OPEN SCIENCE AND RESEARCH REFERENCE ARCHITECTURE 2024–2030 IN A NUTSHELL

Open Science

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1. INTRODUCTION

THE OPEN SCIENCE AND RESEARCH Reference Architecture 2024–2030 provides an overview of the national target state for open science and research in 2030 and assesses its current state.

The reference architecture was created by a working group operating under the Finnish Open Science Coordination (AVOTT) in 2021–2023. Additionally, several other members of the national research community took part in the work through workshops and consultations. The architecture also underwent a round of public feedback in spring 2023. The reference architecture was developed on the initiative of the National Open Science and Research Steering Group and the Ministry of Education and Culture.

This document is a summary of the reference architecture drafted by the AVOTT Secretariat that operates within the Federation of Finnish Learned Societies (TSV). The summary describes the content and use of the reference architecture at a general level and highlights key observations. The summary also contains instructions on how the reference architecture should be utilised.

The reference architecture is based on the Declaration for Open Science and Research 2020–2025, as well as four policies further specifying related goals, objectives, and actions. The declaration and policies form the strategic foundation for the reference architecture. In addition to these, the most relevant international guidelines and national architectures related to the reference architecture have been taken into account.

The reference architecture is a recommendatory document. It can serve as a guiding framework for an organisation, its architecture, or development as it provides a shared model and terminology for the planning and implementation work.

The reference architecture ensures that the open science and research policy framework, i.e. the declaration, policies, and recommendations, are up to date and that the capabilities, services and processes of the research community are in line with the objectives set out in the policies. Furthermore, the architecture is also one of the entities that guides the AVOTT monitoring.

The reference architecture can be found in its entirety in the Eduuni-wiki online service and the QPR Publications Bank, available in Finnish (Toimialat > Opetus- ja kulttuuriministeriö > Avoimen tieteen ja tutkimuksen VA). In addition, the document includes a PDF version to which a link can be found on the avointiede.fi website. The page numbers from which the summary content is fully visible in the actual reference architecture document have been marked in parentheses after the summary content descriptions.

2. EXECUTIVE SUMMARY

THE REFERENCE ARCHITECTURE IDENTIFIES some of the main gaps in services that promote open science and research. Based on these gaps, the following actions are proposed. These actions must be measurable.

Sufficient competence and the necessary training in different areas of open science and research must be guaranteed.

The resource requirements of open research and education must be systematically taken into account in the funding models.

The legal and operational interoperability of the research community's organisations must be ensured, and attention must be paid to the necessary legal competence and interoperability of processes at all community levels.

Artificial intelligence must be considered in the development of open science and research. This involves, among other things, the openness of AI models and responsible utilisation of AI in open science and research.

The maintenance, utilisation and interoperability of architectural work must be ensured and its international interoperability must be promoted, particularly at the EU level.

3. LEVEL OF PRINCIPLE

THE RELEVANT CAPABILITIES, principles and essential documents, as well as the laws, regulations and other external drivers that impose requirements on the reference architecture, were identified at the reference architecture's level of principle (p. 12–67). Among others, the level is linked to the national open science and research policies, the main related architectures, and international policies, such as the UNESCO Recommendation on Open Science.

a. Capabilities and resources

The capabilities described in the reference architecture (p. 51–67) refer to a set of features and resources that allow the objectives set in the policies for open science and research to be achieved. These capabilities may be national or global, or they may be related to an organisation's own operations. The capabilities described in the reference architecture have been divided into three groups: operational, supporting, and strategic capabilities.

Operational capabilities

Supporting capabilities

Strategic capabilities

Operational capabilities include abilities required for practical research and education. They can be divided according to the different operational areas into capabilities required in research processes, capabilities pertaining to the achievement of open science, capabilities related to innovation and commercialisation, and capabilities of understanding the operating environment.

Supporting capabilities organise, develop and support activities, e.g. in the form of communications, legal affairs and training. The area also includes administrative capabilities, such as the capabilities of education administration, financial and HR management, and IT management.

Strategic capabilities are used to transform and steer the national framework of open science and research towards greater openness and responsibility. The area includes various general leadership capabilities and specific capabilities for open science, such as the management of open science activities (AVOTT), i.e. the ability to promote the openness of science and research at the level of individual organisations, and AVOTT monitoring, as well as an understanding and expertise related to openness.

Operational capabilities	Supporting capabilities	Strategic capabilities
Research process	Communications	Leadership
Implementing openness	Legal affairs	Management of AVOTT activities
Innovation and commercialisation	Training in openness	AVOTT monitoring
Understanding the operating environment	Administration	Understanding openness and skills

4. BUSINESS ARCHITECTURE

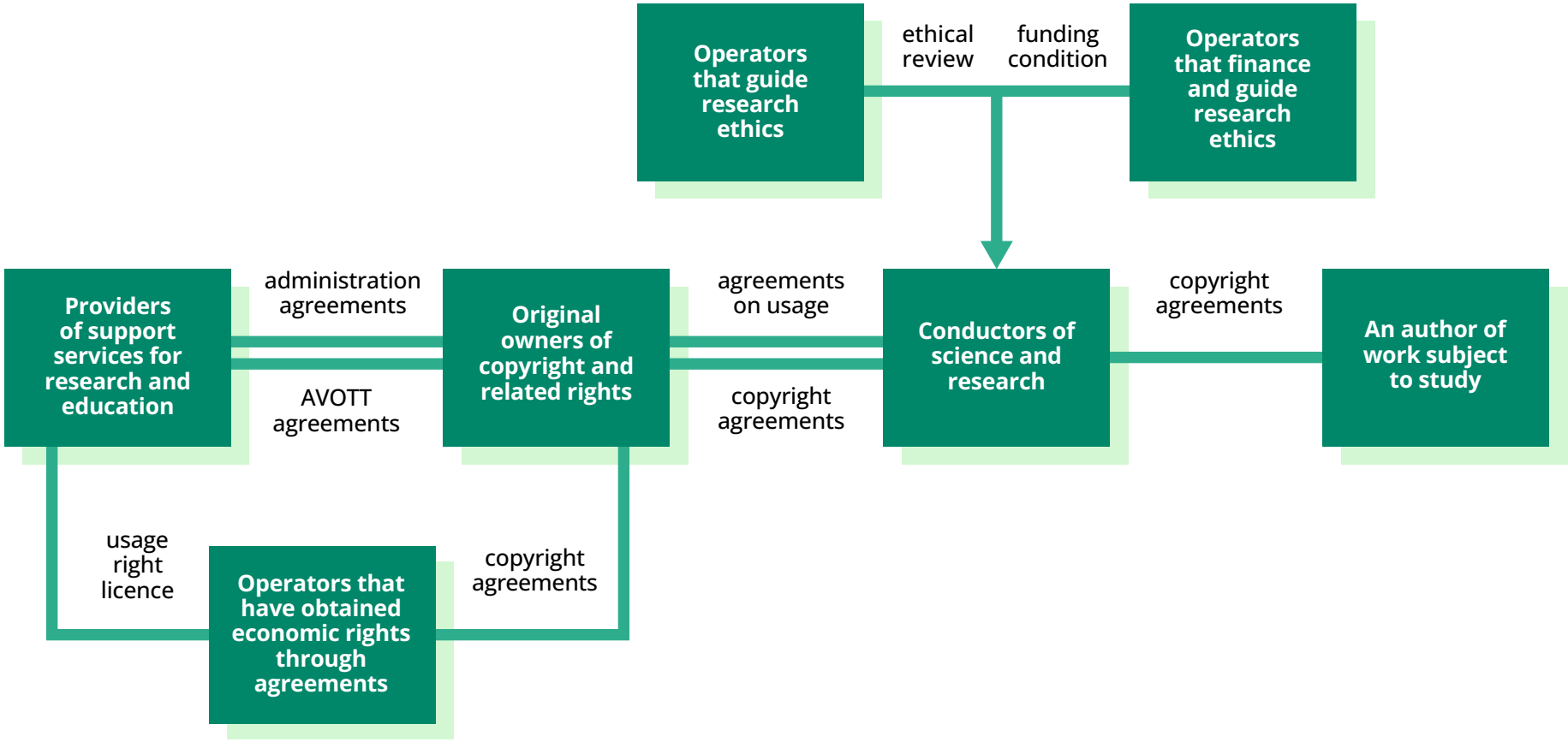
THE BUSINESS ARCHITECTURE (p. 68–149) describes the key operators and roles relevant to the reference architecture, their interactions and the essential business services for the operating environment, along with the processes realising these services. Own service areas include participatory science, openness of learning, responsible evaluation, and cross-cutting services that cover the entire national framework of open science and research.

a. Operators and roles

The diagram (p. 69) illustrates the key operators for the reference architecture. The operators have been divided into groups according to their roles in open science and research. Instead of identifying individual operators, the roles have been described at a general level. The structure of the diagram is read from left to right, moving from parties that finance, direct and evaluate research and education to the users of open science and research.

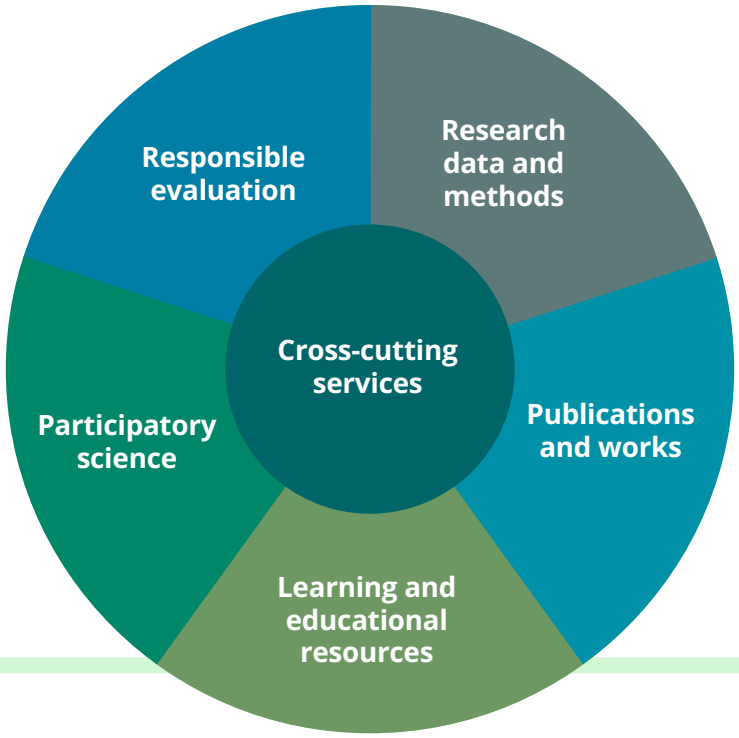
b. Contractual relationships in works and publications

The diagram (p. 82) illustrates the contractual relationships pertinent to the creation of works and publications from the perspective of the reference architecture. The arrows describe the interaction between the operators in terms of various contracts.



c. Service map

The diagram (p. 86–87) illustrates the key service areas for the reference architecture. The service areas have been further divided into services and service processes, which are not shown in the diagram. The cross-cutting services are positioned in the middle of the other service areas.



WHAT DID WE LEARN?

The large number of **CROSS-CUTTING SERVICES** in relation to other service areas shows that the individual service areas of open science and research have a great deal in common.

LEGAL AFFAIRS are a key aspect of the promotion of open science and research for two reasons: the promotion of open science requires competence with openness-related legislation and legislative influencing in connection with the promotion. At a national level, the status of both remains poor.

The challenge in **RESPONSIBLE EVALUATION** is that inappropriate indicators are still being used, as are inappropriate methods in using more responsible indicators. To advance high-quality evaluation processes, support is required for both the evaluation methods and the generation of a knowledge base.

OPEN EDUCATION SERVICES enable research-generated knowledge being disseminated into society. In addition, open education allows learners to be guided onto the path of open science from an early stage onwards.

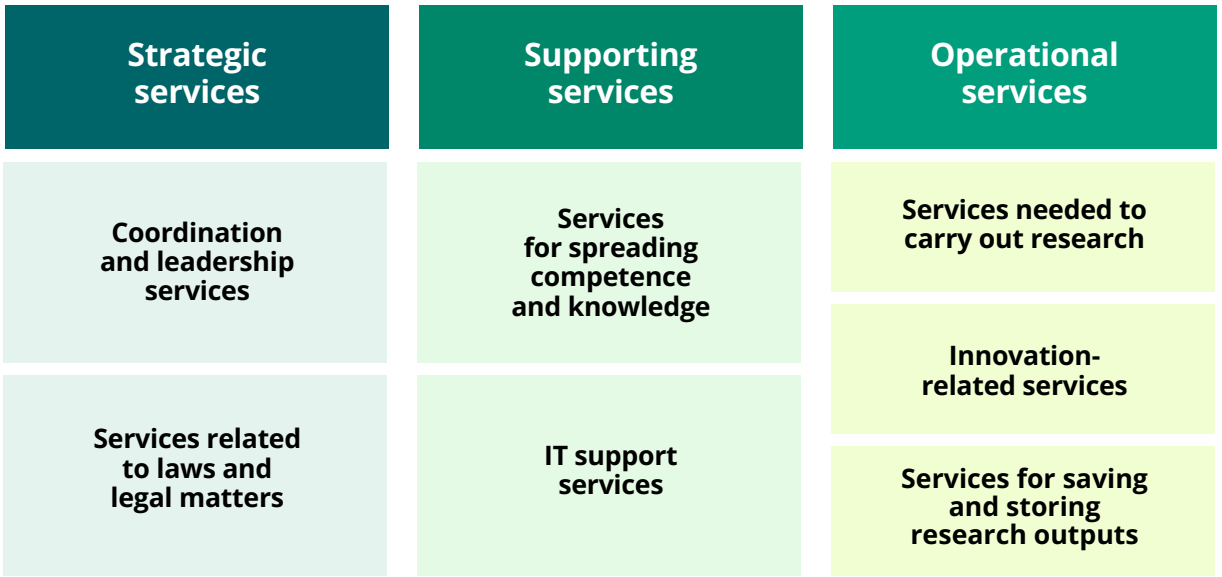
Established practices exist in **OPEN SCHOLARLY PUBLISHING**, but the sector is continuously developing, and continued high quality must be ensured. Open scholarly publishing may seem challenging to researchers and organisations, which is why it is important to invest in support services and economically viable publishing models.

At the local and national level, in particular, little practical support and few tools are available for **PARTICIPATORY SCIENCE**, even though e.g. citizen science is attracting interest and occasionally gaining media visibility.

THE RESEARCH DATA AND METHOD SERVICES are still in development. Only computing services are currently adequately available at the local, national and international level. Making research datasets and methods openly available requires systematic and determined efforts to achieve the objectives of 2030, determined in the reference architecture.

The cross-cutting services identified in the reference architecture can be divided into three groups according to the capabilities map:

1. **Strategic services that include:**
   a. Coordination and leadership services that guide all open science and research operations, e.g. through resource allocation and incentives.
   b. Services related to laws and legal matters, in which operators carrying out open science and research are supported in adhering to existing legislation (such as copyright or data protection laws), and efforts are made to influence the development of legislation in a direction that promotes open science and research.
2. **Supporting services that include**
   a. Services for spreading competence and knowledge, through which information about open science and research can be shared, e.g. through training and communication.
   b. IT support services, where the responsibilities include ensuring the cybersecurity and interoperability of the information systems required for open science and research.
3. **Operational services that include:**
   a. Services needed to carry out research, in particular (e.g. support for compliance with research integrity)
   b. Innovation-related services
   c. Services for saving and storing research outputs.



5. INSTRUCTIONS FOR USE

THE OPEN SCIENCE AND RESEARCH REFERENCE ARCHITECTURE is a public and continuously updated document intended for the members of the research community. The intention is for users to use the reference architecture to plan their activities and identify gaps in their own organisations, e.g. in the form of updating their own reference architecture.

The reference architecture consists of visual descriptions of the target areas' objectives, services and operators, and the roles, relationships, and capabilities between them, that are necessary to achieve the objectives by 2030.

The reference architecture also contains key vocabulary for open science and research. The main glossary document is the Research Management Vocabulary, which is supported by the Glossary of Education (OKSA). In addition, the open science glossary of the Helsinki Term Bank for the Arts and Sciences, updated between 2023 and 2024 by the Open Science Terms working group, as well as the Open Science Policy Machine, intended to be completed in 2024, will be used as support in the future.

When making use of the reference architecture, the recommendation is to go over the following list in relation to the user's own organisation:

- Identify the main operators, objectives, services and capabilities of your organisation, its services and operations.
- Supplement your organisation's architecture or strategy based on the reference architecture.
- When creating your own architecture description, it is recommended to use recognised terminology (the glossaries above) to ensure semantic compatibility.

The following table illustrates the benefits and uses of the architecture based on the needs of different groups and roles.

Role	Benefits of the architecture	What is the architecture used for?
Operators that guide research and education	• Guide the structure of the field and the enhancement of the knowledge base.	Knowledge management support
Research funders	• Provide an overview of the 2030 target state of open science and research and its direction of development. • Provide information about the resource requirements of open science and research.	Knowledge management support
Scholarly publishers	• Provide an overview of the 2030 target state of open science and research and its direction of development.	Operational development
Research organisations	• Describe the cooperation parties and their mutual relationships. • Describe the desired operations of open science and research, and their services.	Developing operations and creating an organisation's own architecture
Researchers and teachers	• Provide an overview of the 2030 target state of open science and research and its direction of development. • Increase awareness of open science and research.	Raising awareness
Other operators in the community	• Increase awareness of open science and research. • Provide an overview of the 2030 target state of open science and research and its direction of development. • Describe the cooperation parties and their mutual relationships. • Ensuring interoperability (e.g. semantic).	Providing joint services and planning cooperation

6. MANAGEMENT MODEL

THE REFERENCE ARCHITECTURE WAS DRAFTED and is maintained by the research community under coordination of the Federation of Finnish Learned Societies (TSV). TSV is the owner and administrator of the architecture and responsible for keeping it up to date. The steering group of the Open Science Coordination in Finland approves the architecture, after consulting the research community. The Steering Group also assesses the need for an update annually. The funding for the reference architecture work comes from the Ministry of Education and Culture. Additionally, CSC provides advice and support in the implementation and utilisation of the architecture.

7. WORKING GROUP THAT DRAFTED THE REFERENCE ARCHITECTURE

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In addition to the working group, several specialists participated in creating the architecture through workshops and public feedback. An expression of profound gratitude is extended to all individuals who contributed to this endeavor.

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Learned Societies