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Annex to D2.1 ~ Catalogue of Minimum Viable Skillsets

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Deliverable Abstract

This Annex to D2.1 offers examples of Minimum Viable Skillset (MVS) Profiles, and provides an example demonstrating how these MVS may be annotated and summarised using Open Science Skills Terms based on available terminologies. Each MVS describes key skills and competences for a role involved in practising Open Science (OS) with the support of the EOSC. MVS Profiles are synthesised from established competences frameworks and resources. They are proposed as an aid to skills development, especially curriculum and course design. Each MVS Profile relates a skillset to the Open Science (OS) practices, activities, and outcomes that may typically be expected of the role concerned. The methodology is further described in the main D2.1 report.

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LIST OF ACRONYMS AND ABBREBIATIONS
[See also EOSC Glossary https://eosc-portal.eu/glossary]

CARE	Collective Benefit, Authority to Control, Responsibility, and Ethics
CSCCE	Centre for Scientific Collaboration and Community Engagement
DMP	Data Management Plan
ELSI	Ethical, Legal and Social Issues
EOSC	European Open Science Cloud
ETHRD IG	Education and Training on Handling of Research Data Interest Group (RDA)
ICT	Information and Communication Technology
IT	Information Technology
JRC	Joint Research Centre
FAIR	Findable, Accessible, Interoperable, and Reusable
MVS	Minimum Viable Skillset
ORCC	Open Research Competencies Coalition
OS	Open Science
R&I	Research and Innovation
RDA	Research Data Alliance
RDM	Research Data Management
RI	Research Infrastructure
RPO	Research Performing Organisation¤
RSE	Research Software Engineer
T4fs	Terms for FAIR skills
WG	Working Group

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Introduction

This Annex to the Skills4EOSC D2.1 Catalogue of Open Science Career Profiles - Minimum Viable Skillsets provides the content of the MVS Profiles for selected roles involved in performing and enabling Open Science.

As described in the main report, the catalogue currently offers the following MVS Profiles: -

MVS Title (Role)
Civil Servant
Data Stewards - Coordinator, Embedded
Early Career Researcher
Ethics Advisor
Knowledge Broker
Legal Expert
Masters student
Policymakers - Research policy, Evidence-based policymaker
Research Infrastructure Professional
Senior Researcher
Undergraduate student

Table 3. Current MVS catalogue entries, with variations

Each MVS Profile is described in one section of this Annex, including two Profiles with variations (Data Stewards, and Policymakers).

The final section of this Annex provides the Open Science Skills Terms used to create a summary ‘OS Skills Scope’ for the Data Stewards MVS.

1 Civil Servant MVS Profile

Civil Servant

Civil servants are usually - but not always - in practice employed by 'Ministers' - so most civil servants work in government departments and are therefore employed by Government Ministers. Civil servant perform the Executive power in a State. The exact nature of civil service employment can vary depending on the country and the specific role, but generally, civil servants are responsible for carrying out a range of administrative, regulatory, or policy-related functions. Examples of civil service roles may include clerks, analysts, policy advisors, inspectors, and managers.One important aspect of civil service employment is that it is typically non-political, meaning that civil servants are expected to remain neutral and non-partisan in their work. This is important to ensure that government and public sector organizations operate fairly and effectively, without being influenced by political bias or favoritism.

Organisational context:

- Sector of government performing the executive power
- Non elected nor appointed professionals in public bodies
- Public administration

Open Science mission for this role

Civil Servant creates and supports open access to scientific knowledge, data, and research results and serves the public interest also through the appropriate re-use of data produced and shared by research actions.

Contributes to which Open Science outcomes?

The main objective is to support Open Science and foster the re-use of Open Science products in policy and decision making. This is mainly achieved through the following:

- working towards making research more transparent, accessible, and reproducible, as well as fostering collaboration and knowledge sharing within the scientific community and beyond;
- making scientific knowledge and research results openly available, to ensure that taxpayers' money is being used effectively and efficiently, and that the benefits of research are being shared widely;
- working to implement policies that support open access to research publications and data, encouraging researchers to make their work openly available,
- facilitating collaboration and knowledge-sharing between researchers, government agencies, and the public;
- promoting open science practices through training and education, and engaging with stakeholders to understand their needs and priorities;
- ensuring the appropriate re-use of data produced and shared by research actions in decision making context.

Main activities

- Clarify and shape OS strategy and priorities for the national and international interest
- Involve and engage the right stakeholders and partners in making

recommendations or decisions on OS
- Shape strategies and plans which help put into practice OS (give a long-term direction)
- Develop the capabilities in OS of the staff
- Engage in the open research process
- Ensure compliance with ethical, legal and regulatory criteria
- Communicate / actively promote OS
- Facilitate the engagement of different stakeholders in co-creation actions

Essential skills and competences

- Good understanding of OS principles and practices, open data, open research and open access
- Developing policies and guidelines that promote OS
- Solid understanding of OS research ethics
- Being familiar with technology and tools used to support OS practices
- Managing projects related to OS
- Providing training and education to researchers, policymakers, and public citizens about OS practices
- Evaluating the impact of OS practices and make recommendations for future improvement
- Good understanding of data management, including data storing, analysis and sharing according to the FAIR and OS principles

Soft Skills

- Communication
- Collaboration
- Leadership
- Citizen Engagement skills
- Negotiation and diplomacy
- Innovative thinking
- Strategic and analytical skills
- Teamwork
- Adaptability to changes

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2 Data Stewards MVS Profile: Coordinator and Embedded Roles

Introduction

A Minimum Viable Skillset (MVS) Profile identifies essential skills and competencies required for Open Science practitioners. The MVS first provides a set of terms[1] describing the 'Open Science Skills Scope' for the role. The terms are keywords summarising the essential skills and competences needed to deal with five dimensions of Open Science, visualised as a wheel showing the extent to which the role deals with each dimension.[2] The Profile takes a closer look at the role's overall mission for Open Science, describing the outcomes and activities typically expected of the role. These provide the basis for the essential skills and competences in the profile.

The Data Steward MVS describes expertise needed to maximise the potential value of digital research objects for the scientific community and the public, while respecting the rights and legitimate interests of all other stakeholders concerned. These include data subjects, the researchers and organisations that produce data and other digital research objects, any vulnerable groups or communities affected, research funders, scientific journals, repositories, and other Research Data Infrastructures. This MVS also encompasses various data professional roles commonly associated with Data Stewardship. It identifies the Data Steward role with various alternative job titles commonly associated with the data stewardship activities described here, e. g. Data Curator, Data Librarian, Data Manager, or RDM Coordinator.

This MVS includes two varieties of Data Steward - '**Coordinator**' and '**Embedded**' roles. These represent two ends of a spectrum, with 'Coordinator' describing a role providing support across research domains and units relevant to an organisation, e. g. 'RDM Coordinator'. At the other end of the spectrum, 'Embedded' describes a role close to a research team and to its domain-specific practices (e. g. 'Earth Sciences Data Manager'). These roles can overlap, influenced by the availability of resources, and by disciplinary and organisational cultures. Data Stewardship expertise is typically distributed across a team, drawing on in-house capabilities and any external services provided to the Research Performing Organisation, e .g. by a Competence Centre.[3] The appropriate distribution of expertise will naturally depend on costs and needs and will be influenced by disciplinary factors, as well as the availability of skills to meet local needs**.**

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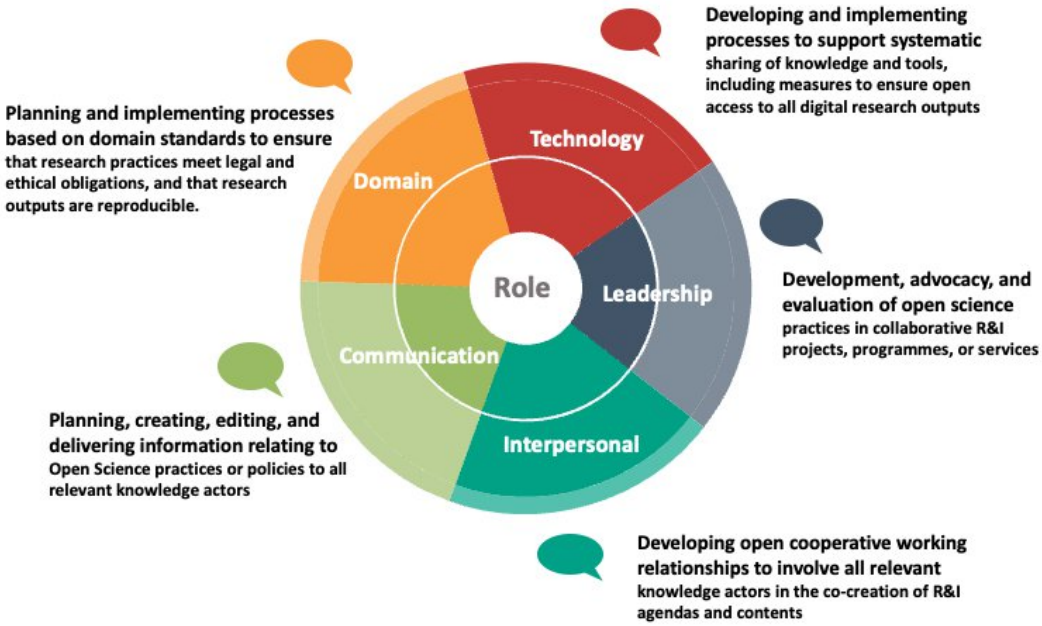
[1] The terms are work-in-progress drawn from terms4FAIRskills (https://www.ebi.ac.uk/ols4/ontologies/t4fs) and CSCE 'skills wheel terms' (https://www.cscce.org/resources/glossary/)

[2] The extent to which the role deals with each dimension is derived from the list of essential skills and competences in the MVS, by counting terms whose definitions are relevant to the skills and competences described.

[3] A Competence Centre acts as a single point of reference in a specific Country/Region/Theme for finding key competencies to enable the practice of Open Science with adequate knowledge of standards, applications and tools and best practices for delivering, managing, re-using, sharing and analysing FAIR data, as well as other digital research objects.

2.1 OS Skills Scope for Data Stewards



MVS Summary

Dimensions	*Data Steward Open Science Skills Terms*
Technology	Data policy; Service level management; Data curation; Preservation; Open access publishing; Data access risk assessment and mitigation; Information security; Product management of technology platforms; Technical support; Data repository management; Data sharing and publication; Assessment on FAIR data criteria; Software preservation; Data curation, Metadata exposure;
Domain	Domain knowledge to contextualise data handling; Data management; Advocacy; Evaluation & assessment; Landscape analysis; Business modelling; Analysis; Project management;
Interpersonal	Mentoring on open and FAIR methods; Advocacy; Engagement; Cultural competence; Mentoring; Teaching and training; Moderation, mediation, and intervention; Creativity; Collaboration;
Communication	Consultation and listening; Knowledge brokering; Copywriting and editing; Knowledge brokering; Speaking and presenting;
Leadership	Data Governance; Community governance; Proposal development; Securing sustainable funding; Community governance;

Figure. Scope of OS skills for Data Stewards, and terms summarising their MVS

Coordinator Data Steward	Embedded Data Steward
Provides a 'centralised knowledge and communication hub' for researchers. Advises and trains on policy, guidelines, data management plans, institutional infrastructure and tools. These may include software code, and its development as a FAIR and open resource. **Associated function titles:** Data Steward, Data Librarian, Research Data Management Specialist, Research Data Manager, Research Data Management Consultant, Research Data Coordinator. Reproducibility Librarian.	Serves research teams, faculties, departments, sections of organisations directly involved in producing research outputs. Helps embed FAIR and CARE principles in research practices, meeting needs of researchers as they arise, and working with others to ensure the long-term **preservation** and reusability of research outputs. These may include software code, and its development as a FAIR and open resource. **Associated function titles:** Data Steward, Data Manager, Data Curator, Research Data Manager
Open Science mission: Data Stewards work with stakeholders to establish, govern and maintain processes. These include collecting research data, making it usable for research objectives, facilitating its transformation into research outputs, assist in their quality assurance, and support informed decision-making on their FAIRness and openness for reuse, according to ethical, legal and social expectations. • *Relevance of Open Science dimensions (1-Low to 3-High): Technology: 3, Interpersonal: 2, Domain: 2, Communication: 1; Leadership: 1* • *Organisational context: Research Performing Organisations, Research Infrastructures, Service Providers, Competence Centres.* • *Related EOSC learning paths: service and resource consumers and providers*	
Contributes to which Open Science outcomes? • Research data and related digital objects are effectively managed to ensure their suitability for curating, sharing, and reuse, and potential impacts towards advancement of research methods appropriate to the discipline(s). Digital research objects are made as FAIR and open as possible, and as closed as necessary. • Opportunities are identified for creating or connecting with professional Open Science networks at institutional, cross-institutional, regional, national, or international levels. • Relevant competence centres with a FAIR data and Open Science support role are utilised effectively according to local needs and policies. • Open Science skills and practices are facilitated and enhanced using, where appropriate, EOSC resources and services, including any relevant Open Educational Resources.	

Main activities - Coordinator	*Main activities - Embedded*
• Contributes to Open Science policy development and community governance by engaging with (inter)national policy-making, bringing cross-disciplinary expertise to local policy development, implementation and monitoring. • Develops institutional guidance on Data management Planning, e. g. templates offering cross-domain knowledge to contextualise data handling and advice on planning how to use local services or infrastructure. • Understands research stakeholder needs and contributes to developing, implementing and monitoring Data Policy and Governance, along with service level management to support this. • Promotes and communicates the importance of Open Science and FAIR to all levels within the organization (e. g. policymakers, senior management, researchers, postgraduates etc.). • Analyses trends through landscape analysis of -data infrastructure, tools, and methods that may improve the organisation's implementation of FAIR and CARE principles to enhance support for decision-making on Open Science. Advises on (meta)data standards and contextual documentation for data archiving. • Monitors relevant RDM skills of researchers and research support staff in the institute and refers researchers to RDM related facilities and services • Develops and delivers training tailored to learners' needs, aligned with wider institutional policies and plans. • Maintains networks of research data managers (RDMs) and research support related colleagues.	• Develops Data Management Plans templates tailored for research teams, offering support in writing a DMP according to the relevant template. Includes provision for archiving and FAIR sharing (standards, metadata exposure, PIDs, licensing, data repository management/selection). • Implements good practice on data and/or software/code during proposal development for funders, and as a regular aspect of doing research, and liaises with other experts inside and outside the institute to adopt effective solutions to challenges. • Advises on technical support for researchers on data sharing and publication infrastructure and tools, adoption of innovations, including those provided by relevant (inter)national data-infrastructures (product management of technology platforms). • Identifies gaps and takes action to ensure ethical conduct and awareness of the potential impacts of data reuse, management and sharing on wider society. • Advises on the use of disciplinary standards and ontologies, and relevant community practices that are applied in producing FAIR research outputs. • Supports researchers on legal and regulatory compliance aligning local practices with these through connections with the institutional privacy officers, legal advisers, and research ethics bodies. • Develops and delivers training tailored to learners' needs, aligned with wider institutional policies and plans. • Maintains networks of RDMs and research support related colleagues.

Essential skills and competences

- Knowledge of Open Science practices, policies and regulation and translation of these (when necessary) to local level.
- Service provision to support specific Open Science practices including: applying FAIR and CARE principles, Open Access (publishing) , data curation and preservation.
- Knowledge brokering about Research Data Management, (personal) data governance and ethics, including to understand information security challenges, and provide access risk assessment and mitigation
- Mentoring on open and fair methods, to develop professional practice including knowledge/awareness of programming, FAIR code and FAIR software and use of standards and ontologies.
- Advocacy, analysis and assessment on FAIR data criteria, FAIR code and software preservation.
- Copy writing and editing guidance and advice material to support infrastructure and tools for data storage, versioning, publishing, and documentation.
- Support Open Science policies and practices through teaching and training design and delivery.
- Monitor the research and funding ecosystem and advise on securing sustainable funding, identifying conflicting motivations, drivers and incentives among different stakeholders.
- Moderation, mediation and intervention through consulting and listening.
- Stakeholder engagement and collaboration building strategic relationships, bridging needs, and speaking and presenting to data creators, users, and research stakeholders about the value of good data management
- Creativity, critical and analytical thinking, curiosity, openness, and cultural competence with a willingness to learn.
- Team- and project management and business modelling, working with researchers/professionals at varying levels of seniority to facilitate results-oriented planning and organising, evaluation and assessment.

OS skills terms *Advocacy; Analysis; Assessment on FAIR data criteria; Business modelling; Collaboration; Community governance; Consultation and listening; Copywriting and editing; Creativity; Cultural competence; Data access risk assessment and mitigation; Data curation; Metadata exposure; Data Governance; Data management; Data policy; Data repository management; Data sharing and publication; Domain knowledge to contextualise data handling; Engagement; Evaluation & assessment; Understanding Information security challenges; Knowledge brokering; Landscape analysis; Mentoring on open and fair methods; Moderation, mediation, and intervention; Open access publishing; Preservation; Product management of technology platforms; Project management; Proposal development; Securing sustainable funding; Service level management; Software preservation; Speaking and presenting; Teaching and training; Technical support;*

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3 Early Career Researcher MVS Profile

Introduction

A key principle of Open Science (OS) is that research is conducted openly and transparently leading to better science. Subsequently, researchers at every career stage have a key role in the promotion of Open Science and its practice. Early career researchers for the purposes of this Minimum Viable Skillset (MVS) include PhD students, postdoctoral researchers, and other researchers within 5 to 8 years of completion of their doctorate degree. The MVS addresses the competencies and skills needed by researchers in the early stages of their research career as is related to Open OS.

Early Career Researcher

Organisational context:

- Governmental organizations
- National agencies
- National funding organizations
- Research Performing Organizations

Defined as :

- PhD students
- Post-doctoral researchers
- Other researchers (working outside of academia and research councils)

Open Science mission for this role

Researchers have a key role in the promotion of Open Science (OS) and its practice. Not only do early career researchers contribute to the wider uptake of skills, building their own individual skills and organizational capacities, openness is at the core of the researchers role. They are an integral part of all production and dissemination of knowledge. OS can be facilitated via data sharing, exploring and reusing data and, data publication, and making codes available, promoting open research through peer review, and reproducible research. By adopting OS approaches, researchers work to ensure that the benefits which openness brings, such as the accessibility, reproducibility and transparency of research, are available to students, colleagues, and to society as a whole.

Contributes to which Open Science outcomes?

By adopting the Open Science (OS) approach in their work, the early career researcher ensures that their research is carried out with a high degree of transparency, collegiality, and research integrity. Mainly, by adopting OS approaches and practices, the early careers researcher contributes to:

- The facilitation of sharing research inputs and outputs
- The adoption and practice of OS and FAIR principles and methods
- More efficient use of science information
- Improvement of the dissemination of knowledge
- Improvement of the reproducibility of scientific findings

Main activities

- Promotes and supports Open Science (OS), which includes joining and supporting its initiatives.
- Produces research data for management, analysis, use, reuse, and dissemination.
- Collaborates with informal and formal research groups, including training students and other early career researchers on OS.
- Interacts with the general public to enhance the impact of science and research.
- Communicates research for scholarly and societal impact.
- Publishes research openly, providing metadata, data, code publicly available.

Open Science activities are apparent in all aspects of the early career researchers work flow.

In conducting research, the early career researcher participates in additional activities essential to Open Science, including the following:

- Open access publishing, which can be applied to peer-reviewed journal articles, theses, book chapters, monographs, and conference papers.
- Opens data, which involves making all data that are necessary to reproduce reported results publicly accessible and digitally shareable.
- Opens materials, which includes having all components of the research methodology.

Soft skills - relevant personal attributes

- Cooperation and collaboration skills.
- Ethical orientation towards open science principles and their broader social goals.
- Adaptable: ability to build openness into the research process, staying up to date with research processes, software, data management systems, etc.
- Time management skills: incorporate Open Science/FAIR practices in a timely way during the research cycle.
- Communication and interpersonal skills: engage with a variety of stakeholders.
- Project management
- Presentation skills
- Critical thinking

Essential skills and competences

- Good understanding of OS and its practices, in a discipline-specific context, particularly knowledgeable of policies, opportunities and practices of OS (e.g., open access, data storage and archival).
- Sound knowledge of the data life cycle and adequate capacity to implement discipline-specific FAIR principles.
- Ability to assess FAIRness of existing resources and make OS-compliant choices to capture, process, analyse, and preserve data
- Upgradable digital skills: experience in using tools for conducting research, managing and sharing research output. Commitment to undertaking training on digital-oriented research practices
- Research management skills: Ability to design an open research strategy, implement an open research vision, and coordinate research activities that embed open science principles
- Entrepreneurial skills: Ability to identify and apply for OS funding opportunities; ability to acquire funding that furthers open science goals, writing grants and funding applications
- Good understanding of the relevant legal aspects related to research and their field of expertise, and relevant Open Science practices, including, but not limited to: Intellectual Property Rights (eg copyright, patents, and trade secrets) and other Non-Personal Data (eg use of IoT data and research data), Personal Data Protection and Governance (eg processing Personal Data under the current legal framework, and following existing policies on Data Protection), Privacy, and (Open) Licensing rules and frameworks.
- Good understanding of ethical principles (e.g., transparency, diversity, and accountability) and

best practices (e.g., avoiding bias in data processing when using data-driven technologies) applicable to their field of expertise, including, but not limited to the general ethical principles, frameworks and codes of conduct applicable to research (e.g., the RRI Framework; the European Code of Conduct for Research Integrity);

- Ability to balance (personal and non-personal) data protection requirements with Open Science/FAIR principles.

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4 Ethics Advisor MVS Profile

Introduction

This document acknowledges the existence of specific positions (e.g. Data Ethicist) and Ethics Committees inside research organizations and for different~~t~~ce types of research~~es~~ and potential ethics issues (e.g. research using AI systems, potential dual use/military use, animal experimentation, societal issues). Therefore, the role of the Ethics Advisor addressed in this document shall be understood as a more general approach to ethics in the context of Open Science, and research in general. The Ethics Advisor's tasks and activities may be carried out by Committees or by professionals with similar roles, as is the case of the 'Ethics Officer' and 'Ethics Expert'.

The "Data Protection Officer" role has a complex nature and, according to the GDPR, does not require a specific (eg. legal) background: they "shall be designated on the basis of professional qualities and, in particular, expert knowledge of data protection law and practices and the ability to fulfil the tasks" provided in the GDPR. It it not uncommon, and the law specific allows it on its art. 38(6), that the DPO "may fulfil other tasks and duties" that do not conflict with their role as DPO. Therefore, as an example, the DPO may also be the Legal Expert. However, as it can be seen from its tasks in the GDPR (art 39), the tasks executed by the DPO goes beyond the legal field and may require additional expertise, some of them shared by the Ethics Advisor.

Minimum Viable Skillset

Ethics Advisor

Includes:

- Ethics Officer;
- Ethics Committees;
- Data Protection Officer*;
- Data Ethicist;
- Ethics Expert.

Organisational context:

- Research Organizations
- Higher Education Institutions
- Funders
- Ministries
- Public Administration
- Research Infrastructures
- International Organizations

Open Science mission for this role

Promote Openness, FAIRness and the ethical principles of responsibility/accountability, transparency, pluralism, and respect/inclusion in the realization of Open Science in the context of the organization/ research project.

Contributes to which Open Science outcomes?

The main objective of the Ethics Advisor is to promote and support Open Science in a responsible/accountable, transparent, plural and inclusive manner. This is mainly achieved through

the following:

- Raising awareness of the ethical principles in open research through the interaction with stakeholders, and advocacy activities;
- Identifying and addressing main ethical issues in the practice of Open Science in the context of the organization/ research project.

Main activities

- Map and identify ethical concerns inside the organization/ research project;
- Advise the organization on the compatibility of local practices with ethical principles and the existing frameworks and codes of conduct (eg FAIR, CARE principles, the European Code of Conduct for Research Integrity, RRI framework);
- Advocate for pluralism and inclusion in Open Science;
- Sets up policies, guidelines and other instruments necessary to the realization of the ethical principles concerning OS;
- Interact with stakeholders in order to ensure that research is being conducted in a responsible and transparent manner, and that consider all stakeholders rights and interests.

Soft skills

- Leadership
- Effective communication
- Stakeholder engagement and networking
- Management skills
- Critical and Analytical thinking
- Collaboration
- Sharing knowledge and processes

Technical skills and competences

- Good understanding of OS and its practices.
- Ability to establish the appropriate strategy, frameworks and course of actions to foster and enhance OS.
- Expert knowledge of the FAIR principles and how to apply them (eg publishing research data in a way that is Findable, Accessible, Interoperable and Reusable) [4]
- Ability to identify ethical issues, raise awareness and apply the necessary measures to address the existing and applicable ethical principles (eg transparency and accountability), frameworks (eg RRI Framework) and codes of conduct, including but not limited to the ones concerning research (eg European Code of Conduct for Research Integrity – ALLEA and the

[4] 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. pp. 18-22.

OECD's Best Practices for Ensuring Scientific Integrity and Preventing Misconduct)[5]

- Ability to identify and address ethical issues related to personal data governance during all the data lifecycle, including but not limited to the management of personal data (eg collecting, storing and sharing), development and management of related policies, and knowledge of the applicable regulations on privacy and personal data protection that may concern to ethical aspects [6]
- Ability to raise awareness and provide instructions on (research) data ethics, and whenever needed, on specific scenarios and fields of research (eg in case of using data-driven technologies, this may include an expert knowledge on the rules provided in the Artificial Intelligence Act and related regulations and knowledge of best practices related to avoiding bias in data processing)[7]
- Ability to establish connections and ease communication between different players (eg researchers) and bodies (eg legal department and the research ethics committees) when addressing ethical issues [8]
- Knowledge of the necessary resources to raise awareness and advise on the ethical use and management of intellectual property rights and non-personal data[9]

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5 Knowledge Broker MVS Profile

Knowledge Broker

"Knowledge broker" is a term used to identify individuals or teams who, in a variety of contexts, act as intermediaries to facilitate the knowledge transfer from experts of a specific domain to a wider audience. The practice of knowledge brokerage covers diverse use cases, that have the common objective of **disseminating scientific information and facilitating its usage by society.** Typical cases include appointed individual experts or expert groups informing public authorities or agencies about scientific findings, or aggregating research data to provide an overview of a specific phenomenon or field, thus supporting the practice of evidence-based decision making, provide trustable and understandable information to laypeople etc. Knowledge Brokers typically use their expertise to connect people with the information and resources they need to make informed decision, filling the gaps between science and various stakeholders, such as policymakers, practitioners, or the public. Sometimes this role is played by a group of people as committees or societies.

Honest Broker

An "honest broker" is a knowledge broker serving a particular function as an ~~n~~ impartial mediator **to facilitate communication and decision-making** among individuals or groups with differing interests or values. The honest broker i **remains neutral and unbiased**, to provide all parties with accurate information, and to help them negotiate and find common ground. Honest brokers are often used in situations where there is a need for a fair and transparent process, such as in conflict resolution or public policy development.

Organisational context:

- Ministries
- Governamental organisations
- Research Performing Organisations
- National Agencies
- National funding organisations
- Communication/Media Agencies or Organisations
- Commitees and Learned Societies

Open Science mission for this role

The knowledge broker plays a crucial role in bridging the gap between research and practice by connecting researchers with stakeholders who can benefit from their work. The knowledge broker helps to create a more open, transparent, and collaborative research environment, which can lead to more effective and impactful research outcomes. This may involve working closely with researchers to translate their findings into actionable recommendations or providing policymakers with access to the latest accessible scientific evidence to inform decision-making. Additionally, they may be involved in promoting Open Science practices within their organization or community, such as advocating for open access publishing or developing data sharing policies and support the

dissemination of research findings to a wider audience.

Contributes to which Open Science outcomes?

The Knowledge Broker contributes to multiple Open Science outcomes by facilitating the dissemination and accessibility of research findings, fostering collaboration and knowledge exchange among diverse stakeholders, and promoting transparency and reproducibility in research. The main objective of the Honest Broker is to support ''evidence informed policy making'' by serving as the link and catalyst for knowledge synthesis and exchange between researchers and policymakers. In reaching these aims, the Knowledge Broker and Honest Broker support the uptake of Open Science and FAIR principles during the knowledge production process to maximise its impact and improve both accessibility and transparency of research findings. This is mainly achieved through the following:

- identifying the information needs of reference stakeholders/interlocutors and addressing them by bridging specialised scientific data and information and facilitate the stakeholers' understanding and correct interpretation of this information
- analyzing, evaluating, and drafting concrete policy options, but also building capacity and create links for continuous knowledge exchange, adopting as much as possible co-creation and accessible approaches
- linking knowledge producers and users and objectively facililtating or directly translating science into policy-usable knowledge in a transparent and accessible way
- enhancing the uptake of scientifically developed knowledge into public policy by supporting the application of Open Science and FAIR principles in the knowledge production chain
- identifying options, helping policymakers understand the likely impact of choices, and providing advice from a scientific viewpoint
- helping researchers understand the potential impact of their outcomes to policy makers
- advocating on the application of FAIR principles and Open Science, identifying how these principles relate to research goals and practices, and to the organisation's local policies and processes

Main activities

- Bridge the interface between science and policy
- Ensure mutual understanding among these parties
- Ensure alignment between the needs of the policy community and the evidence synthesis provided
- Ensures that the policy community have a good understanding of the implications of the evidence proffered
- Ensure the quality and transparency of evidence synthesis
- Ensure the evidence synthesis had appropriate expert inputs
- Identify options and and providing advice from a scientific viewpoint
- Identify constraints, uncertainties and caveats
- Contextualise the FAIR and OS principles of specific domains
- Identify strengths and weaknesses in how OS is applied
- Identify needs of change in OS policy or practice in relevant research domains
- Ensure all actors are engaged in co-creation actions

Technical competences

- Being familiar with policy making practices and procedures
- Understanding of open, ethical and responsible research principles
- Managing considerable amount of information related to OS practices
- Searching, retrieving, appraising and synthesizing evidence
- Developing and maintaining network of researchers, policymakers, and other stakeholders to help promoting and implementation of OS practices and to support co-creation activities
- Providing training and education to researchers, policymakers, and public citizens about OS practices
- Evaluating research findings and identify potential conflicts of interest.
- Tailoring resources to local needs and assessing the context of implementation

Soft skills

- Communication
- Collaboration
- Leadership
- Self-confidence
- Citizens and stakeholders engagement skills
- Influencing skills
- Mediation skills
- Negotiation and diplomacy
- Team building and teamwork
- Problem-solving skills
- Innovative thinking
- Analytical and research skills
- Adaptability to changes
- Networking and interpersonal skills
- Stakeholder management and influencing skills
- Mentoring skills
- Facilitation skills
- Change management skills

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6 Legal Expert MVS Profile

Introduction

Open Science, and research in general, often deals with resources that may require additional actions to ensure compliance with the current regulatory framework. Both personal and non-personal data are subject to a complex set of national, regional and international regulations that must be observed in order to ensure that third-parties' rights are not infringed. However, in fields like Intellectual Property Rights, often it appears to exist a tension between the current legal framework still heavily based on an exclusive-property-approach and the openness needed to realize Open Science objectives. This, among others, is one of the main challenges for the Legal Expert, which can be also referred to as 'Legal Consultant', 'Lawyer', 'Regulatory Affairs Manager', and 'Technology Transfer or IP Lawyer'.

It is important to highlight that term "Legal Expert" comprises a broad scope of professionals that may or may not be legally able to provide legal advice. Legal Experts like a Regulatory Affairs Manager may not have their full academic background on Law, but may have developed their expertise during a LLM (Master of Laws), for example. This means that they can have substantial knowledge on legal issues, but are not necessarily qualified to provide legal advice in the EU. And this would be because, despite being a matter to be addressed internally by Member States, the legal profession (eg lawyers) is often regulated and to act as a practising lawyer and provide legal advice, the professional must, for example, be approved in a Bar Examination and minimum years of law school.

The "Data Protection Officer" role has a complex nature and, according to the GDPR, does not require a specific (eg. legal) background: they "shall be designated on the basis of professional qualities and, in particular, expert knowledge of data protection law and practices and the ability to fulfil the tasks" provided in the GDPR. It is not uncommon, and the law specific allows it on its art. 38(6), that the DPO "may fulfil other tasks and duties" that do not conflict with their role as DPO. Therefore, as an example, the DPO may also be the Legal Expert. However, as it can be seen from its tasks in the GDPR (art 39), the tasks executed by the DPO goes beyond the legal field and may require additional expertise.

Finally, some of the skills and tasks listed here may also be found in other roles in addition to the ones mentioned in this document. It should be noted that Archivists, Records Managers, Information Security Officers and Offices that provide support to researchers on the seeking and managing research grants may have a legal background and/or have to deal with issues involving, for example, the (re)use of protected material, contractual and licensing issues and further uses for preservation.

Minimum Viable Skillset

Legal Expert

Includes:

- Legal Consultant
- Legal Advisor
- Lawyer
- Regulatory Affairs Manager
- Data Protection Officer*
- Technology Transfer/IP Lawyer

Organisational context:

- Research Organizations
- Higher Education Institutions
- Funders
- Ministries
- Public Administration
- Research Infrastructures
- International Organizations

Open Science mission for this role

Promote Openess and FAIRness in an exclusive-property-based legal system, while mitigating legal risks through actions directed towards the compliance with the regulatory framework on personal and non-personal data.

Contributes to which Open Science outcomes?

The main objective of the Legal Expert is to provide legal information and/or advise the organization on how to realize OS principles in accordance with the existing regulatory framework. This is mainly achieved through the following:

- The organization will be able to adopt existing licensing frameworks (eg Creative Commons) and enjoy the free uses allowed under the existing legal framework (eg copyright limitations and exceptions);
- The organization will be equipped with policies, contracts and other instruments necessary to the realization of the legal rules and ethical principles concerning OS.

Main activities

- Promote and support open access and other OS-related legal and ethical principles;
- Monitor the regulatory landscape and national policies concerning OS (eg GDPR, ODD, DGA, Data Act proposal, IPR-related directives and regulations);
- Assess and address legal risks concerning Intellectual Property Rights (eg , Personal and Non-Personal Data Protection and Governance, Licensing and Information Security;
- Employ ~~the~~ existing instruments (eg licensing frameworks, rights retention strategies) and normative tools (eg copyright exceptions and limitations) to promote Open Science;
- Develops policies, contracts and other instruments necessary to the realization of the legal rules and ethical principles concerning OS;
- Advises the organization on the compatibility of local practices with the current legal framework.

Soft Skills

- Problem-solving
- Effective communication
- Critical and Analytical thinking
- Collaboration
- Translating needs/bridging function
- Research skills
- Flexibility and adaptability
- Proactiveness and responsiveness

Technical skills and competences

- Good understanding of OS and its practices.
- Ability to establish the appropriate strategy, frameworks and course of actions to foster and enhance OS.
- Expert knowledge of the FAIR principles and how to apply them, especially the one concerning (re)usability (eg copyright licensing rules and existing frameworks like the Creative Commons licenses) [10]
- Ability to identify ethical issues and apply the necessary measures to address the existing and applicable ethical principles, frameworks and codes of conduct, including but not limited to the ones concerning research (eg the RRI Framework and the European Code of Conduct for Research Integrity – ALLEA)[11]
- Ability to address legal issues related to personal data governance, including but not limited to the management of personal data, development and management of policies on privacy and data protection (eg consent forms, data policies, etc) and expert knowledge on the application of regulations on privacy and personal data protection[12]
- Ability to develop, negotiate and assess data use agreements, and expert knowledge on the regulation that commonly governs these documents[13]
- Awareness of existing information security and risk management standards that may affect data governance, especially when it concerns to personal data protection [14]

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- Ability to raise awareness and provide instructions and/or advice on the responsible use of data-driven technologies, which may include an expert knowledge on the rules provided in the Artificial Intelligence Act and related regulations (including sector-specific regulations) and knowledge of best practices related to avoiding bias in data processing[15]
- Expert knowledge of intellectual property rights and non-personal data and its management, including but not limited to: (i) expert knowledge and ability to apply rules contained in the main national, regional and international rules on intellectual property rights (eg copyrights, patents, trademarks, trade secrets etc) and other non personal data (eg rules available in the Open Data Directive, Data Governance Act and Digital Services Act), (ii) ability to develop, negotiate and manage agreements involving IP rights and other non-personal data, (iii) expert knowledge on the existing (open) licensing rules and frameworks and (iv) non-legislative measures that may be related to IPRs and other non personal data (eg rights retention strategies)[16]

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7 Masters student MVS Profile

Introduction

The Minimum Viable Skillset (MVS) for Master's students is one of two student MVS produced (the other for undergraduate students). Master's level education is more specialised and focused than the undergraduate level. Subsequently, the MVS for Masters students considers the skills and competencies in Open Science (OS) as is needed for a more focused study, incorporating OS into their project workflows. This is a generic profile for students in postgraduate education.

For information related to basic skills for researchers, see the MVS designed specifically for early career researchers, which addresses the minimum skills and competencies needed for PhD student and post-doctoral researchers.

Master's Students

Organisational context:

- Research Performing Organisations (Universities)

Open Science mission for this role

It is recognised that Open Science skills should be immersed within formal education at its earliest stages. By engaging with Open Science practices and acquiring relevant knowledge of OS early in their careers, the benefits of these practices can be recognised, even if their careers are not in academia.

Contributes to which Open Science outcomes?

Non-research graduate students contribute to the following Open Science outcomes:

- The adoption and practice of OS and FAIR principles and methods
- Increasing transparency and knowledge sharing in research processes
- Increasing knowledge and awareness of digital literacy

Main activities

- Supports OS practices.
- Engages with OS outputs.
- Contributes to data literacy activities that improve their understanding of the concepts and principles of Open Science, including:
    - Interpreting and critically evaluating data;
    - Finding, selecting, accessing, and creating data sets;
    - Ethically use and cite data;
    - Understand basic data types and formats;
    - Communicating data with visualizations;
    - Understand how the data was collected;
    - Manipulate data from different sources, formats, and structures;
    - Understand how to share data;
    - Understand how to store data;
    - Understand why it is important to manage data.
- Plans, organises, and manages research activities as related to dissertations. Specific activities related to OS include:
    - Utilising a data management plan to describe efforts to make research reproducible, including providing descriptions of the data via metadata, research procedures and analyses;
    - Writing manuscripts and/or dissertations transparently, sharing hypotheses and justifying decisions, and sharing methodologies;
    - Sharing any data used for projects, making the data available for other researchers.

Soft skills - relevant personal attributes

- Collaboration skills, ability to engage in teamwork
- Assignment and/or dissertation management
- Communication and interpersonal skills
- Written communication skills

- Verbal communication skills
- Time management skills
- Problem solving skills
- Critical thinking
- Presentation skills
- Organizational skills, including goal setting and prioritizing skills

Essential skills and competences

- Ability to analyse OS and FAIR concepts and ideas in the respective field of study.
- Understanding of the research life cycle, particularly the processes of conducting research including planning, design, analysis, publication, and dissemination.
- Ability to organise project workflow throughout the research life cycle, including file folders, document naming conventions, version control, cloud storage, etc.
- Intermediate digital research skills, data management, data communication, efficient literature searches.
- Ability to understand, use, and analyse the appropriate data (type and format) for research projects.
- Ability to obtain and apply open science knowledge and FAIR principles, including relevant discipline or domain-specific information.
- Open publication literacy skills, including knowledge of how to navigate open access sources, knowledge of open access publication models.
- Knowledge of ways to share and produce FAIR research data (including code and software), including knowledge of how to use institutional repositories.
- Basic understanding of the relevant legal issues related to Open Science practices, including, but not limited to: Intellectual Property Rights (eg knowledge on copyright-related issues like Open Access, Open Licensing, using and citing third-parties works) and other Non-Personal Data (e.g., being aware of rules on the use of "research data"), Personal Data Protection and Governance (eg using Personal Data under the current legal framework, and following existing policies on Data Protection).
- General understanding of ethical principles (e.g., transparency, diversity and accountability) and best practices (e.g., avoiding bias in data processing when using data-driven technologies) applicable to their field of expertise, including, but not limited to the general ethical principles, frameworks and codes of conduct applicable to research (e.g., the European Code of Conduct for Research Integrity);
- Knowledge of data protection requirements with Open Science/FAIR principles.

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8 Policymakers MVS Profile: Research policy, Evidence-based policymaker Roles

Policy Maker

Type 1: Research Policy/Decision Makers Facilitating OS

Organisational context:

- Ministries (about research and beyond)
- Governmental organiszations
- National agencies
- National funding organiszations
- Research Performing Organisations
- Data Protection Authorities

Open Science mission for this role

Create the appropriate awareness and the circumstances that foster the support of Open Science programs, and uptake of Open Science practice for effective policy making in service of the common good.

Contributes to which Open Science outcomes?

The main objective of this type of Policy maker is to set the ground for ''evidence informed policy making'' (Topp et al. 2018) by establishing the right environment that supports Open Science and fosters the use of Open Science in policy and decision making. This is mainly achieved through the following:

- Setting up the right frameworks, incentives, and financial support to enhance the use of Open Science and ensure its continuous support.
- Creating the appropriate partnerships with key stakeholders.
- Building a team of experts.

Main activities

- Promotes and supports OS.
- Engages all the appropriate target audiences & key stakeholders.
- Identifies actions to advance national policies on FAIR and OS.
- Understands the importance of addressing gaps in provision of digital skills for FAIR and OS.
- Promotes digital skills for data intensive science transferable across different sectors.
- Sets up policies or a strategic framework which serve to promote a preferred course of action and could include financial support research.

Essential skills and competences

- Good understanding of OS and its practices.
- Ability to establish the appropriate strategy, frameworks and course of actions to foster and enhance OS.
- Ability to mobilize human resources.
- Ability to mobilize financial resources.
- Ability to advocate and mobilize key enablers (lobbying).
- Ability to identify relevance of OS practices to policy contexts of scientific research
- Ability to assess the financial sustainability of policy outcomes
- Knowledge of the FAIR principles
- Knowledge on Intellectual property rights and non-personal data management
- Knowledge of the Ethical principles, frameworks and codes of conduct
- Knowledge on legal issues related to personal data governance
- Knowledge on data use agreements

Policy Maker

Type 2: Evidence-informed Policy and Decision Maker

Organisational context:

- Ministries (about research and beyond)
- Governmental organisations
- National agencies
- National funding organisations
- Research Performing Organisations
- Data Protection Authorities

Open Science mission for this role

Gather information through consultation and research and reduce and extract from the relevant information a policy, set of policies or a strategic framework, which serve to address a specific issue (European Commission. Directorate General for Research and Innovation. and EOSC Executive Board. 2021, p.22).

Contributes to which Open Science outcomes?

The objective of this type of policy maker is to ensure "evidence informed policy making" (Topp et al. 2018) by designing policies that are based on relevant and credible research data. This is achieved through the following:

- Thorough research of available open data and identification of information that is timely, relevant and credible.
- Appropriate consultation of researchers and other stakeholders like citizens, considering the specificity of their activity (scientist vs. politician) and role (honest broker vs. issue advocate).
- Synthesis of gathered information to design a policy relevant to a specific issue.

Main activities

- Identifies available OS outcomes relevant to an issue that requires a policy.
- Collaborates with expert communities for elicitation, review and evaluation of data and design of a policy.
- Deploys appropriate monitoring and evaluation to measure the impact of a policy designed based OS outcomes.
- Ensures inclusiveness in evidence's production and evaluation.
- Promotes and supports OS.

Essential skills and competences

- Knowledge of OS practices: thoroughly understanding of the opportunities, limitations, and constraints of OS in policy making, special focus on privacy, security, and FAIR principles and other legal and ethical issues of OS.
- Knowledge management: identify the relevance of outputs with a specific issue, synthesize outputs of research and consultation, facility management skills to understand the services and resources needed to conduct the activity of the scientific community.
- Monitor the landscape: ability to monitor and evaluate existing policies
- Policy evaluation: ability to monitor and evaluate policy implementation
- Knowledge of the FAIR principles
- Knowledge on Intellectual property rights and non-personal data management
- Knowledge of the Ethical principles, frameworks and codes of conduct
- Knowledge on legal issues related to personal data governance
- Knowledge on data use agreements
- Knowledge on the responsible use of data-driven technologies
- Information security and risk management

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9 Research Infrastructure Professional MVS Profile

Introduction

Research Infrastructures (RIs) support “research communities to conduct research and foster innovation” and constitute a major component in building an OS environment in so far as they aim at both “skilling researchers” and providing a wide range of “supporting staff”. RIs pool together tools, Standard Operating Procedures (SOP) and good practices to monitor and make accessible the entire research process.

The Minimum Viable Skillset (MVS) for Research Infrastructure (RI) professionals therefore considers the specificities of the functions represented in such organizations with regard to Open Science (OS). The functions can be diverse and correspond to many function titles, however, as these functions are in great part defined by the organization’s role, the content, context, and prospect of the missions are common to all RI professionals. The MVS for RI professionals proposes therefore a generic description of the role, which can be applied with adjustments to various functions. More detailed descriptions of specific functions can be found in other MVS, e.g. in the MVS for data stewards operating in RIs.

Research Infrastructures professionals

Research Infrastructure (RI) professionals contribute to open science development by being "operators who have experience and insights into scientific or technical issues whilst also being a professional manager". RI professionals also play a specific role in coordinating and engaging the scientific community.

Associated functions titles: Infrastructure manager, Project manager, Service manager, Chief Technology Officer, Data manager, Data steward, Researcher

Open Science mission for this role

The OS missions of RI professionals therefore entail: spreading a Responsible Research and Innovation (RRI) and OS culture; managing the RI; providing, handling and maintaining services, resources, and tools; harmonizing and improving a common EU OS space; supporting and monitoring FAIRification; providing training, sharing best practices, and building a research community.

Contributes to which Open Science outcomes?

The European Commission describes the main objectives of RIs and these represent OS outcomes provided by the RI professionals:

- Generalize OS practices and reduce fragmentation of the research ecosystem
- Avoid duplication of effort
- Facilitate and support research outputs sharing
- Produce open, usable and accessible research data and publications
- Boost innovation and research projects
- Facilitate cross-disciplinarity and cooperation with industry

Main activities

Service

- Provide knowledge-related facilities and resources such as collections, archives or scientific data infrastructures; computing systems, communication networks, and any other infrastructure
- Provide technological alignment, standards implementation
- Provide guidance about FAIR principles and FAIR implementation
- Ensure technical policy consistency throughout projects and activities of the RI

Support

- Coordinate and engage the research community's relevant stakeholders with a special attention to young generation
- Set up and offer foundational and specialized digital skills training for scientific community, data professionals, ELSI experts, Data Protection Officers;
- Facilitate in-person and online training and development of communities of practice
- Support the application of RRI principles through the consideration of impact's anticipation, inclusiveness and transparency dimensions of research
- Instruct researchers on open licensing and open software according the legislation on the reuse of public funded research data

Coordination

- Foster new partnerships and innovative services through internal and external collaboration
- Share knowledge to address socio-economic challenges, and take care of users' needs.
- Position the RI in the local, national and international environment; identify regional research priorities and set consistent strategies
- Identify and negotiate with potential funders; identify new funding tools (private-public partnerships, special projects, commercial funding, fee for service, consultancy)

Essential skills and competences

1/ General skills

- Expertise and competence in RRI, OS and research governance, as well as diverse EU research policies and systems
- Technical knowledge and skills needed for service development and provision, including data use agreements, information security and risk management
- Expertise in innovation and business development
- Staff management and project management skills
- Ability to empower people to implement OS by establishing transparent, accountable and sustainable processes
- Ability to plan and implement FAIR and open science principles and meet the requirements for reproducible research.
- Ability to identify and meet scientific communities' needs
- Expertise in developing guidelines in multidisciplinary areas
- Fostering a common vision among various stakeholders
- Ability to understand ethical and legal implications of research: Intellectual property rights and non-personal data Management, Knowledge of the Ethical principles, frameworks and codes of conduct, Legal issues related to personal data governance, Responsible use of data-driven technologies
- Ability to create, plan, coordinate public events, public in-formation pathways

2/ Soft skills

- Networking in inclusive/pluralist/participatory environments
- Community engagement expertise
- Team building and teamwork
- Leadership and coordination
- Sharing knowledge and processes
- Pedagogical skills
- Analytical and research skills
- Flexibility and adaptability
- Proactiveness and responsiveness

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10 Senior Researcher MVS Profile

Introduction

The Minimum Viable Skillset for Senior Researchers focuses on Open Science (OS) activities and skills relevant for senior researchers. Senior researchers are typically defined as those who are established within their fields, developed a level of independence, and typically lead research projects. The profile highlights the role of Senior Researchers in setting the agenda by implementing OS policies, raising awareness, and mentoring and training Early Career Researchers in the principles of Open Science.

Senior Researchers

Organisational context:

- Governmental organizations
- National agencies
- National funding organizations
- Research Performing Organizations

Open Science mission for this role

Senior Researchers are key actors within institutional contexts in promoting Open Science and FAIR principles among research colleagues, and in supporting them ensuring that relevant data or other research outputs are made FAIR/Open in accordance with domain standards and stakeholder expectations. They are expected to be catalysts for change in how research is conducted by centering open science practices, and show leadership through implementing Open Science policies in their own research projects and teams, as well as their role in mentoring and training students, raising awareness of open science among undergraduate and masters students, and acting as a bridge between the scientific community and technical services. To achieve this mission, Senior Researchers are expected to possess an expert-level understanding of Open Science and FAIR principles and their applications in their discipline-specific contexts, including regulatory, ethical and policy requirements. In turn, they need to be supported by research organizations in this mission, in the form of Open Science policies and relevant resources to implement them.

Contributes to which Open Science outcomes?

The main objective of the Senior Researcher is to conduct and oversee high quality and reproducible research, undertaken with integrity. Given their role in supervision, education, hiring, journal editing, peer review, and informing institutional policies, Senior Researchers can establish a research environment that supports and implements Open Science. Crucially, Senior Researchers have a responsibility to manage and nurture Early Career Researchers. This can be achieved via the following:

- Advocating for and championing Open Science principles and policies in their institutions
- Promoting education and training about open science skills, resources and solutions amongst other researchers and students
- Integrating Open Science knowledge into their own teaching and research practices

Main activities

- Applies Open Science policies, strategies and best practices
- Promotes and supports Open Science principles in their disciplinary fields by training other researchers in open science practices, methods and skills
- Contributes to education and professional development of students and Early Career Researchers by developing curricula and programs in Open Science methods, including data management.
- Provides researchers in their group with appropriate knowledge and support to understand regulatory, ethical and policy requirements affecting their research
- Designs and manages research activities
- Builds and coordinates research teams
- Establishes collaboration networks

Essential skills and competences

- Recognize discipline-specific Open Science principles and identify practices relevant to them at every stage of the research workflow.
- Outline relevant practices of Open Science and FAIR principles create guidelines for their research teams.
- Ability to identify and keep track of open research funding, and acquire funding that furthers Open Science goals through writing grants and funding applications.
- Mentoring and training researchers and students in Open Science practices throughout the research life-cycle, and nurturing professional development of Early Career Researchers in accordance with Open Science principles.
- Ability to build professional collaboration frameworks between academia and industry or other sectors to enable Open Science, build research projects that embed open science principles throughout.
- Ability to collect, annotate and document data and software, create metadata, use relevant taxonomies, handle big data sets and use existing repositories.
- Developing expert-level awareness of legal aspects related to Intellectual Property Rights (eg copyright, patents and trade secrets) and other Non-Personal Data (eg IoT data and research data), Personal Data Protection and Governance (eg processing Personal Data under the current legal framework, and managing data use agreements and policies on Data Protection), Privacy, and (Open) Licensing rules and frameworks, as well as the use of data and information which may be considered sensitive.
- Developing expert-level awareness of ethical principles (eg transparency, diversity and accountability) and best practices (eg avoiding bias in data processing when using data-driven technologies) applicable to their field of expertise, including, but not limited to the general ethical principles, frameworks and codes of conduct applicable to research (eg the RRI Framework; the European Code of Conduct for Research Integrity);
- Ability to balance (personal and non-personal) data protection requirements with Open Science/FAIR principles.
- Applying open publication practices, such as publishing preprints, publishing in open access journals and platforms, ensuring data and code are available in open repositories to the extent possible.
- Engaging with stakeholders outside academia to maximize research impact.

Soft skills - relevant personal attributes

- Effective communication
- Ability to provide constructive feedback
- Research management and leadership
- Time and people management
- Teamwork and collaboration
- Problem-solving
- Research integrity

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11 Undergraduate Student MVS Profile

Introduction

The Minimum Viable Skillset (MVS) for Undergraduates addresses the minimum competencies and skills needed by undergraduate students at the completion of their degree program in Open Science (OS). The MVS profile for undergraduates considers that undergraduate students do not typically undertake extensive research projects. However, there are opportunities for undergraduates to interact with data and software whilst working on assignments. Therefore, this MVS for undergraduate students is a general profile developed specifically in regard to data literacy knowledge, as it serves as basis for relevant OS activities and knowledge of the FAIR principles. For information related to basic skills for graduate students who are undertaking research activities, typically via dissertations and other assignments, see the MVS designed for Master's Students. For the basic skills and competencies needed for early career researchers, including postgraduate students (PhDs), please see the MVS for early career researchers.

Undergraduate

Organisational context:

- Research Performing Organisations (Universities)

Open Science mission for this role

It is recognized that Open Science skills should be immersed within formal education at its earliest stages. Undergraduates are potential future researchers and open science practitioners. By taking part in relevant open science training early, undergraduates become concerned citizens and better equipped to support open science.

Contributes to which Open Science outcomes?

The undergraduate contributes to the following OS outcomes:

- Developing data literacy abilities
- Acquiring a baseline of generic foundational digital skills
- Adopting awareness and understanding of OS and FAIR principles
- Adopting responsible and ethical use of data

Main activities

- Contributes to data literacy activities that improves their OS knowledge and skills, including:
  - Interpreting and critically evaluating data
  - Finding, selecting, accessing, and creating data sets
  - Ethically use, collect and cite data
  - Understand basic data types and formats
  - Communicates data with appropriate visualizations
  - Understands how the data was collected

Essential skills and competences

- Organizing and documenting
- Foundational digital research skills
- Understanding the big why - why it is important for society at research and data is open and FAIR
- Knowledge of the research life cycle
- Ability to identify general knowledge and awareness of open science and FAIR principles, including identify relevant discipline or domain-specific information
- Ability to apply basic open science principles in the relevant parts of the research life cycle , such as:
  - Recognise reliable and trustworthy sources of data
  - Evaluate the quality and reusability of the data
  - Recognizing the different open access model for scientific publications
  - Knowledge of how to share e FAIR research data (including code and software), including knowledge of how to use repositories

Soft skills - relevant personal attributes

- Collaboration and interpersonal skills, being particularly able to engage in teamwork
- Written communication skills
- Verbal communication skills
- Time management
- Problem solving skills
- Critical thinking

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12 Open Science Skills Terms

List of OS Skills Terms

t4FS: 84 (of 223 in total) 'data stewardship activity' terms, selected for relevance and appropriate level of granularity, mainly from 2nd level of t4FS hierarchy; sorted alphabetically here; italicised terms have been reworded for clarity	CSCCE Glossary: 45 terms listed according to 5 dimensions, selecting those included in 'skills wheel' for scientific community managers
Access control & authorisation management	Interpersonal
Assessment on FAIR data criteria	Engagement
Audit and evaluation	Collaboration
Change management	Teaching and training
Cloud environment management	Networking
Community building	Mentoring
Creativity	Moderation, mediation and intervention
Crediting research contributors	Emotional integration
Data access risk assessment and mitigation	Cultural competence
Data acquisition	Consultation and listening
Data analysis	Program management (= Leadership)
Data anonymisation and de-identification	Operational planning and implementation
Data archiving	Time management
Data categorisation	Record-keeping
Data citation	Project Reporting
Data costs management	Evaluation and assessment
Data curation	Event planning
Data destruction	Financial management
Data discovery	Community governance
Data driven decision management	Meeting facilitation
Data exploration	Program development (= Domain)
Data governance	Strategy development
Data harmonization	Landscape analysis
Data ingestion	Business Modeling
Data integration	Proposal development
Data mining	Advancement, growth and

Data modeling
Data policy
Data processing
Data production
Data profiling
Data quality assessment
Data quality assessment & review
Data recovery
Data registration
Data repository management
Data rescue
Data scaling
Data selection
Data sharing and publication
Data stewardship coordination
Data transformation
Data validation and cleaning
Data wrangling
Depositing in repository
Digital archiving
Digital format and media migration
Digital scholarship
Digitisation
Domain knowledge to contextualise data handling
Ethical application of patents, licenses
Evaluating repositories for data deposit/sharing
Identity management
Information governance
Information security
Interface testing
Meeting/conference organisation
Mentoring on open and fair methods
Metadata catalog management
Metadata creation
Metadata exposure
Open access publishing
sustainability
Advocacy
Project/programme design
Change management
Recruitment, welcoming and onboarding
Communication
Content planning
Content creation and curation
Copywriting and editing
Marketing and branding
Knowledge brokering
Media relations
Outreach
Speaking and presenting
Social media
Technical
Media production
Data analysis
Data visualization
Data management
Systems administration and maintenance
Product management of technology platforms
Web and UI design
Content Management System (CMS) administration
Technical support

Open innovation
Open peer review
Persistent identifiers management
Preservation
Preservation costs management
Privacy governance
Programme governance
Project management
Provenance information management
Research governance
Research integrity process design
Research integrity, attribution, impact awareness
Research management
Resource management
Securing networks for data integrity
Securing sustainable funding
Selecting appropriate data handling methods
Service level management
Software preservation
Stakeholder engagement on societal impact
Storage management
Strategic/long-term planning
Training in open and fair methods
User acceptance testing

13 Annotation of Data Stewards MVS with OSS Terms

OS competence dimensions

- **Technology:** Developing and implementing processes to support systematic sharing of knowledge and tools, including measures to ensure open access to all research outputs.
- **Domain**: Planning and implementing processes based on domain standards to ensure that research practices meet legal and ethical obligations, and that research outputs are reproducible.
- **Interpersonal**: Developing open cooperative working relationships to involve all relevant knowledge actors in the co- creation of R&I agendas and contents
- **Communication**: Planning, creating, editing, and delivering information relating to Open Science practices or policies to all relevant knowledge actors
- **Leadership**: Development, advocacy, and evaluation of open science practices in collaborative R&I projects, programmes, or services.

1) For each statement in column 1 pick up to 5 terms from KEYWORD tab and copy to relevant dimension (columns C to G), separated by ';' 2) based on number of terms (';') in each colum assess relevance of dimension as High/ Medium/ Low

Essential Skills & Competences	technology	#	domain	#	interpersonal	#	communicatio n	#	leadership	#
Data Steward										
Knowledge of Open Science practices, policies and regulation and translation of these (when necessary) to local context.	Data policy;	1	Domain knowledge to contextualise data handling;	1	Mentoring on open and fair methods; Advocacy;	2	Consultation and listening;	1		0
Service provision to support specific Open Science practices including: applying FAIR and CARE principles, Open Access, data curation, preservation, archiving and responsible re-use.	Service level management; Data curation; Preservation; Open access publishing;	4		0		0		0		0
Knowledge about Research Data Management, (personal) data governance and ethics, information security and risk management.	Data access risk assessment and mitigation; Information security;	2	Data management; Domain knowledge to contextualise data handling;	2		0		0	Data Governance;	1
Awareness raising among data creators users, and research stakeholders of the value of good data management.		0	Advocacy; Evaluation & assessment;	2	Engagement; Cultural competence;	2	Knowledge brokering;	1		0

Provide advice and support on use of infrastructure and tools for data storage, versioning, publishing, and documentation	Product management of technology platforms; Technical support; Data repository management; Data sharing and publication;	4		0	Mentoring;	1		0		0
Support Open Science practices, policies and practices through training design and delivery.		0	Landscape analysis;	1	Teaching and training;	1	Copywriting and editing; Knowledge brokering; Speaking and presenting;	3		0
Monitor the research and funding ecosystem, identifying conflicting motivations, drivers and incentives among different stakeholders.		0	Landscape analysis; Business modeling;	2		0		0	Community governance; Proposal development; Securing sustainable funding;	3
Knowledge/awareness of programming, FAIR code and FAIR software and use of standards and ontologies	Assessment on FAIR data criteria; Software preservation; Data curation, Metadata exposure;	3		0		0		0		0
Conflict management/mediation (with a patient, empathic approach)		0		0	Moderation, mediation and intervention;	1		0		0
Critical and analytical thinking		0	Analysis;	1		0		0		0
Stakeholder engagement and networking to translate and bridge needs		0		0		0		0	Community governance;	1
Creativity, curiosity and openness (willingness to learn)		0		0	Creativity;	1		0		0
Team management and project management (results oriented planning and organising)		0	Project management;	1	Collaboration;	1		0		0
Number of terms (';')		14		10		9		5		5
Relevance (High, Medium, Low)		HIGH		MED		MED		LOW		LOW