues so that researchers are not left struggling with sub-optimal solutions and to bridge what risks becoming a growing divide between data specialists and researchers in their different subject domains. More courses to develop capacity in data science – as recommended in a number of reports, including the recent *Growing the Artificial Intelligence Industry in the UK* – are certainly needed. But so are much greater



efforts to ensure that the research community as a whole is better equipped to deal with the challenges as well as the opportunities of digital research. Training to establish good scholarly practice in the digital age needs to start at the undergraduate level, but there is also a need to tackle current skills deficits.

- Steps to that end include encouraging funders and research organisations to:
- recognise data skills and practice in their reward systems;
- establish more training programmes for researchers in different subject domains;
- promote the development of peer support networks;
- ensure that specialist support is provided close to researchers in their institutions and subject domains, with clear responsibilities for the provision of that support; and
- provide sustainable career paths for professional data experts, building on the existing commitments to support professional technicians



10. Appendix 3: Case Studies from Research Performing Organizations

10.1 Copenhagen University, Denmark

In 2020 the Danish E-Infrastructure Cooperation ([DeIC](#)), supported by the [National Forum for Research Data Management \(DM forum\)](#) published the report: "National Coordination of Data Steward Education in Denmark: [Final report to the National Forum for Research Data Management](#). The report provides an analysis of data steward education in the private and public sectors and the role of the Data Steward in different organisational contexts. Recommendations in the report are:

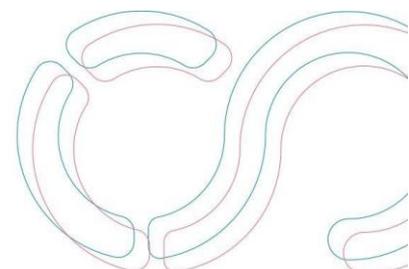
- **Develop curricula and career paths for Data steward profiles in policy, research, data and infrastructure** ([Staiger et al., 2019](#)) and as agents of change, i.e. skills to champion data stewardship across an organisation in political, technical and research contexts.
- Develop Curricula that **develop the Data Steward's technical and soft skills. Soft skills, such as teaching, mediation, communication and team management**, are valued across stakeholders, domains, data steward profiles and in-service development - be it generic Data Stewards in advisory positions or Data Stewards embedded in research projects and other data workflows.
- **Experiment with innovative teaching pedagogies**, which increase the availability and effectiveness of training programmes, such as online and blended learning, cases from industrial partners, internships and on-demand learning.

As candidates for Data Stewardship training programmes have different educational and professional backgrounds, their purpose for taking a Data Steward education will differ. The report suggested **different models of education**, each building on the findings of the report:

- A one-year master's study programme for candidates who already have basic programming skills and subject knowledge. The programme would be available to anyone with a Bachelor's degree.
- A pre-master upskilling programme followed by the one-year master's described in the previous sentence.
- A two-year university candidatus, providing foundational knowledge in programming and data analysis, internships, disciplinary specialisation and data management.
- Finally, part-time training as a data steward is an alternative career path for those with research experience, e.g. a PhD or postdoc.

Prequalification: Application for Data Steward education at the University of Copenhagen (UCPH)

In the Spring of 2020, Copenhagen University, in collaboration with the Royal Library Denmark/Copenhagen University Library, initiated a prequalification for a one-year master's in Data Stewardship. The prequalification was made possible by a political agreement based on the recommendations of the Expert Committee on Quality in Higher Education in Denmark, particularly **more flexible university education**. Universities can apply for funding to establish one-year master



programmes (60 ECTS). The aim is to give students more educational options after completing their bachelor's or candidatus degrees and **create a more flexible labour market**. Building on the recommendations from the report described above, UCPH saw the possibility of offering a **cross-faculty education in Data Stewardship**. The prequalification described a one-year programme that would be developed in collaboration with the University Library, the Humanities, Law, Social Science, Science and Health faculties. In order to ensure a correspondingly broad user involvement, it was decided that all UCPH's **user panels must have the opportunity to provide input to the education**. The purpose of the broad user involvement is to find the employment areas where education seems to have the greatest potential.

The one-year programme described **foundational data/IT skills combined with legal and ethical knowledge and disciplinary-specific data comprehension**. The aim is to give the students an understanding of secure and ethical management, organisation, analysis, visualisation and communication of data and data workflows, both generic and discipline-specific. The programme builds on three foundational competencies:

1. **IT competencies:** data modelling, data management, automatised data collection, cleaning and storing data, infrastructure, data science and machine learning.
2. **Legal and ethical competencies:** GDPR, FAIR, security, data ethics and ethics in Artificial Intelligence.
3. **Disciplinary-specific data competencies:** knowledge about data, systems and data practice in the social sciences, health, natural and bio-sciences, law or humanities. Disciplinary courses can also reflect branches of industry. Typically, the choice of disciplinary course will be a continuation of the student's bachelor or candidatus.

The programme consists of 6 courses (7,5 ECTS each) plus a project module, 15 ECTS. The study year is divided into four blocks of nine weeks, each including an exam. Thus, two blocks per term. The students follow two courses per block. Two-course block electives are in an area the student chooses to take a deep dive into. **Currency of the education will be ensured through the addition of new electives in collaboration with UCPH's user panel, surrounding industry and job-market analyses**. A final project module, in which there is also an exam, gives the student the opportunity to work on a data-related subject within a chosen discipline.

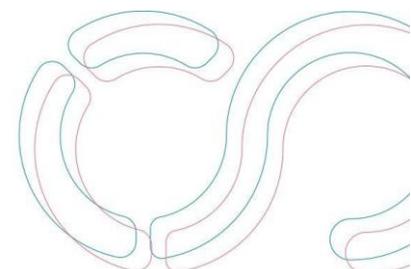


Table 1: One-year master programme in Data Stewardship: structure

Year 1	Block 1	Block 2	Block 3	Block 4
	Python for data science	Data modelling, management and security	Data analysis & processes	Elective 2: Methods
	Data governance	Elective 1: Disciplinary speciality	Project (15 ECTS)	
Elective 1 – disciplinary speciality		Elective 2 - methods		
Health data		Machine learning and artificial intelligence		
Sequential Data and Bioinformatics		Open data & FAIR		
Social data		Project management/change management		
Organisational and cultural heritage data		Citizen Science		

Graduate profiles

Please find selected examples of suggested graduate profiles below:

Profile 1: Background in history/art history. Electives: Organisational and cultural data + Citizen Science

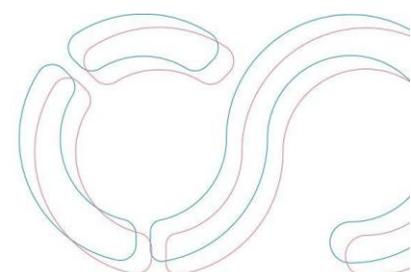
Students with a background in history/art history or knowledge of historical mainlines, eras, issues and dissemination of the same. A combination with the electives in Cultural Data and Citizen Science will provide a unified data steward profile that can help digitise and systematise historical, cultural data of historical importance and, where relevant, use Citizen Science to promote digitisation and collection of unknown or unregistered data.

Profile 2: BSc Biology. Electives: Health data + Machine learning/Artificial Intelligence (ML/AI)

Bachelor with a background in biology or equivalent in-depth knowledge of biological and chemical processes. A combination with the specialisation courses in Health data and ML/AI will provide a data steward profile that has relevant domain knowledge professionally and data-wise and can help collect, curate and prepare health data with a view to subsequent ML/AI-based analysis and product/service development.

Profile 3: Information Science. Elective: Social Data + ML/AI

Bachelors with a background in information science have extensive knowledge of the interaction between registration, organisation and search of data and ethical issues at the same. A combination with a domain course in Social Data and method specialisation in ML/AI will provide a data steward profile that can organise and process social data, including purification of data and visualisation of



the same. This is with a view to creating the basis for the establishment of new knowledge about, eg. The use of organisations' information systems thereby contributes to strengthening the interaction between organisations and their users for more efficient use of usage data and ethical aspects associated with this.

Profile 4: BA Law. Electives: Health Data + Open Data & FAIR

A bachelor in law combined with the specialisation courses Health Data and Open Data & FAIR. It will give overall a health data steward profile that can help with principles and practices in the use of personal health and trial data. This includes but is not limited to securing data collection processes, publication, storage, sharing and integration of health data from different parties, but at the same time, with respect for rules/legislation in relation to the individual person's privacy and confidentiality.

Profile 5: Bsc Geography. Electives: Organisational and cultural data + Open Data and FAIR

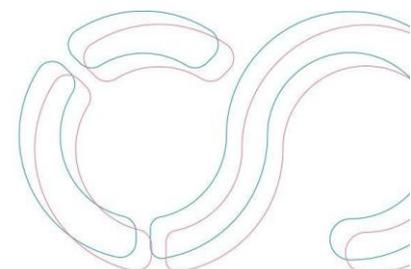
Bachelors with a background in geography have in-depth knowledge of the challenges that the collection of large data sets poses to an organisation. This especially applies to data that is relevant for urban planning and environmentally relevant data at municipal, regional and state levels. Here, e.g. on GIS-based datasets. By combining geographers' in-depth knowledge of large datasets with specialisation courses in Organisational & cultural data, and Open Data & FAIR, will the candidate have a strong starting point for participating in projects that require a qualified knowledge of organisational processes and knowledge of handling data based on FAIR principles.

Profile 6: BSc in pharmacy. Electives: Sequence data and bioinformatics + ML/AI or Open Data & FAIR

Bachelors in pharmaceuticals have in-depth knowledge of pharmaceuticals and the interaction between biology and chemistry. A combination with the domain course in sequence data and bioinformatics will provide a data steward profile that, with deep professional insight, can work with data generation and handling within bioinformatics. In combination with the method course in ML/AI, will the data steward profile also gain in-depth knowledge of common analysis techniques and will be able to contribute to the collection of data, cleaned and prepared as best as possible for further analysis. Alternatively, a combination with the methods course in open data and FAIR can provide a profile where detailed work can be done with data quality, availability, reusability and interoperability for research and development.

Brief: on the need for data stewardship education in Denmark

Data has become a central value-creating element in Danish society, and, not least because of this, **there is an acute national and regional need for data and IT specialists**, and the supply cannot really keep up with the demand. An analysis by the Danish High Schools [Danske Gymnasier] and The Danish Society of Engineers [IDA] (["Mismatch on the labour market for IT graduates in 2030"](#)) claims that **the shortage of IT specialists in Denmark could reach as high as 22,000 in 2030**. The proposed data steward master programme is unique in the Danish and Nordic education landscape and contributes to the training of data specialists in extensions of existing (not necessarily IT-technical) bachelor's degree qualifications. Data steward training can ensure that relevant data tasks, both



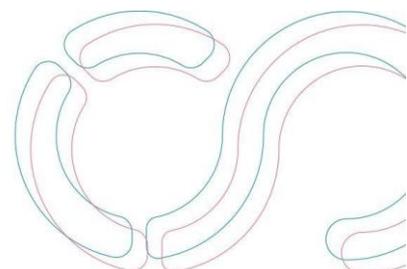
technical and disciplinary-specific and governance-related, are handled with a relevant interdisciplinary approach and thus frees up resources of computer scientists and developers for their core tasks within, e.g. software development, machine learning and artificial intelligence.

As part of the prequalification work, a survey was conducted. Eighty-four per cent of the respondents (115 people) assessed that data steward graduates are fully or partially relevant to their company/organisation. The respondents represented ten industries at the management or specialist level across the whole country. The second round of the survey documents that companies such as Novo Nordisk, Leo Pharma, Grundfos, Arla Foods, The Danish Film Institute and Statistics Denmark are all interested in hiring data steward graduates. Together they estimate that they **alone will need 150-200 data stewards over the next five years**. UCPH conservatively estimates that **there is an annual need for at least 50 data steward graduates in the Danish labour market**. This number is partly based on the generally increasing demand for digital and especially data skills towards 2030, the respondents' estimate of 150-200 data stewards over the next five years and the large majority of respondents acknowledging the employability of the graduates. Therefore, UCPH, after a trial period, has the ambition to **raise the number of graduates to 100-200 annually**.

Recommended improvements to the one-year master in data stewardship

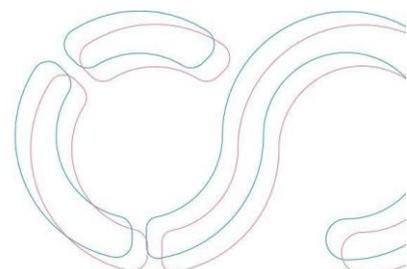
The following areas for improvement and concerns have been raised by the user panels and survey respondents:

- The master's programme is at the present time only available for students with a bachelor's or candidatus from a university. Hence, graduates from vocational colleges cannot apply. **The programme could beneficially be offered as an option for further or open university education.**
- The majority of the master programme will be conducted in the Danish language. **There is a need for data stewards in both Danish-speaking and English-speaking industries** in the Danish labour market. In this first iteration of the programme, the education includes elements that are anchored in disciplinary areas with either a Danish- or English-language conceptual world. In this way, the graduates will stay dressed to work as data stewards in companies and organisations, regardless of whether the working language is Danish or English.
- Working as a data steward embedded in a research team is a special case that requires the student to have research training or equivalent experience and understanding, as exemplified at [TU Delft](#). The one-year master does not claim to provide "research data stewards". **There is an oversupply of PhDs, and currently, business leaders complain that PhDs do not have the right competencies and skills for a career in business.** We see data steward training as an alternative job opportunity and career path for PhDs and PostDocs that also will fill the need for data support in the research team. At the present time, upskilling for junior researchers is not offered at UCPH.



- **A one-year stand-alone educational programme is not enough** to cover the need for training in data stewardship. More than skills, it requires the steward to have maturity and accountability to be able to be responsible for an organisation's data. The programme is seen as the "first step", after which the graduate develops their competencies and experience with regard to data needs at their place of work.
- In Denmark, competence development in data stewardship is at present time limited to short workshops and on-demand learning offered by external professional networks across Europe and participation in Skills4EOSC and EOSC Task forces. The following Danish university educations include elements of data stewardship, but no full-time courses in data stewardship are offered. Further, not all the courses are part of the Danish Open University and, as such available as single-course training options for data stewards and other professionals who are not enrolled in the university. **Data stewardship skills are taught in a variety of contexts with different stakeholders in mind** as part of the:

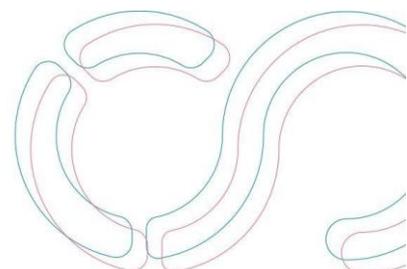
Business analytics (Denmarks Technical University), Business Administration and Data Science (Copenhagen Business School), Computer Science (6/8 Danish universities), Data Science (IT University & University of Southern Denmark), Informatics (Aalborg University), Information Science and Cultural Communication (University of Copenhagen), Information Technology (Denmarks Technical University), IT and leadership (Aalborg University), IT and Cognition (University of Copenhagen), Communication technology and system design (Denmarks Technical University), Communication & IT (University of Copenhagen), Mathematical modelling and computing (Denmarks Technical University), Software design (IT University), and Social Data Science (University of Copenhagen).



10.2 ETH Zurich, Switzerland

ETH Zurich is the mandated organisation for Switzerland in the EOSC Association. It takes a leading role in the further advancement of the principles of open science, open access and Open Research Data in Switzerland. In response to the call for proposals on data stewardship as part of the Swiss ORD Action Plan (see above), ETH Zurich has submitted a plan for the establishment of a Data Stewardship Network at the university. The plan outlines the creation of a service-oriented network of employees that already fulfil tasks in data stewardship and who want to extend these efforts or orient them more towards the openness of research data. In particular, this includes (1) ORD professionals and research data management specialists who are already employed at ETH Zurich specifically for those tasks and (2) ETH Zurich researchers (e.g., postdocs or senior scientists) with additional responsibilities related to research data management. Furthermore, a crucial step in professionalising data stewardship at ETH Zurich will include the tailoring of existing consulting services, training material, and guidance documents to the target group of data stewards and other ORD professionals in order to be able to implement a “train-the-trainer” approach. The ETH Zurich Data Stewardship Network¹⁶ was launched in January 2023 and already comprises over 30 active members. It will be coordinated, maintained and supported by employees of the ETH Library and Scientific IT Services. The Data Stewardship Network is foreseen to operate in 2023 – 2024, and there exists a commitment to maintain the network beyond this time frame.

¹⁶<https://library.ethz.ch/en/researching-and-publishing/data-management-and-policies/research-data-management/data-stewardship.html>



10.3 Universitat de Barcelona, Spain

The University of Barcelona (UB) is an example of commitment to open science, having an open access policy since 2011. In its institutional mission, the UB declares that it is an "open university" and includes the figure of a delegate of the rector for open science within its team. In addition, the university has the institutional repository "Dipòsit Digital" and cooperates with the deposits managed by the Consorci de Serveis Universitaris de Catalunya (CSUC). Finally, the UB, as a member of the League of European Research Universities (LERU), is working on the recommendations of its "Open Science and its Role in Universities" roadmap, with the aim of moving towards a cultural change for the implementation of open science in higher education.

There is currently a growing demand for training of staff involved in research support, so they can give appropriate advice to researchers. The university course "Open Science: promotion, support and evaluation", taught at the Faculty of Information and Audiovisual Media of the University of Barcelona, aims to respond to this demand.

This training is mainly intended for staff from university and research libraries, management teams in university and research centres, and staff from management units in institutes, centres and facilities, who carry out activities linked to research assessment, research support and knowledge management, and who want to improve their knowledge, integrate the experience into their work and reflect on their adaptation to this new environment. The primary objective of the course is to offer a current and global panorama of open science, as well as to develop practical cases that serve as a basis for creating or improving support services for research staff in a manner consistent with the new demands in university institutions and research centres.

The course "Open Science: Promotion, Support and Evaluation" was taught for the first time in 2022, face-to-face (with some non-face-to-face sessions and independent work) and was worth a total of 7 ECTS. The course teachers were national and international experts. A total of 25 students participated, all of them university graduates with experience in supporting research in university libraries (10 out of 25 = 40%) and research centres or management organisations (15 out of 25 = 60%).

The course consists of two modules:

- Module 1: "Fundamentals of open science" consists of six basic theoretical thematic units where the teaching staff and invited lecturers propose a series of theoretical presentations and discussions around the different topics. Students do independent work at the end of each unit.
- Module 2: "Research support in an open science context" is a predominantly practical module with five thematic units. It is conducted in the form of a workshop for the analysis of practical cases about policy evaluation, organisation of services and resolution of queries, guided and conducted by a team of teaching collaborators. Students work in groups and present the resolution of the different cases, followed by discussion with the rest of their classmates and feedback from the teaching staff.

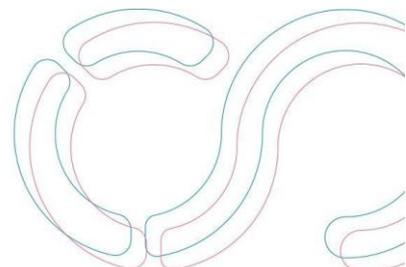


Table 2: The units worked on in the course

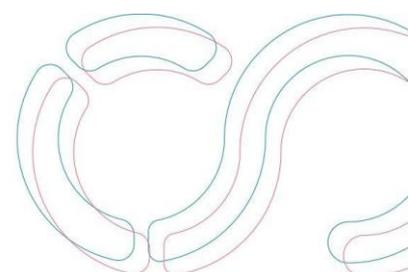
MODULE 1 (4 ECTS)	Unit 1. Introduction: science, scientific research, and open science
	Unit 2. Scientific integrity, transparency, and replicability
	Unit 3. Management of research data in accordance with FAIR principles
	Unit 4. Scientific communication in an open-access environment
	Unit 5. Assessing research in an open-access environment
	Unit 6. Science with and for society: citizen science, open educational resources and the openGLAM movement
MODULE 2 (3 ECTS)	Unit 7. Assessing scientific policies
	Unit 8. The organisation of research support services
	Unit 9. Analysis of funding agreements and research assessment calls
	Unit 10. Support actions in data management and open publications
	Unit 11. Design of information and training resources for research staff

The aspects related to the training in data stewardship are worked, first and theoretically, in unit 3 of the course, through the subject of research data management in accordance with the FAIR principles. Some of the topics discussed in this unit are the following:

- Typology and characteristics of research data.
- Open data and FAIR principles.
- Research data management planning: Data Management Plans (DMP). Tools for developing DMP.
- Policies, strategies, and requirements for the management of research data.
- Creation, reuse, and treatment of data. Storage, organisation, formats, anonymisation, and ethical aspects.
- Publication, dissemination, and preservation of data: data repositories, characteristics and typologies. The European Open Science Cloud (EOSC).

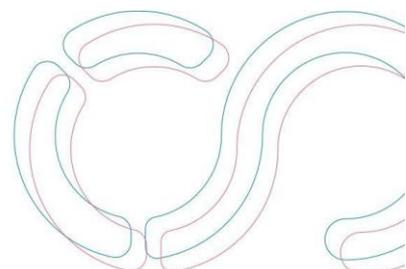
In module 2, the acquisition of the participant's own competencies and skills are deepened, through the practical cases in which specific actions related to research support are worked on, such as analysis of calls for funding, analysis of calls for evaluation in research, actions to support communication, actions to support data management, design of information and training resources for research staff. All of these aligned with the training skills of the course.

During and after the implementation of the first edition of this course (at the end of each module),



the students were surveyed to give insights into which aspects of the course could be improved. A clear motivation and need to receive more training in data management was seen, and, for this reason, the practical cases were focused more on this topic and on the work of specific skills to this research support profile. The development of these data management cases was aimed at the possible real implementation in the institutions of the participating students.

At this moment, the second edition is being prepared for the next academic year, 2023-2024, given the importance of the subject and the need for training detected. The new edition aims to include more practice and attention to research data.



10.4 Universidad Pablo de Olavide, Spain

The Pablo de Olavide University, located in Sevilla, launched the Research Data Management Service from the Library/CRAI (Learning and Research Resource Centre). As an extension of the research support services, it offered information, training, and consultancy.

Thus, in the first place, information materials were developed - a guides and tutorials portal of the Library/CRAI. In parallel, the first very general and introductory training actions were offered to all interested researchers, along with participation in talks addressed to the principal researchers of international projects. In a few months, the first consultancies were made for the development of project proposals and data management plans. In the following years, the provision of these services has been strengthened on three fronts: information, with the preparation of more materials and updating the existing ones; training, with a very significant expansion of the type of training actions and the target audience; and consultancy, providing support to a greater number of researchers and showing availability when opening calls.

The postgraduate course on "Research support services: information, data, evaluation and scientific publication" emerges as an action to transfer good practices learned to other professionals in the sector. The first time it was taught was in the 2021-2022 academic year at the Pablo Olavide University of Sevilla and consisted of a total of 20 ECTS. Up to 30 students participated in it, and the modality of studies was virtual. In the study plan, we see that the course consists of three modules and a final project. The modules are developed through different subjects. These are worth 2 ECTS and the final project, 4 ECTS (see table 3).

The program has an eminently practical character focused on the presentation of real cases and the participation of students. Not in vain, the course staff is made up entirely of professionals with extensive experience who, in addition, in some cases, carry out parallel research and teaching activities at various universities. Although the course is based on the necessary theoretical basis, its largest weight lies in the development of digital skills, tools, and methods so the student, having as a starting point the life cycle of research, information, and scientific data, is able to learn by doing. In the final part of the program, students must develop a project for the implementation of a support service for researchers.

The postgraduate course is designed as complementary training for all those who carry out or want to carry out research support, advice and consultancy work in organisations and institutions of the scientific system. It is also designed for company employees working with digital tools, information and data processing, knowledge creation and dissemination processes, research funding procedures and advancement in the research career, as well as the management of research data throughout its life cycle. It is, therefore, a training offer aimed at both practising professionals and those who want to pursue a new career. The profiles of the students who have participated in this program up until now are professionals who work or will work in research support services, in libraries, but also in other units and information services linked to academic and research institutions. There are also a certain number of participants who perform these tasks as independent professionals or within service companies.

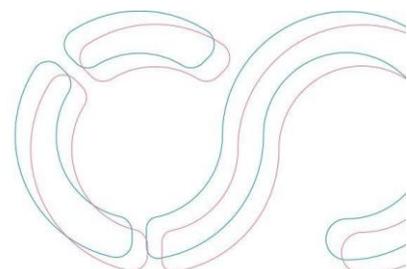


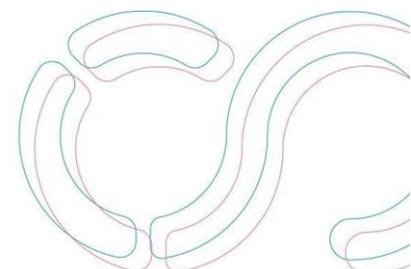
Table 3: Course modules

Module 1: Reference, information, and consultancy to support research	1. Digital research: support from libraries.
	2. Reference services in information units. Support for literature reviews.
	3. Research consultancy services.
Module 2: Open access, scientific communication, and evaluation of research activity	4. Open access, publication, and scientific communication.
	5. Bibliometrics and Research evaluation. Scientific information systems. 6. Advice on the development and evaluation of the research career.
Module 3: Management and visualisation of data at the research service	7. Research Data Management.
	8. Data visualisation and scientific information. Introduction to Big Data.
Final project	9. Final project

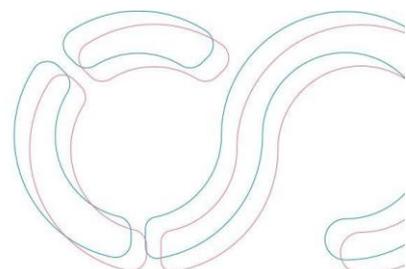
Thus, adapting to this student profile, this course focuses on acquiring competencies and skills in data stewardship. The intention is to educate students to become competent in analysing, synthesising, and managing available information and documents effectively, as well as knowing how to design innovative research support services that respond to current and future needs. One of the most relevant objectives of the course is for students to gain in-depth knowledge of the scientific communication ecosystem and how it is being affected by the open science and open access movement. The students, through the course, also develop skills in the use of digital tools commonly used within the research flows and which are based on the management of information and data.

Right now, the postgraduate course is celebrating its second edition. Given the success of the first, in which the number of students had to be increased, even so leaving applicants without registering, a second edition was proposed that, in substance, follows the thread of the first one. The number of synchronous sessions has been doubled, and new profiles have been incorporated into the teaching staff, mainly in the field of data management, visualisation, and Current Research and Information Systems (CRIS).

In addition to this programme, directed mainly, as has been said, to research support professionals, the Library/CRAI of the University launched a series of training aimed at researchers and doctoral



students linked to research data management. Thus, within the general training plans of the university for both groups, training actions have been developed related to the location and reuse of data, its management, its treatment, its processing and analysis, its deposit and creation of Data Management Plans. As part of this training effort, several research and visualisation data guides were created, are openly available and are commonly offered as training support material. During this academic year, in addition, some contents have been transferred, in an introductory manner, to the training programs in digital competence offered to undergraduate and master's students.



10.5 University College Cork, Ireland

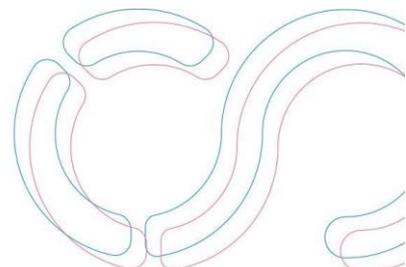
National context/landscape

In 2018, the Health Research Board (HRB) began the process of formalising the role of the data steward in the Irish landscape through their links with GO FAIR by organising a [five-day training programme](#) for the first Irish professional data stewards. This was aimed at building capacity to address the evolving requirements in the data stewardship area in the Irish Higher Education system. The HRB's [Policy on Data Management and Sharing](#), which came into effect in 2020, was one of the first clearly-articulated data management policies on a national level in Ireland.

Through a stepwise process and in consultation with key stakeholders, the National Open Research Forum (NORF) produced Ireland's first open research-focused [National Action Plan \(2022-2030\)](#), which states that 'by 2030 Ireland will have a mature ecosystem of infrastructures to support the responsible management and sharing of research data and other outputs in line with the FAIR principles... Data stewardship will be firmly established in the national landscape, with data stewards providing key expertise to assist researchers with research data management needs. Action, A5.1 of the plan, commits to 'support the development and professionalisation of research data stewardship nationally' by establishing a national data stewardship network'; to 'professionalise, embed and create sustainable career pathways for the role of the data steward within the national landscape' and 'develop a national approach to data stewardship training informed by best practices internationally' (p.19).

[Impact 2030](#) is the Irish government's 'blueprint for building a more inclusive and engaged research and innovation system'. This outlines that 'Under *Innovation 2020*, significant progress was made in particular on the Open Research and Research Integrity agendas' and promises continued support in those areas (p.28). The blueprint document states that "*Connecting Government: a digital and ICT Strategy for Ireland's Public Service*" will help to effectively harness data held by the Public Service, for example, through improved data sharing, thereby enhancing its use as evidence in public policy development and implementation (pp. 28-29). Also concerning public sector data, Ireland's [Open Data Directive](#) (2021) mandates the release of public sector data in free and open formats. [Impact 2030](#) also references the work of NORF in driving the agenda for open research, and one action of Impact 2030 under the 'Research Culture' pillar is 'Strengthen support for key cross-cutting policy agendas including Open Research and Research Integrity (p. 54)

UCC's Dr Coffey was project lead in a successful bid to the NORF 2022 Open Research Fund for the '[National Data Stewardship Network' project](#) named [Sonraí](#) to 'enable the development of data stewardship across the national research landscape by improving the recognition and professionalisation of data stewards and data stewardship skills, and facilitate knowledge development throughout the emerging community of research data management support staff'. The project's vision is a sustainable and cohesive network of data stewards nationally, which will promote and support the secure and effective management of our national data assets and the transition to a FAIR and open research data landscape.



Skills, roles and competencies

UCC has an established Research Data Service, which provides university-wide support for best practices in data management, preservation and sharing since 2018 and the appointment of the Research Data Coordinator, Dr Aoife Coffey. In 2021, the Research Data Service led a [Research Data Stewardship survey project](#), gathering information on research data stewardship activities in UCC, the scope of those activities, and any gaps in current resources and skills, with results later presented online to the university community. Conclusions included that there had been increased data stewardship activities in the previous three years and the suggestion that data stewardship training and upskilling were needed within the community.

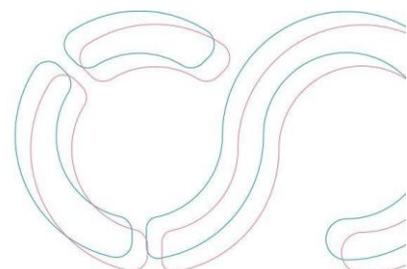
In 2022, Dr Deborah Thorpe was appointed as Research Data Steward at UCC Library to contribute to the development of researchers' skills in research data management and FAIR data, with a special focus on domain-specific support for researchers with arts and humanities data. Dr Coffey has provided on-the-job training to Dr Thorpe in this new role in the form of mentoring in supporting researchers with their data management planning needs, the collaborative organisation of researcher training workshops, helping to form connections with other data stewards working within and beyond the university; and the collaborative design of a project to offer domain-specific embedded data stewardship support at UCC.

Data stewardship training

The Irish Research Data Management HEAnet mailing list was established in February 2021 by University College Dublin (UCD) Data Manager Jenny O'Neill and Therese Ahern of Munster Technical University with the stated aim of offering support to those in Ireland who support researchers with research data management; being a place to flag useful resources; and being a venue to share information. One of the first posts to this mailing list was to publicise the first in a series of webinars across March-May 2021 on Open Research in Ireland, organised by the NORF Working Group on FAIR data, that focused on 'support for FAIR data through policy enhancement, professionalising data stewardship, and monitoring FAIR data and open science'. UCC took an active organisational and speaking role in these webinars with Dr Coffey and Eoghan O'Carragain (former UCC Head of Research and Digital Services), presenting on the landscaping work of the WG and open research infrastructures.

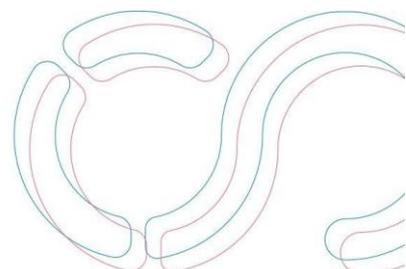
Dr Coffey co-organised a three-day NORF/FAIRsFAIR/EOSC Synergy workshop in 2021 to support the development of data stewardship skills among staff in higher education institutions and other research-performing organisations in Ireland. This was followed in 2022 by a webinar on the development of a Research Data Service, co-organised by Dr Coffey in collaboration with Jenny O'Neill of UCD.

Data stewardship training has been available at UCC since 2019, and the creation of the Research Data Service, a self-guided unit hosted on our Virtual Learning Environment, is available university-wide, and this is supported by regular in-person and online classes. Dr Coffey has made contributions to undergraduate and postgraduate modules across a range of disciplines regularly since her appointment. In 2020 she collaborated on a project funded by the National Teaching and



Learning Forum to create an OER on Open Research targeting undergraduate and taught postgraduate programs. This resource is now freely [available nationwide](#) and includes research data management and FAIR.

Training in data-related skills is continuing to evolve since the appointment of the Research Data Steward at UCC due to increased capacity. In 2022, a six-part Research Essentials workshop series launched, focusing on FAIR data; research data management; metadata for researchers; open access; OpenRefine and Tidy Data. This is being continued and expanded into 2023 and reviewed in light of feedback gathered after every workshop. Dr Thorpe has also begun to organise domain-specific training, such as an educational visit by the Digital Repository of Ireland aimed at researchers with arts and humanities data (March 2023). Both Dr Coffey and Dr Thorpe have undertaken Carpentries Instructor Training (2022-23) in order to expand skills training at UCC further in the coming years.



10.6 University of Bologna, Italy

The University of Bologna (UniBo) has been an active participant in the international debate on open science for many years, starting from the signature of the Berlin Declaration in 2003 and of the Messina Declaration in 2004. The commitment of the Alma Mater to building an open, transparent and shared science is expressed both externally, through its participation in national and international networks as well as internally.

The 2017 University policy on open access to research publications and the inclusion of open science courses in academic curricula (e.g. the "[Open Science](#)" course held by prof. Silvio Peroni in [the Digital Humanities and Digital Knowledge Master's Degree](#), the course on [Data literacy](#) of prof. Stefania Mignani) confirms Unibo's commitment.

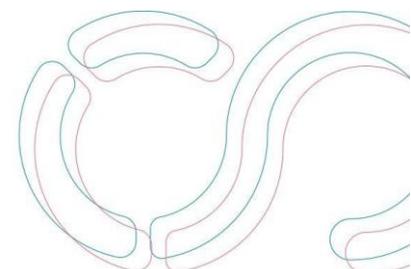
Since 2019, open science has been included in the University's strategic plan. [The Strategic Plan 2022-2027](#) is the programming document outlining the University's mission, objectives and areas of intervention. In this context, objective 31, "Fostering the development of Open Science", states the commitment of the University towards promoting awareness and training activities on open science, supporting the participation of the University in national and international networks and initiatives on open science; creating services and digital infrastructures to support open science; encouraging open access publications in all areas of knowledge; encouraging FAIR research data management; promoting citizen science activities. This objective takes into account the relevance of FAIR (Findable, Accessible, Interoperable and Reusable) Research Data Management as a foundation of the research flow, which needs to be pursued independently of its "openness".

To support the fulfilment of the presented objective, the steering committee identified the need to equip the University with specialised data stewards who will delve into the topic of research data and, in particular, map existing international networks for the various identified disciplinary macro-areas, propose services and identify resources (including infrastructures) that will guarantee the FAIR management of research data. In addition, there is a strong focus on the FAIR management of research data and the related requirements of the new European framework programme for research and innovation, Horizon Europe, and the main national funding programmes.

Skills, roles and competencies

The implementation of the data stewards project started with the recruitment of four research fellows, each one representing a different disciplinary area (e.g. Health, Technology, Humanities, Social Sciences). The fellows were selected based on their specialised training and on their previous research experience in the domain areas to ensure the best support to researchers with domain-specific problems in data management.

The activity of the data stewards has been focused on four major aspects: 1) building consciousness towards the themes of Research Data Management and FAIR principles; 2) supporting research data management and Data Management Plan (DMP) drafting in the context of Horizon 2020 and Horizon Europe competitive research projects; 3) performing a benchmarking analysis to evaluate the scenario of the main monitoring models and type of services already



implemented to support open science and FAIR Research Data Management in other Universities; 4) performing a comparison analysis within the Italian and European scenario in terms of Research Data Management Policies.

An analysis of the workflow for the FAIR management of research data and the drafting of the DMP was carried out, with the identification of specific strategies for interacting both with individual researchers (in the case of projects with a single beneficiary) and with extended working groups (in the case of projects with several partners, in which UniBo plays the role of coordinator). In particular, the focus was on two aspects: helping researchers identify their research data and building a path of consciousness in the management of the data.

The first point saw the definition of different approaches and methodologies of analysis, depending on the context and the disciplinary field. The second point was approached by developing tools to support the literacy of researchers on the obligations and requests of the funding body in the context of the Horizon Europe programme, the correct management of the data and the consequent drafting of the DMP.

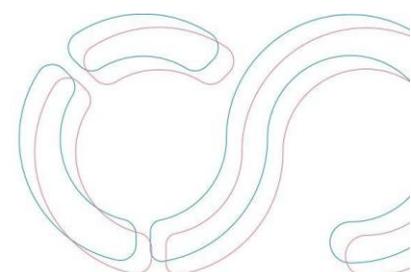
Parallel to these educational actions, direct support was given to the drafting of DMPs for several Horizon Europe, Horizon 2020 and PNRR projects, both single- and multi-beneficiary.

A benchmarking analysis was conducted to compare the different strategies adopted by a set of twelve European universities in terms of infrastructures, services and support systems for the correct and FAIR management of research data. These outputs will be employed to further develop the support and infrastructures needed to implement FAIR research data management at the University of Bologna. The policies on Research Data Management adopted by the same universities were studied and compared with the objective of writing and proposing an analogous policy for the University of Bologna. Since 2018 the Alma Mater has provided its researchers with a policy dedicated to open access to publications. Thus the objective is to accompany it with another one focused on Research Data Management. Up to now, only two Universities in Italy, the University of Padova and the University of Milan, have such a policy to give directions to their researchers.

Data stewardship training

The training of the data stewards was conducted in the first month after their recruitment and covered the following aspects: FAIR principles, proper management of research data, including privacy, ethics and intellectual property aspects, purpose and structure of a Data Management Plan (DMP); open science and open access to publications, with a focus on mandatory practices in the context of the Horizon 2020 and Horizon Europe funding programmes; Organisation of the University and division of competences in supporting the management of competitive research projects and the University's infrastructure for publications and research data; Specific training for the different subject areas: in-depth "hands-on" training on FAIR data management and open access sharing through interaction with tutors and the respective research groups.

The training was a combination of a series of online courses and resources together with lectures, conducted jointly by different areas of expertise at the University of Bologna (such as the Research Area, Knowledge Transfer Office, and Digital Library...), which support researchers at different



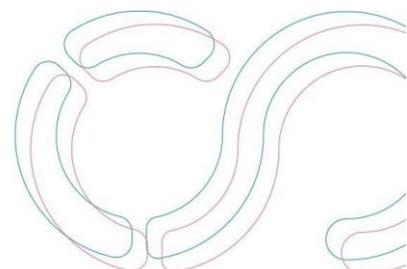
stages of their research work. The training also included a "Train the trainer" course with Dr Shalini Kurapati, former Data Steward of TU Delft, who shared her experience, points of attention and useful tools for the correct management of data.

Parallel to the training, the group carried out an in-depth study of the existing training offer available online, dedicated to data stewards. In line with the actions promoted by the EOSC Data Stewardship curricula and career paths Task Force, a mapping of the training offer was prepared with annotations in the margin to define its target and effectiveness. The mapping is an incremental work aimed at creating an index of training opportunities.

This review analysis existed in an annotated index of the main topics for a forthcoming training cycle for data stewards: both external training materials, available on the web and created ad hoc internally at the University, were organised accordingly in specific folders.

The training plan and materials are the basis for building the training of new data stewards who will join the group. Each data steward is supposed to be the contact person for a macro subject and to organise and verify the training of the new colleague with regular meetings.

In addition, starting from the Academic Year 2022-2023, in the frame of the RltrainPlus project, task 2.2, led by UniBo (Prof Monica Forni), a specific PhD training related to European Research Infrastructures, European Open Science Cloud and Data Management. The pilot is run at the Biotechnological, Biocomputational, Pharmaceutical and Pharmacological Sciences PhD program in cooperation with the University Politecnica de Madrid (Prof Oscar Corcho).



10.7 University of Vienna, Austria

The University of Vienna has been at the forefront of open science and Research Data Management (RDM) in Austria. Vienna University Library hosted the [launch of the EOSC](#) in 2018 and has had a leading role in the [EOSC initiative in Austria](#). Together with the partner institutions in the [FAIR Data Austria](#) project (2020-2022), the University designed [data stewardship models](#) for Austrian RPO based on international best practices.

As there was no formal training program for data stewards available in Austria at the time, the Library developed a formal further education program – the [certificate course “Data Steward”](#) – alongside a new network of data stewards embedded on the level of individual faculties. The goal of the course is to help participants from Austria and other countries acquire knowledge and key competencies to perform tasks as data stewards at research institutions.

Certificate Course “Data Steward”: The Basics

- Academic degree: Certificate from the University of Vienna
- Language: English
- Duration and scope: 2 semesters part-time, 15 ECTS credits
- Target groups: People with research experience and research support staff that want to work as data stewards at research institutions
- Costs: 2950 €
- Part of the continuing education program of the [Postgraduate Center of the University of Vienna](#)

Developing the Course

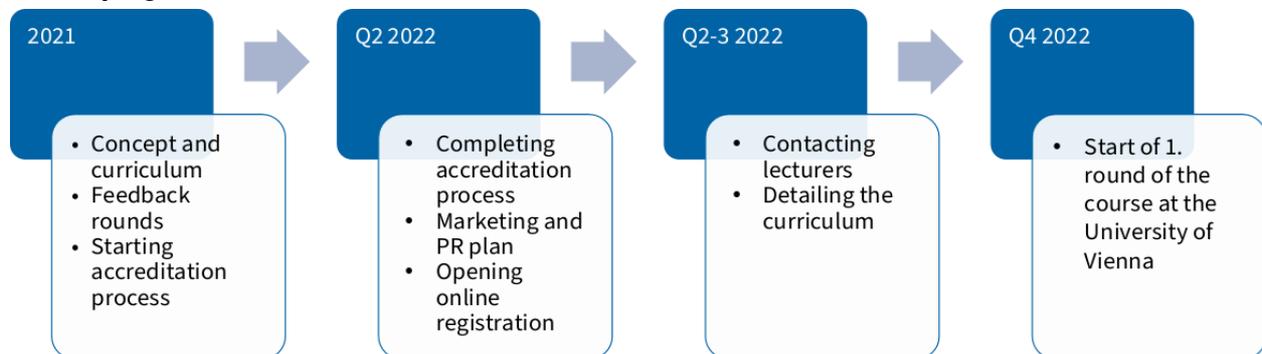


Figure 4. Timeline

The course has three main objectives:

- Competence acquisition
- Peer-to-peer learning
- Community building

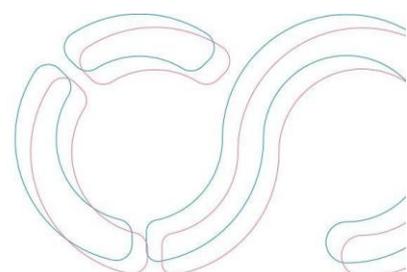
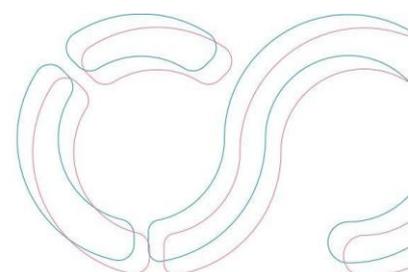




Figure 5. Data Stewards Competences. Source: Gruber, A. et al. (2021): Kompetenzen für Data Stewards an österreichischen Universitäten. DOI: [10.31263/voebm.v74i1.6255](https://doi.org/10.31263/voebm.v74i1.6255)

The curriculum of the certificate course “Data Steward” is based in part on the certificate course “Data Librarian”, which was offered by four Austrian research libraries in 2018-2020. Further, we utilised the results of the FAIR Data Austria project and similar further education programs in other countries – especially [DataTrain](#) of the U Bremen Research Alliance and the certificate course RDM ([Zertifikatskurs FDM](#)) of the TH Köln and the State Initiative for RDM in North-Rhein Westphalia ([Landesinitiative für Forschungsdatenmanagement fdm.nrw](#)).

The initial curriculum design was reviewed in three workshops with experts for data stewardship and research data management training from the FAIR Data Austria partner institutions and the DINI/nestor Research Data WG – Training/Further Education ([AG Forschungsdaten – UAG Schulungen/Fortbildungen](#)) in July-August 2021. The recommendations were invaluable in finalising the curriculum as well as the learning objectives together with the instructors. The formal accreditation process of the University of Vienna was completed in May 2022.



The course consists of five obligatory modules and takes two semesters part-time.

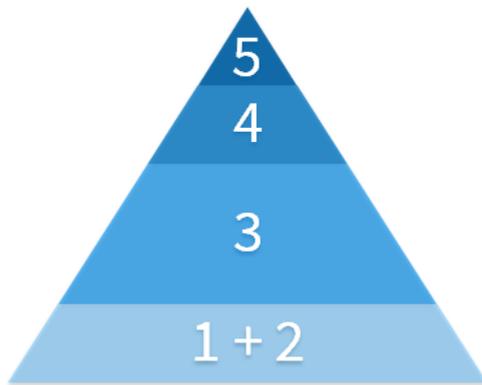


Figure 6: Modules and Contents

Module 1 (2 ECTS): Basics of Research Data Management (RDM) and Open Science

Module 2 (3 ECTS): Basics of IT and Data Science

Module 3 (6 ECTS): FAIR Research Data in the Research Data Lifecycle

Module 4 (2 ECTS): RDM Support

Module 5 (2 ECTS): Data Stewardship in Practice: Project Work

Module 1 introduces the most important concepts of RDM and open science, good scientific practice, cost estimation and financing models, legal and ethical aspects of RDM as well as the roles and tasks of data stewards at research

institutions.

In **module 2**, the participants learn about data science and data-driven research. Moreover, they acquire the basics of programming based in part on the [Carpentries](#) curricula, such as working with the unix shell and Python or version control with Git.

Module 3 builds on the two introductory modules and covers further relevant subjects along the research data life cycle, such as:

- Project management and funding landscape
- Data management plans (DMP) and DMP tools
- Data organisation and visualisation
- Metadata and research data documentation (incl. persistent identifiers, ontologies, etc.)
- Data security and storage
- Repository management and long-term preservation
- Interoperability and data migration
- Data reuse (incl. legal requirements)

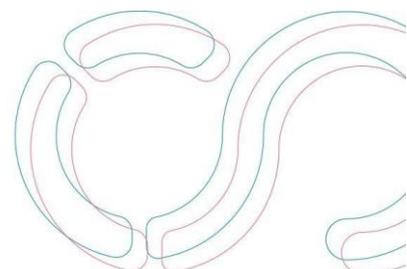
This module also allows the students to learn more about research data management in specific research disciplines from current data stewards – natural and life sciences, humanities, social sciences and technical sciences.

Within **module 4**, the participants focus on translating their newly acquired knowledge to the typical tasks of data stewards. The focus is on developing support services for research data management, conducting training, as well as needs assessments and requirements engineering.

The **fifth module** includes an individual or a group project applying the acquired skills and knowledge to data stewardship practice.

Instructors and Peer-to-Peer Learning

The modules are split into 2 to 8-hour sessions taught by [experts](#) from Austria and other European countries. The first module takes place on-site in Vienna for one week in October and includes an



optional socialising and cultural program. The following four modules are conducted online with a mix of interactive live sessions and self-study. The participants are part of set study groups they can work with within the live sessions as well as for assignments to facilitate exchange among disciplines and countries.

The first round of the course started in October 2022 with 25 participants from 10 countries. The course is set to finish in the summer of 2023, with the second round starting in October 2023.

