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FAIR Data Austria – Paving the Way for Enhanced Research Data Management and Collaboration

Abstract

In an age dominated by digital information, the importance of accessible and well-managed research data cannot be overstated. The FAIR Data Austria project is at the forefront of pioneering initiatives that cultivate a culture of data sharing and collaboration, adhering to the principles of Findability, Accessibility, Interoperability and Reusability (FAIR). The project addresses the challenges associated with implementing FAIR principles – from technical complexity to cultural barriers – and takes a multi-faceted approach that includes capacity building initiatives, community engagement and the development of tools and infrastructure to facilitate FAIR research practices.

Keywords

FAIR Data Austria, Research Data Management, Scientific Research, maDMPs, Repositories

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1   Introduction

Digitization has fundamentally transformed the way scientific research is conducted. With the availability of modern technologies and increasing connectivity, researchers can effectively collaborate to address complex societal issues, leading to interdisciplinary partnerships and fundamental new insights with significant societal impact. As research becomes more digitalized, funding agencies have also recognized the importance of setting clear goals for the research they support. There are strategies and measures in place to ensure that research outcomes are discoverable and accessible, maximizing their potential for use.

These developments have profound implications for the research community. The challenge lies in conducting interdisciplinary research and bringing about a shift in the mindset of researchers. Instead of viewing themselves solely as focused experts with self-generated data, they should prioritize data discoverability and structured collaborations. Achieving this requires a sustainable research infrastructure.

In this article, we first provide essential background on Open Science and FAIR (Findable, Accessible, Interoperable, Reusable) principles and extend the narrative to encompass international initiatives and developments, setting the stage for a nuanced understanding of the broader context. We than delve into national developments, focusing on the FAIR Data Austria project, where we outline its objectives, methodologies, and the strides it has made. Throughout this exploration, we shed light on the remarkable achievements and tangible results of the FAIR Data Austria project, offering readers valuable insights into the lessons learned from its implementation.

2 Background

2.1 Embracing Open Science: A Paradigm Beyond Boundaries

In the ever-evolving landscape of knowledge creation and dissemination, the paradigm of Open Science (OS) emerges not merely as a buzzword within the scientific community but as a transformative force with implications far beyond traditional research boundaries. Contrary to misconceptions, Open Science is not confined solely to the realm of scientific inquiry; rather, it serves as a means to democratize knowledge as a global public good (UNESCO, 2022). Its effectiveness hinges on active engagement with the public, emphasizing the pivotal role of inclusivity and accessibility. Beyond the technical aspects, it calls for a shift in perspective – a recognition that embracing Open Science is not just about the methodology but about embracing core values that underpin the scientific process.

Quality and integrity stand as keystones in the Open Science framework, fostering collective benefit rather than individual gain. Open Science seeks to democratize the entire scientific process, challenging the conventional notion that openness is limited to the dissemination of research outputs. It is a call to action, urging the scientific community to re-evaluate not only what is shared but how it is shared. As we navigate the complex terrain of Open Science and Scholarship, it becomes evident that this movement is not just about doing the same things openly; it is about doing things differently. It involves the embrace of new actors who, too, hold valuable knowledge, expanding the collective intellect beyond the confines of established institutions (WOELFLE et al., 2011).

2.2 Understanding FAIR Principles

The application of the FAIR principles signifies a commitment to ensuring that data is effectively managed and utilized in the digital age. The acronym FAIR encapsulates four key tenets that guide the handling of data and emphasize that data should be easy to find, accessible, interoperable across different systems, and designed for reuse (WILKINSON et al., 2016; JONES & GROOTVELD, 2017).

Findable:

To make data findable means to enable others to discover and locate the information effortlessly. This involves employing clear and consistent metadata, unique identifiers, and indexing strategies. A findable dataset is one that is easily located by both humans and automated systems.

Accessible:

Accessibility is about making data available to others. It involves enabling humans and machines to access data, if necessary, under certain conditions and restrictions. FAIR does not mean that data has to be open.

Interoperable:

Interoperability is crucial for data integration and collaboration. It ensures that data can be seamlessly combined with other datasets, or used by various machines and applications. Standardized formats, protocols, and interfaces play a vital role in achieving interoperability, allowing for the creation of more comprehensive and insightful analyses.

Reusable:

The ultimate goal of managing data is to facilitate its reuse for new research endeavours. To make data reusable, it is essential to document and structure it in a way that others can comprehend and effectively build upon. Clear documentation that conforms to community norms, well-defined methodologies and unambiguous licences so others know what kinds of reuse are permitted enhance the likelihood that data can be leveraged for future investigations.

2.3   International developments

In essence, adhering to the FAIR principles transforms data into a valuable and renewable resource. By making data findable, accessible, interoperable, and reusable, researchers contribute to a more efficient and collaborative scientific ecosystem, driving innovation and discovery across various fields. These advancements carry far-reaching implications for the research community that requires a paradigm shift in how interdisciplinary research is conducted. The challenge at hand involves

not only breaking down traditional disciplinary boundaries but also instigating a fundamental shift in the mindset of researchers. Rather than perceiving themselves solely as specialized experts generating independent data, researchers should adopt a collaborative approach that prioritizes data discoverability and structured interdisciplinary partnerships.

To address these challenges and foster a culture of collaborative data-driven research, numerous international initiatives have emerged as pioneers in the field. Notable among these are the Research Data Alliance (RDA)[2], GO FAIR Foundation[3], CO DATA[4], OpenAIRE[5], or the European Open Science Cloud (EOSC)[6]. In essence, these international initiatives collectively strive to establish a sustainable research infrastructure that addresses the current challenges but also lays the foundation for a future where collaborative, interdisciplinary research is the norm, ensuring that research data is not only generated but also shared and utilized to its full potential. With the EOSC[7], the European Commission aims to achieve these goals by pursuing the vision of a "Web of FAIR data and services".

3   National Developments

Like other European countries, Austria is implementing measures and strategies to promote Open Science, Research Data Management and the FAIR principles. These approaches include incentives for Open Science practices, the promotion of FAIR data and research integrity, the provision of infrastructure, training, and support for researchers, the development of Data Stewardship programs, and the establishment of roles for Data Stewards.

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2   https://www.rd-alliance.org/

3   https://www.gofair.foundation/

4   https://codata.org/

5   https://www.openaire.eu/

6   https://eosc.eu/

7   https://eosc.eu/partnership/

The Open Science Policy Austria[8], adopted by BMBWF (Federal Ministry of Education, Science, and Research), BMDW (Federal Ministry for Digital and Economic Affairs), and BMK (Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology), provides the framework for these efforts (OPEN SCIENCE POLICY AUSTRIA, 2022). The Policy aligns with the Open Data and Public Sector Information Directive[9] 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.

Two key implementation mechanisms are the BMBWF calls "Digital and Social Transformation in Higher Education" from 2019 and "(Digital) Research Infrastructures" from 2022 (BMBWF, 2020; BMBWF, 2023). These calls aim to drive digital transformation in higher education and support the development of digital research infrastructures.

Collaboration and strategic cooperation in projects related to digitization, along with the coordinated planning of necessary follow-up activities, are crucial for securing long-term project success and developing sustainable strategies for the management of research data and information. In this context, the "Research Data Cluster" was established (initiated by BMBWF) and encompasses five projects: FAIR Data Austria[10], RIS Synergy, Austrian DataLAB and Services, Shared RDM Services & Infrastructure, and ARI&Snet – Austrian Research Information & Service Network. A particular focus is placed on identifying synergies and potentials for resource-efficient collaboration among the various research institutions in the country.

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8   https://www.bmbwf.gv.at/Themen/HS-Uni/Hochschulgovernance/Leitthemen/Digitalisierung/Open-Science/Open-Science-Policy-Austria.html

9   https://digital-strategy.ec.europa.eu/en/policies/psi-open-data

10 https://forschungsdaten.at/en/

4   FAIR Data Austria

The BMBWF-funded FAIR Data Austria project (runtime 2020–2022) aimed to establish an integrated research data management system, considering the FAIR principles, for Austrian universities, supporting the entire lifecycle of research data (BLUMESBERGER et al., 2021).

The project consortium, led by Graz University of Technology (TU Graz) in collaboration with core partners TU Wien and the University of Vienna, as well as cooperation partners such as the Medical University of Graz, the University of Innsbruck and the Academy of Fine Arts Vienna, represents a joint effort to promote collaboration between Austrian universities[11]. This collective effort has maximized synergies and consolidated the role of Austrian institutions in the international research landscape while actively supporting the implementation of EOSC.

The FAIR Data Austria project has been completed and represents an important milestone in Austria's drive towards Open Science and improved Research Data Management (RDM). Building on its achievements, the project has successfully developed and established a range of tools and services, including machine actionable Data Management Plans (maDMPs), repositories for research results, cross-university RDM training and Data Stewardship programs.

4.1   Managing Research Data Lifecycle with maDMPs

A Data Management Plan (DMP) describes the processes associated with the creation, management, sharing and preservation of research data that result from any research activity. DMPs are to be prepared ahead of the activity so that all involved can know what is to be done with the data obtained, and thus serve as a basic framework for describing the intricacies of scientific experiments and describe aspects such as data storage, accessibility and the conditions for data reuse. It is worth noting that most funding agencies worldwide require the submission of Data Management Plans for research projects, emphasizing their essential role in ensuring transparent and comprehensive handling of data throughout the research lifecycle (MIKSA et al., 2021).

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11 https://forschungsdaten.at/fda/

A notable advancement is represented by machine-actionable Data Management Plans (maDMPs), a recommendation endorsed by the RDA (MIKSA et al., 2020). These plans facilitate the seamless exchange of information outlined in traditional DMPs in a format that machines can act upon. Essentially, maDMPs offer a structured approach to organizing the information typically found in conventional DMPs (MIKSA et al., 2019; MIKSA et al., 2023).

FAIR Data Austria's DAMAP tool[12] emerges here as a key player, an open-source software designed to create DMPs with machine-actionability at its core. DAMAP integrates seamlessly with existing institutional services (i.e., it takes information from personnel and project databases, retrieves data from institutional repositories, and provides a list of storage locations), allowing it to be customized to different researchers' needs.

The development journey of DAMAP sheds light on crucial lessons learned, emphasizing the delicate balance between user experience and the depth of information needed. The tool has successfully navigated challenges related to automatic prefilling of information, requiring proactive engagement with various university departments. To achieve integration with existing systems, the importance of common interfaces and controlled vocabularies becomes evident, paving the way for future improvements and collaborations. The DAMAP tool is currently established at TU Wien and TU Graz. Ongoing and future work involves further development of DAMAP, its deployment at various universities, and its long-term opening to a wider range of users.

4.2   Establishing Repositories for Research Results

Repository platforms serve as fundamental pillars in the research ecosystem, ensuring the preservation, sharing, and reuse of research results. Through the utilization of the InvenioRDM open-source software[13], the FAIR Data Austria project partners have been actively engaged in the collaborative project led by CERN[14], establishing

12   https://damap.org/

13   https://inveniordm.web.cern.ch/

14   https://inveniosoftware.org/products/rdm/

as well repositories for research results across various institutions. This collaborative effort has provided valuable insights to our developers, making them key experts in advancing repository software, and has also empowered institutions like TU Graz and TU Wien to incorporate features at an accelerated pace with enhanced testing, surpassing the efficiency of isolated development.

Institutions such as TU Graz, TU Wien, and the University of Innsbruck have successfully establishment next-generation repositories for research results based on InvenioRDM. The positive response from researchers highlights the central role of institutional repositories in adhering to FAIR principles and relieving researchers of the burdens associated with data security responsibilities.

Repositories for Databases

While traditional repositories excel at storing files, databases present a unique challenge. The FAIR Data Austria DBRepo, a solution for a specialized database repository, aims to preserve database-stored data and to provide essential functionalities such as insertion, update, and deletion of records. Focused on relational databases, this repository concept incorporates a rich API, allowing users to design databases directly within the repository from the project's inception, according to the FAIR principles, supporting reproducible queries, versioning of data and searching for specific research datasets[15] (WEISE et al., 2021). As core functionalities solidify, the emphasis on an open-source, community-driven approach promises continuous improvement and evolution.

4.3 Cross-University RDM Training

In the realm of data-intensive research, providing researchers and support staff with robust RDM training is imperative. FAIR Data Austria, recognizing this need, has embarked on developing cross-university training modules that are easily accessible through various media formats, ensuring wide availability and reusability as Open Educational Resources (OER).

To expedite these efforts, a dedicated Training Task Force, comprising representatives from partner universities, was established in December 2020. This task force

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15 https://www.ifs.tuwien.ac.at/infrastructures/dbrepo/1.3/

conceptualized a cross-university training approach, encompassing (i) webinar series "Research Data Management in Austria", (ii) a curated collection of OER materials, and (iii) the development of RDM courses at individual universities.

The webinar series "Research Data Management in Austria" stands as a highly effective mechanism for knowledge transfer and stakeholder engagement in the dynamic landscape of data-intensive research. Serving as a cornerstone of FAIR Data Austria's comprehensive training initiative, these webinars provide an accessible and interactive platform for researchers, support staff, and service providers to delve into various aspects of RDM. Covering topics such as Data Clearing House, Cloud Native Labs in the Austrian Open Cloud Community, Electronic Lab Notebooks, Repositories for Research Data (InvenioRDM), and more, the series not only imparts essential RDM skills but also fosters interdisciplinary collaboration and awareness. The success of around 40 webinars, with a national and international attendance, underscores their significance in meeting the growing demand for RDM training.

The curated OER collection[16] provides a concise introduction to nine crucial RDM topics (FÜRST et al., 2022). This collection, designed for location and time-independent learning, serves as a valuable resource for self-study. Offering compact materials, it enables individuals to delve into key RDM themes at their own pace, fostering a flexible and accessible approach to acquiring essential knowledge in the realm of data management.

The experiences gained from implementing cross-university RDM training highlight a growing interest in RDM training that requires sustained resources at institutional and national levels. Key lessons include the importance of raising awareness about sharing sensitive data, addressing technical challenges in virtual training, and advocating for stronger international cooperation in future initiatives.

4.4   Professionalisation of Data Stewardship

An initiative within the FAIR Data Austria project has worked on streamlining Data Stewardship in Austrian research institutions. The initial findings of the case study are based on surveys, interviews and workshops conducted in the Austrian context

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16 https://fair-office.at/lernen-sie-mehr/

(REICHMANN & HASANI-MAVRIQI, 2021). There, it was found that while data governance is a challenge for any institution, the challenges faced by universities are particularly complex, because the academic community expects universities to keep data secure while respecting privacy and academic freedom. In addition, universities find themselves at very different stages of adoption of appropriate data management mechanisms. Amongst the challenges faced by Data Stewards, the breadth of competencies they are expected to bring to institutions makes it difficult to establish the list of necessary and sufficient conditions and related tasks and required training that they must fulfil.

The main outcome of this initiative is formalized as a toolbox, and presents Data Steward models, the corresponding competencies, and available training (HASANI-MAVRIQI et al., 2022). The toolbox is intended to enable universities to choose the appropriate implementation strategy according to their conditions 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. Models range from a Data Steward Contact Point, in which a single data steward acts as a point of contact for inquiries, a Data Steward Office, which provides direct advice and wider support, to a Data Steward Network, which provides discipline-specific knowledge and support. The report highlights the importance of competencies such as communication, technical expertise and discipline-specific knowledge for Data Stewards and suggests that a team of Data Stewards is required to fulfil all competencies.

There are several challenges in implementing Data Stewardship at Austrian universities to meet the demands of data-driven scientific research. There is no consensus on the skills, roles and responsibilities of Data Stewards, and different universities have different perceptions of Data Stewardship. Funding for Data Steward positions is also a major challenge, as the source of funding and the nature of the Data Steward role may vary depending on whether they build on existing resources or are newly hired. Furthermore, funding Data Stewards from project resources can be detrimental to building a knowledge base, but there are valid reasons for implementing Data Stewardship at project level. The conflicting demands of securing ongoing funding and ensuring appropriate disciplinary Data Stewardship pose a significant problem.

4.5   International Alignment

The members of the FAIR Data Austria project have actively participated in and contributed to various international initiatives, demonstrating their strong commitment to advancing global standards in Research Data Management. Their involvement extends to influential organizations such as the RDA, GO FAIR Foundation, CO DATA, OpenAIRE and the EOSC Association, where they have led national nodes and participated in working groups to shape policies, advocate for open and interoperable data practices and promote collaborative frameworks. Through their active involvement in these initiatives, FAIR Data Austria project members have shared their expertise and gained valuable insights into international best practices, aligned the project with global standards and promoted interoperability. This collaborative engagement underlines the project's ambition to create a harmonized and accessible research data landscape on a broad, international scale.

5   Conclusion

In conclusion, the FAIR Data Austria project has successfully brought together diverse stakeholders, fostering collaboration and knowledge exchange among researchers, data professionals, policymakers, rectorates and representatives from the public sector. This collaborative culture has facilitated interdisciplinary cooperation and collective growth. The project marked advancements in research data management tools and services and demonstrated a commitment to creating an efficient and collaborative research environment.

One of the project's notable achievements has been the establishment of dedicated teams at partner universities, emphasizing the importance of FAIR data management and encouraging active community engagement beyond the project team. Furthermore, the development of open-source solutions across all facets of the research data lifecycle has been a pivotal accomplishment, with many of these solutions currently in the roll-out phase or already operational. FAIR Data Austria has also set the stage for future developments and alignment with international initiatives, emphasizing the importance of sustaining connections and the network formed during the project.

The FAIR Data Austria project has left a lasting impact on Research Data Management in Austria, promoting Open Science, Open Innovation, and a shared vision of a FAIR and accessible research landscape. By addressing the intricacies of data planning, preservation, and database management, these tools pave the way for a more accessible and sustainable research future.

Looking to the future, the tools, services and networks established as part of the project are suitable for achieving further progress in the area of open science and open innovation. The journey continues with the BMBWF-funded project "Shared RDM Services and Infrastructure," led by TU Graz and spanning 2023–2026[17]. This project builds upon the achievements of FAIR Data Austria, expanding its reach and influence with the inclusion of six additional partners into the consortium.

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17 https://forschungsdaten.at/en/sharedrdm/

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