Ahokas, Minna; Assinen, Pauli; Eriksson, Lise; Fält, Katja; Fredriksson, Malin; Fuchs, Siiri; Glerean, Enrico; Harjunen, Catarina; Hradecka, Lucie; Hynnä, Nina; Jäntti, Helena; Kanerva, Päivi; Koikkalainen, Riitta; Koiranen, Joona; Kuusiniemi, Mari Elisa; Kvist, Ari-Pekka; Laine, Katja; Lennes, Mietta; Marjamaa, Minna; Moisio, Marja; Mäntylä, Elina; Nurmi, Niina; Nurminen, Elina; Nykyri, Susanna; Nyström, Janne; Näpärä, Liisa; Rantasaari, Jukka; Rauste, Päivi; Saarenpää, Taina; Satama, Manna; Sinisalo, Riikka; Småros, Anna; Sunikka, Anne; Söderholm, Maria; Virtanen, Mika; Tuikka, Anne-Marie; Xu, Qingbo

Advancing RDM Careers: A Framework for Expert Education in Finland

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Advancing RDM Careers: A Framework for Expert Education in Finland

Final full report

By: Roadmap for professional qualification of data management experts working group (also called RDM Experts Working Group)

Abstract

In the fast-paced digital era, the demand for research data management (RDM) experts has increased across various sectors in Finland. However, a gap exists in professional training for individuals aspiring to become RDM experts. Traditionally, self-taught RDM experts train newcomers while fulfilling their primary roles in research organisations.

This report by the Professionalisation of RDM Experts Working Group addresses the lack of a formal education path by proposing a framework for a specialised training programme in Finland. The proposed training programme, consisting of a modular curriculum, aims to provide systematic high-quality education catering to the needs of various sectors, including research organisations, public administration, and companies.

The report describes the collaborative efforts of the working group, including meetings, workshops, and interactions with relevant stakeholders. The work began with an environmental scan of current Data Steward education, after which the group split into three subgroups: Subgroup 1 developed promotional material for building awareness; Subgroup 2 outlined the main content of the education; and Subgroup 3 focused on finding an organiser and securing funding.

The report concludes with plans for the implementation, ongoing discussions on funding models, and the selection of Tampere University's Continuing Education as the partner for planning and organising the education. Continuous dialogue with stakeholders and international collaboration are emphasised, following the model set by the University of Vienna's Data Steward training.

In summary, the Professionalisation of RDM Experts Working Group's final report outlines a comprehensive plan to address the growing demand for RDM expertise in Finland through the development of a specialised training programme aligned with national and international standards and principles.

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Introduction

In the rapidly advancing digital era, research data management (RDM) experts have become increasingly important across various sectors. However, Finland currently faces a gap in professional training for individuals aspiring to become data management experts, a role that is critical in ensuring the integrity and utility of research data. This report by the Professionalisation of RDM Experts Working Group aims to address this gap by outlining a framework for the development of specialised training programmes in Finland.

RDM professionals, who have traditionally been self-taught, find themselves at the forefront of training newcomers, often in addition to their primary roles within higher education, research infrastructures, libraries, and private-sector research entities. Recognising the growing demand for RDM expertise, accentuated by the digitalisation of research processes, this report proposes the establishment of a formal training path that is aligned with the needs of working life and supports the orientation of new professionals in this evolving field.

Environmental scan of current data steward education

Current educational and training programmes do not sufficiently include training aimed at developing and maintaining the data management skills required across the various sectors of society. For example, data management experts working in higher education institutions currently have to acquire their skills through their job tasks. Further training leading to qualifications would support more resource-efficient and higher-quality science and functioning in the information society. The project supports the efficiency of the national research system by strengthening the necessary broad connection with working life and continuous learning, the importance of science and data as part of functioning in the information society and promotes the inclusion of data management skills in higher education studies. The content of the project follows the principles made within the scope of national Open Science and Research Coordination (AVOTT) and partly responds to the objectives set out in them. It also supports the Ministry of Education and Culture’s continuous learning strategy Objective 1 by creating a clear path for developing and qualifying as an expert in the field.

The proposed programmes are intended to provide systematic high-quality education that caters to the needs of higher education institutions, research institutes, public administration, and companies. With the first training programmes in Europe having already been launched, Finland faces the challenge of developing its own curriculum, especially one that adheres to Finnish legislative requirements and covers the expansive subject matter of RDM, including data protection, security, documentation, storage, sharing, publishing, and ensuring the further use of data.

This necessity is underpinned by the findings of Barend Mons (2020), who estimated a requirement of approximately 500,000 data stewards in Europe to manage the vast output from 10 million noteworthy data producers. The urgency is echoed in the European Research Data Landscape’s Final Report (2022), which highlights the acute need for data management skill enhancement, especially among young researchers and doctoral students.

In light of these needs, the recommendations from relevant bodies such as the European Commission (2022) and the open access research data policy by the Federation of Finnish Learned Societies (TSV) (2022) are clear: professional support for researchers in managing data and the promotion of FAIR data principles are paramount. The latter not only accelerates scientific progress and public benefit but is also a cornerstone of evidence-based decision making and lifelong learning.

How did we work?

The working group was established under the national Open Science and Research Coordination (AVOTT). The working group had an open registration procedure. The first meeting was on 15.2.2022. Thirty-seven people participated in the working group. The working group participants are listed in Appendix 1. The working group had a total of 17 meetings, and an average of 20 members attended each meeting. The last meeting was on 19.1.2024.

We began with an environmental scan of data steward education. The whole working group participated in this. Together, we also collected training ideas and wishes.

The initial preparation for the groupwork included brainstorming workshops in which we discussed what types of qualifications we needed, what skills would be necessary, and what type of educational format would be suitable for achieving formal qualifications for RDM experts. These workshops, drawing on the group members' experience of working with RDM, were informed by and compared with the sources reviewed as part of the environmental scan.

At the working group's seventh meeting, we divided into three subgroups, whose tasks were:

- Subgroup 1: Prepare background material to answer the question: Why do we need this education?
- Subgroup 2: Outline content of the education
- Subgroup 3: Find an organiser and start-up funding for the education

The subgroups reported their work to the working group meetings every six weeks. The subgroups met and worked independently. We grounded the work of the subgroups together.

Identification of required steps

The working group was tasked with creating a roadmap for the professional development training of data management professionals. Drawing on previous work, it was reasonably straightforward to focus on determining the practical steps required to realise the education. We condensed these steps into the following stages.

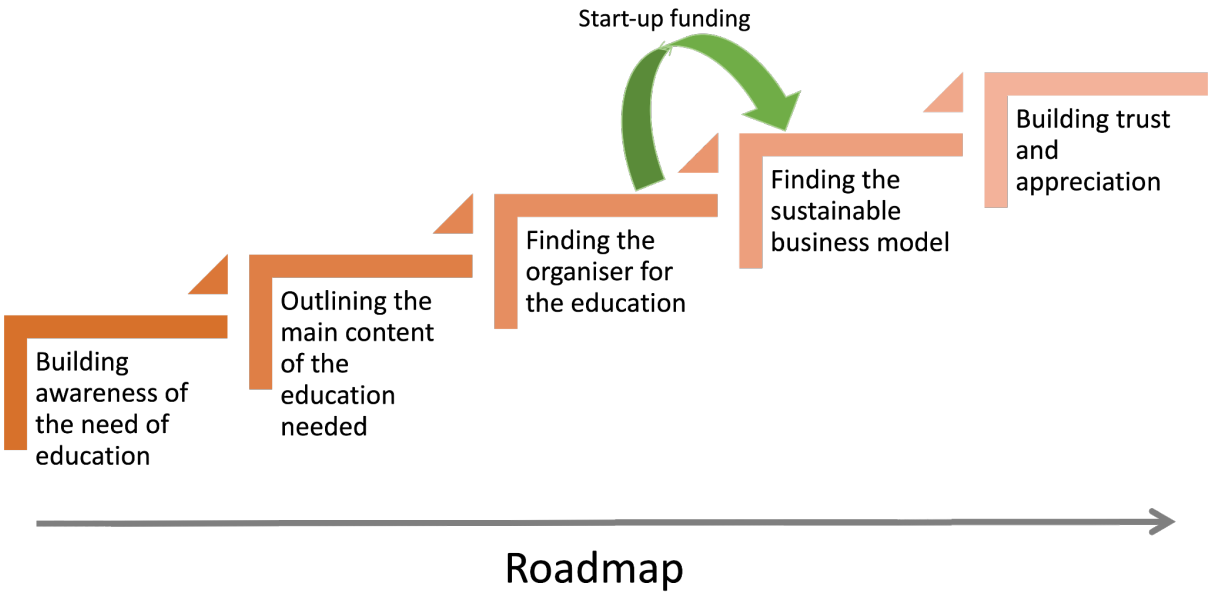

Figure 1: Main steps of the roadmap.

1. Building awareness of the need for education.

Data management experts and most professionals in the field recognise the need to organise vocational training. However, the need for education or its absence is not generally acknowledged, so increasing awareness is essential.

2. Outlining the main content of required education

The necessary content of the required education has been discussed in several previously published reports (see Appendix 2). However, to clarify the matter, it was necessary to create a separate description of the required education content.

3. Finding the organiser of education

Education requires an organiser. It was important to identify which entities could be suitable for this task.

4. Finding a sustainable business model for education

To ensure the continuity of education, a viable funding model needs to be devised. To get started, some form of initial funding akin to seed money would be necessary.

5. Building trust and appreciation

To derive benefit from the education, it is crucial to strengthen employers' trust in the usefulness of the training.

The working group decided to start implementing tasks according to these steps. Subgroup 1 was assigned the task of addressing point 1, Subgroup 2 point 2, and Subgroup 3 for points 3 and 4. Regarding point 5, we hope the collaboratively planned education, through extensive cooperation, will build trust from the perspectives of both the employers and participants.

Work of the subgroups

1. Subgroup 1: Building awareness of the need for education

1.1 Task of the group

Subgroup 1's main task was to build awareness of the required education by preparing promotional material. The subgroup consisted of 10 members, who met six times (28.11/11.1/8.2/14.3/26.5/31.5) to plan the content and coordinate the tasks and to refine the prepared promotional material.

1.2 How the group worked

We started by defining the main audience groups of the promotional material. We recognised the following target audiences:

- The Ministry of Education and Culture (OKM); possible provider of the funding
- Higher Education Institutions' (HEI) organisations (management, HR); recruiters of data stewards
- Companies; recruiters of data stewards
- Open science and research (AVOTT) community; AVOTT coordination and the professionals already working in the field

The first task was to prepare material for the funder, the Ministry of Education and Culture, and HEI management. Second, promotional materials would be prepared for the HEI (students and professionals) and AVOTT communities in the form of newsletters. Companies could also be contacted. Initially, we planned to make tailored promotional material for the different target groups.

The next step was to decide the promotional material's format. We chose to design the material in the form of a PowerPoint presentation. We also discussed a logo for the marketing. The reference materials used in producing the presentation are listed in Appendix 2.

The work was divided among the subgroup members so that each member chose one of the reference materials to work on. Hence, each item of reference material was analysed by summarising the reports' main findings. We then transferred these main findings to our PPT presentation to create its structure and main content.

Our target promotional PPT presentation originally included seven topics:

- i) background and aims of the group
- ii) how does a Data Steward (DS) relate to other professionals?
- iii) why DS professionalisation is needed
- iv) the current international situation
- v) the situation in Finland
- vi) what is required (e.g. the number of professionals and the long-term continuation of funding are important)
- vii) recommendations by the group

1.3 Outcome

The final material was simplified, consisting of six topics: why; benefits; roadmap; assignments of the working group; the plan; next steps.

The promotional PPT presentation has been used at the

- OKM. Subgroup 3 had a discussion with the ministry in May 2023.
- TSV. AVOTT steering group meeting on the 29.5.2023
- Open Science and Research Summer Conference 13.6.2023
- Open Science and Research Winter Conference 2023.

The education's organiser will take responsibility for the future planning and execution of the materials.

2. Subgroup 2: Outlining the main content of the required education

2.1 Task of the group

Subgroup 2 was given the task of developing a training curriculum for Research Data Management (RDM) experts. We built on the materials gathered in the previous working group workshops and agreed that the curriculum should be modular, including various courses to improve both technical and soft skills. Its structure was planned to cover basic principles, specific topics, and practical elements like internships. Initially, the idea was to create a minor subject with 25 credits, but the plan also considered offering certification through a combination of basic and advanced courses. The main goal was to create a curriculum distinct from existing Data Science and Analytics programmes in Finland, focusing more on data management skills in research, which would complement learners' existing abilities. While the subgroup did not delve into detailed teaching methods or syllabus design, we aimed to set the overall content and learning objectives, recognising that these skills could also be useful outside academia.

To ensure our curriculum was aligned with national and international standards and avoided duplicating existing efforts, we focused on utilising existing RDM resources and studies on RDM expert skills. In particular, we followed the Skills4EOSC project, funded by the European Commission's Horizon Europe programme (GA 101058527), which aims to harmonise scientific data management professionalisation. Additionally, Iryna Kuchma (a member of the Data Stewardship Curricula and Career Paths EOSC task force), joined our eighth meeting to provide insights from the Data Stewardship Curricula and Career Paths EOSC task force.

2.2 How the group worked

The subgroup consisted of 10 members. In addition to subgroup discussions at the general working group meetings, the subgroup met three times to discuss the direction of our work and collaborate on the task.

We started by collecting a list of existing educational resources and searching for reference materials on the skills and competencies necessary for RDM professionals. The six reference materials' reporting on prior enquiries on this topic can be found in Appendix 1.

To achieve our goal, we first compiled a spreadsheet listing topics based on the skills or competencies covered in the reference literature. Between meetings, the subgroup members worked independently on the shared spreadsheet to combine related topics into themes that could be covered in the curriculum's individual courses and to describe the related learning goals based on the reference literature.

On 4 April 2023, the University of Vienna presented their certificate course for Data Stewards in a webinar organised by OpenAIRE. We recognised many similarities with our efforts and the curriculum we had outlined so far. The University of Vienna course had already been accredited as a further education course granting a certificate to graduates. Because formalising a curriculum which would grant the certification of professional qualifications was our group's goal, we considered it practical to compare our curriculum draft with the University of Vienna course. We noted that harmonising curricula across Europe would also benefit the certification's international transferability. This was discussed at the general working group meeting on 14 April 2023.

The University of Vienna (UV) course follows a similar structure of modules, starting with general concepts and continuing towards more practical topics, with project work as the final module (similarly to our suggestion to include internship-like work in which course participants can apply new knowledge and their educational or professional background in a practical setting).

Our suggestion for the curriculum originally worked on the assumption that we would need to provide 25 credits to enable the accreditation of a minor subject in a higher education setting and provide specialised content for professionals involved in various aspects of RDM. Our original suggestion therefore strove to offer a wide range of specialised courses, making use of all aspects considered in the reference literature. However, the UV course provided an example of a 15-credit package sufficient for the professional certification of individuals from diverse backgrounds, offering generic, domain-agnostic, and interdisciplinary content. At the general meeting, we discussed this and recognised that the level of specialised expertise we tried to include was developed through a combination of knowledge, experience, and the honing of soft skills, and could not be achieved with formal education alone. Meanwhile, the UV course covered the essentials for people from different backgrounds to specialise in RDM, and the more specialised expertise would be achieved by a combination of background knowledge and further work experience.

The UV course is aligned with the direction for which we aimed in our course content development and provides many useful tips for course development and implementation.

The course encourages participants to relate the content to their existing knowledge, which promotes the seamless integration of new skills. Networking opportunities with trainers and colleagues further enhance learning. Because expertise is further developed in practice, the UV course organisers plan to create an alumni community that will provide a platform for ongoing engagement and collaboration between participants. The UV course assigns participants to small groups from different backgrounds who collaborate on tasks and exchange knowledge. Conflict resolution within the group and confrontation with different approaches helps participants develop the key social and personal skills required for collaboration. Working in small groups promotes active participation and encourages quieter individuals to share their ideas. We discussed that such a collaborative way of working had the potential to provide additional soft skill and expertise development which we originally tried to cover through course content.

2.3 Outcome

We compared our suggestions for the curriculum based on the reference literature with the structure and content of the University of Vienna certification course and combined them into the following suggestion for a curriculum consisting of five modules, with suggestions for possible optional add-on training in more specialised topics which could be provided depending on the availability of trainers and demand from participants.

The content of the five modules is suitable for the various roles or career paths described in the reference literature, which can be summarised as policy-oriented, research-oriented, data-science/analysis-oriented, and infrastructure-oriented RDM expert profiles, with an additional “agent of change” role which can be adopted by all. Each participant can apply the acquired knowledge to the context of their background. The target group can include professionals, researchers, or advanced students (MA or PhD level).

The main content of the required training consists of a formalised package of the background knowledge and skills required to specialise in research data management (RDM) and help others in an expert role. In addition to the content, it is recommended to engage participants in activities such as groupwork, projects, practice cases, or internships to support soft skills development, the practical application of new knowledge, community building, and knowledge exchange. Below is an outline of how the course could be organised, and which topics are important for future research data management experts:

Module 1 (2 ECTS): Basics of RDM and Open Science
Content:
- Digital data types
- Introduction to the research data life cycle
- Basics of data organisation and documentation
- Basic legal and ethical aspects
- Open Science and data sharing.

Module 2 (3 ECTS): Basics of IT and Data Science
Content:
- Introduction to data science, incl. machine learning, coding basics, carpentries…
- Secure Data Storage
    - Backup

    • Access control

Optional add-on training:
• Research Methods and Software Management
• FAIR for research software.

Module 3 (6 ECTS): FAIR Data in the Research Data Life cycle
Content:
• FAIR principles in quantitative and qualitative science
• DMP
• Digital data types and file formats
• Metadata
• Data appraisal and long-term storage of data: repositories and digital preservation
• Persistent identifiers
• Discipline-specific use cases.

Module 4 (2 ECTS): RDM Support
• Consulting, training, needs assessment, requirements engineering …

Optional add-on training (specialised support):
• Data protection for research data
• Research ethics principles
• Basics of biobanks research and secondary use of health data
• RDM in grant applications
• Research project management.

Module 5 (2 ECTS): Data Stewardship in Practice: Project Work
• Flexible options: Project work, short internship, work experience report, …

3. Subgroup 3: Find an organiser and start-up funding for education

3.1 Task of the group

Subgroup 3 had two main tasks: 1) finding a coordinating body; and 2) applying for funding for the training.

As the aim was to have the best possible coordinating body for the planning and organisation of training, it had to meet certain conditions. We defined these conditions as follows:
The organiser should be someone who

- can award credits for the education
- is a recognised player in the sector
- is committed to organising the training
- has a good working relationship with a body that already provides data management services and therefore has a good understanding of the skills required in the field.

The group's second task was to consider what type of start-up funding was available, the requirements for applying for the chosen funding, and the discussion of the possible organiser of the education.

Points to consider included establishing:

- what type of funding model would best suit our purposes
- if we would need to apply for external funding for the course, and if yes, where and when
- how to secure the education's continuity
- how the training would be organised in practice, and by whom
- the number of credits for the course.

3.2 How the group worked

To identify the potential organiser of a coordinating body, we had preliminary discussions with universities offering degrees in information science and/or records management and archival science. In these cases, we contacted the centres for continuous learning and the units providing training in this field (University of Eastern Finland, Tampere University, University of Oulu, Åbo Akademi). We also contacted the University of Helsinki Centre for Continuing Education HY+. Open Science and Research Coordination (AVOTT) was contacted in the context of the funding application.

It was necessary to examine the funding model, as the starting point was that this was not a degree course, i.e. the funding would not come from the basic funding of higher education institutions. Funding models were discussed with library managers, while interest in resourcing the training and the possibility of library staff participating in paid training were explored. Funding models were also discussed with potential training providers. In the case of in-service training especially, it was decided that the training participant would pay. This would also ensure the continuity of the training after the pilot scheme funded by the Ministry. In terms of international benchmarks, the University of Vienna course is fee-based, as are courses from commercial providers. One of the options discussed was a hybrid model, in which materials were openly available, but if you wanted a certificate for the training, you would have to pay for it.

3.3 Outcome

Almost all the parties showed an interest in organising the training. We were thus able to choose from several good options with whom to continue the negotiations. We finally selected the Tampere University community's Continuing Education as a partner to plan and organise the training. A coordinator will be provided by external funding. The university library and the centre for continuous learning will share the responsibilities.

Based on discussions with university libraries, it can be stated that libraries generally viewed the proposed training positively. The training was considered somewhat necessary. Yet when asked about the cost at which they would be willing to send new employees for training, it was difficult to obtain a clear answer. It seems the cost of training cannot be very high.

Funding for the training plan was sought from the Ministry of Education and Culture (special grants for promoting science). Before preparing the application, a preliminary discussion was held with the ministry to review the application's possibilities, conditions, and criteria. The

application was written during the spring of 2023, and the application deadline was before midsummer. A positive decision on the application was received in December 2023.

It is intended to use the grant to hire a coordinator for the training and cover other costs related to the initiation of the training, such as the planning and implementation of the training content, the technical implementation of the course platform and content, material production, compensation for previously produced materials, marketing, travel and meeting organisation costs, and administrative expenses.

A year will be allocated to plan and prepare the training. The planning will be conducted by a working group, coordinated by a coordinator hired for this task. After a year, the training will be launched for the first time. It is planned that the training will be organised with an initial onsite session followed by online sessions, for example. At the end of the training, there will be a practical internship period and a development task.

The training is intended to be designed modularly, allowing participants to complete only part of it or the entire programme. A course certificate is obtained only by completing the entire programme. The plan is to organise the training annually, and its scope will be 15 credits. Collaborative partners in the training plan also include CSC – IT Center for Science and the Open Science and Research Coordination (AVOTT) collaboration group. Active dialogue is ongoing with the organisers of the Data Steward training at the University of Vienna (https://postgraduatecenter.at/en/programs/communication-media/data-steward/), and there are preliminary discussions about the possibility of implementing some training themes in international cooperation.

In the funded project, a comprehensive 15-credit qualifying education is planned, providing skills for various data management professions. The training will be implemented twice to allow participation while working. The project will also conduct a market analysis to ensure the optimal implementation of the training format based on current training needs and target groups.

Conclusions and next steps

Experts in data management are needed in professions that have emerged with the digitalisation of research and those that will emerge in the near future to support and enhance scientific research and the sharing of results. This is a common understanding among individuals currently working in data management expert roles. The need for comprehensive education is widely recognised.

As a result of the exploration conducted by the working group, divergent perspectives also emerged. In particular, individuals without practical experience in data management expert roles found it challenging to assess the appropriate size of a training programme. In such cases, solutions such as proposing a course lasting no more than a few days were suggested. Yet those with a technical background believed existing training offerings could be tailored and combined to create a sufficient knowledge base for working in data management roles. This is certainly true, particularly when oriented towards roles such as

software engineers or data scientists. There was also a notion that there were already enough experts in the field, particularly in the corporate world.

The working group decided to rely on the intuition of data management experts already working in the field and the results of studies conducted elsewhere on the subject. However, the divergent perspectives clearly indicate the importance of increasing awareness. Awareness needs to be increased regarding the need for professional competence in data management, the required skills, and the necessity of training.

The working group's goal is to design a roadmap and actively lay the groundwork to initiate the necessary training in Finland. Based on the work of the working group and its subgroups, we were able to create a concrete plan and seek funding for it.

Next steps

The year 2024 will be allocated for the education's planning and preparation. The planning will be conducted by a working group, coordinated by a coordinator hired for this task. After a year or eighteen months, the training will be launched for the first time. At the end of the training, there will be a practical internship period and a development task.

It is intended that the training will be designed modularly, allowing participants to complete only part of it or the entire programme. A course certificate will be obtained only by completing the entire programme. The plan is to organise the training annually, and its scope will be 15 credits. Collaborative partners in the training plan also include CSC – IT Center for Science and the AVOTT collaboration group. Active dialogue is ongoing with the organisers of the Data Steward training at the University of Vienna (https://postgraduatecenter.at/en/programs/communication-media/data-steward/), and there are preliminary discussions about the possibility of implementing some training themes in international cooperation.

Reference materials

D7.4 How to be FAIR with your data: A teaching and training handbook for higher education institutions. https://zenodo.org/records/5837500

European Commission (2022). *European research data landscape: Final report*. https://op.europa.eu/en/publication-detail/-/publication/03b5562d-6a35-11ed-b14f-01aa75ed71a1/language-en/format-PDF/source-275372809

EOSC skills and capabilities (the tables from the EOSC appendix are in our other document)

Mons, B. (2020). Invest 5% of research funds in ensuring data are reusable. *Nature*, *578*(7796), 491. https://doi.org/10.1038/d41586-020-00505-7

Open research data and methods. National policy and executive plan by the higher education and research community for 2021–2025: Policy component 1 (Open access to

research data) and 2 (Open access to research methods and infrastructures). https://doi.org/10.23847/tsv.667
Professionalising data stewardship in the Netherlands: Competences, training and education. Dutch roadmap towards national implementation of FAIR data stewardship. https://zenodo.org/records/4623713

The Research Data Management toolkit for Life Sciences: Data life cycle. https://rdmkit.elixir-europe.org/data_life_cycle

Appendices

Appendix 1. Working group participants

Minna	Ahokas	CSC – IT Center for Science
Pauli	Assinen	University of Helsinki
Lise	Eriksson	Åbo Akademi University
Katja	Fält	Tampere University
Malin	Fredriksson	Åbo Akademi University
Siiri	Fuchs	CSC – IT Center for Science
Enrico	Glerean	Aalto University
Catarina	Harjunen	Åbo Akademi University
Lucie	Hradecka	Aalto University
Nina	Hynnä	Häme University of Applied Sciences
Helena	Jäntti	University of Eastern Finland
Päivi	Kanerva	Tampere University
Riitta	Koikkalainen	National Library of Finland
Joona	Koiranen	Metropolia University of Applied Sciences
Mari Elisa	Kuusniemi	University of Helsinki
Ari-Pekka	Kvist	University of Oulu
Katja	Laine	University of Vaasa
Mietta	Lennes	University of Helsinki
Minna	Marjamaa	Laurea University of Applied Sciences
Marja	Moisio	University of Helsinki
Elina	Mäntylä	University of Turku
Niina	Nurmi	University of Helsinki
Elina	Nurminen	Metropolia University of Applied Sciences
Susanna	Nykyri	Tampere University
Janne	Nyström	Arcada University of Applied Sciences
Liisa	Näpärä	National Library of Finland
Jukka	Rantasaari	University of Turku
Päivi	Rauste	CSC – IT Center for Science
Taina	Saarenpää	University of Lapland
Manna	Satama	University of Eastern Finland
Riikka	Sinisalo	LUT University
Anna	Småros	Arcada University of Applied Sciences
Anne	Sunikka	Aalto University
Maria	Söderholm	Finnish Environmental Institute
Mika	Virtanen	University of Oulu
Anne-Marie	Tuikka	Turku University of Applied Sciences
Qingbo	Xu	Hanken School of Economics

Appendix 2. Subgroup 1 reference literature

- Professionalising data stewardship in the Netherlands: Competences, training and education. Dutch roadmap towards national implementation of FAIR data stewardship. Link: https://zenodo.org/records/4623713
- National Coordination of Data Steward Education in Denmark: Final report to the National Forum for Research Data Management (DM Forum). Link: https://zenodo.org/records/3609516
- National Coordination of Data Steward Education in Denmark: Next steps. Link: https://zenodo.org/records/4278944#.Y2i8y8tBxPY
- Gaps in data stewardship: What kind of needs for training do data stewards face in supporting research? Link: https://www.rd-alliance.org/system/files/RDA-PDS-IG_Training_Landscape_Gaps-in-Data-Stewardship_Inital-Report_2022.pdf

Appendix 3. Subgroup 2 reference literature

Reference	*Annotated bibliography*
1) EOSC Skills and Capability Framework	The EOSC Skills and Capability Framework, as described in the report, is designed to assist organisations in planning the professional development of their staff who operate or use EOSC services. It focuses on identifying competencies and learning materials that match required capabilities, especially in data stewardship. Although the document is somewhat old (2018), there is a detailed summary in Annex A1 of the skill set required from multiple perspectives of users (researchers, research software developers, data managers) and support roles.
2) Claudia, E., Katarzyna, B., Coffey, A. M., Cornet, R., Danciu, A., Demchenko, Y., ... & Zhou, B. (2021). D7. 4 How to be FAIR with your Data: A Teaching and Training Handbook for Higher Education Institutions. https://doi.org/10.5281/zenodo.6674301	The handbook is a resource designed to assist higher education institutions in incorporating FAIR (Findable, Accessible, Interoperable, Reusable) principles into their curricula and teaching. The greatest value is the detailed list of practical materials like competence profiles, learning outcomes, lesson plans, and additional supportive information.
3) Demchenko, Y., Stoy, L., Engelhardt, C., & Gaillard, V. (2021). D7. 3 FAIR Competence Framework for Higher Education (Data Stewardship Professional Competence Framework). https://doi.org/10.5281/zenodo.5361917	The “FAIR Competence Framework for Higher Education (Data Stewardship Professional Competence Framework)” is part of the FAIRsFAIR project’s Work Package 7. The presented framework is designed based on a job market analysis for Data Steward and related professions. It has been validated against existing Data Stewardship frameworks and is structured for easy integration into academic curricula.
4) Jetten, M., Grootveld, M., Mordant, A., Jansen, M., Bloemers, M., Miedema, M., & van Gelder, C. W. (2021). Professionalising data stewardship in the Netherlands. Competences, training	The “Professionalising Data Stewardship in the Netherlands” report emphasises the importance of a structured approach to professionalising data stewardship. It focuses on defining competencies, training, and education for data stewards, aligning with the Dutch roadmap towards implementing FAIR data stewardship. Although this is another long document, the tables are extremely valuable, as they contain considered definitions of the roles required in data management and open science, and the related knowledge needed to achieve the

and education. Dutch roadmap towards national implementation of FAIR data stewardship. https://zenodo.org/records/4623713	goals.
5) Gaps in data stewardship: What kind of needs for training do data stewards face in supporting research? RDA-PDS-IG_Training_Landscape_Gaps-in-Data-Stewardship_Inital-Report_2022.pdf (rd-alliance.org)	"Gaps in Data Stewardship" analyses the training needs of data stewards in research, identifying gaps in the current training materials and skill sets of data stewards and researchers in Research Data Management (RDM). It discusses challenges in professionalising data stewardship and recommends learning pathways for data stewards. Section 3.1 (Gaps) and 3.2 (Solutions in Governance of Data Stewardship) are important and valuable contributions to our subgroup's topic.
6) Data Stewardship Curricula and Career Paths (Unpublished presentation from Skills4EOSC, Data Stewardship Curricula and Career Paths)	The "Data Stewardship Curricula and Career Paths" presentation for the Skills4EOSC project focuses on developing curricula and career paths for data stewards, aiming for international recognition and alignment. It outlines two main work streams: defining a minimal curriculum for data stewards and establishing career paths for them. The presentation includes a description of roles within the EOSC ecosystem, situational examples for each role, and a list of required skills.