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3:2024

OPEN SCIENCE AND RESEARCH REFERENCE ARCHITECTURE 2024–2030

RESPONSIBLE RESEARCH SERIES

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Open Science and Research Reference Architecture 2024–2030

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INTRODUCTION

THE OPEN SCIENCE AND RESEARCH Reference Architecture describes the desired state of the target area in 2030.

“A reference architecture provides a common model and terminology for designing an architecture of an entity under development and implementing it, and it defines the structures involved and their interrelationships. A reference architecture guides the architecture of an organisation or entity under development. Its scope and coverage may vary. For example, it can be an internal, sector-specific or globally shared model, such as an ISO standard." (JHS 179)

The Open Science and Research Reference Architecture was developed on the initiative of the National Open Science and Research Steering Group and the Ministry of Education and Culture. The reference architecture enables a controlled development and response of open science and research in continuous change. It ensures the stability of research structures as important facilitators of research.

The Open Science and Research Reference Architecture is based on the goals set out in the Declaration for Open Science and Research, as well as the policies specifying these goals and the objectives and actions derived from them. Where necessary, the architecture has been complemented on the basis of international open science frameworks, such as UNESCO Recommendation on Open Science.

There is no clear boundary between open science and closed science; rather, the open and closed variants form a continuum, where previously closed datasets may become open over time, for example. This is why the reference architecture describes the structures of science and research extensively – as open as possible and as restricted as necessary.

The Open Science and Research Reference Architecture was created by a two-year working group appointed by the National Open Science and Research Steering Group. In the spring of 2021, a preparation group appointed by the Steering group prepared the task assignment for the working group. The working group chairs included Jukka Heikkilä from the Finnish Union of University Professors (first chair in 2022) and Susanna Nykyri from Tampere University (first chair in 2023). Ilmari Jauhiainen and Marita Kari from the Federation of Finnish Learned Societies served as the secretaries of the working group. The Open Science and Research Reference Architecture underwent a round of public feedback for the period of 17 April – 2 June 2023.

The working group that created the Open Science and Research Reference Architecture

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In addition to the working group, several other operators participated in creating the architecture through workshops organised for this purpose and public feedback. A huge thank you to all those who contributed to the work.

EXECUTIVE SUMMARY

THE OPEN SCIENCE AND RESEARCH Reference Architecture is a way to structure, design and steer open science and research at a national level. It allows the digital transformation to be managed. The reference architecture provides a comprehensive overview of the target state of open science and research activities and supports the development of these activities. The Open Science and Research Reference Architecture ensures that open science and research policies, i.e. the declaration, policies and recommendations, are up to date. In addition, it allows open science and research capabilities, services and processes to be compatible with the policies.

The Open Science and Research 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:

- 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. Additionally, resources must be allocated for the development of emerging open science and research services and competence (e.g. research methods, open education, responsible evaluation and participatory science).
- The legal interoperability of the research community's organisations must be ensured and attention must be paid to the necessary legal competence at all of the community's levels. One element in ensuring legal interoperability is to draw up model agreements.
- The operational interoperability of the research community's organisations must be ensured, and attention must be paid to seamless interoperability of open science and research processes.
- Artificial intelligence must be taken into account in the development of open science and research. This involves, among other things, the openness of AI models, AI ethics and responsible utilisation of AI in open science and research.
- The Open Science and Research Reference Architecture must be actively utilised in the development of the Open Science and Research Policies and in Open Science and Research monitoring.

- The Open Science and Research Reference Architecture must be kept up to date and resources must be allocated to the architecture work. The future architecture work will also include ensuring the interoperability of Open Science and Research Reference Architecture, TILA and DAHA reference architectures in the future, making use of reference architectures in organisations and supporting the development of the organisations' enterprise architecture.
- The international interoperability of architectural work must be promoted, in particular at the EU level, e.g. in the EOSC network. Additionally, adequate resources must be ensured for international architectural work.

1. STRUCTURES

1.1 THE ARCHITECTURE'S MANAGEMENT MODEL

The reference architecture has a simple and clear management model that guides its development and maintenance. The management model describes how the management of the architecture work and the reference architecture is organised, what roles the management involves and how the enterprise architecture work is carried out in practice (Source: JHS 179).

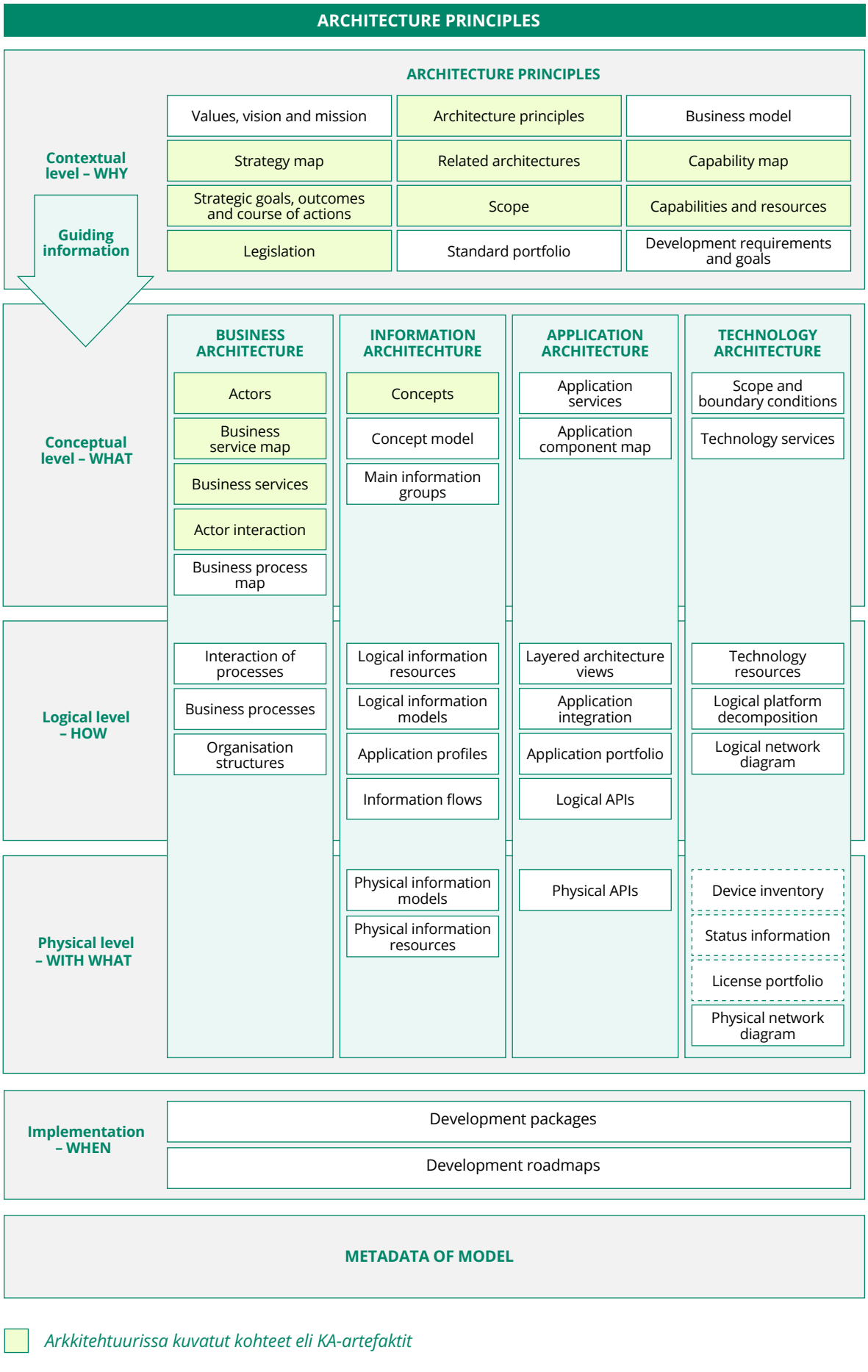
Management model of the reference architecture		Clarifications and additional information
Parties responsible for the open science reference architecture		
1.	The architecture is owned and managed by the Federation of Finnish Learned Societies.	The architecture is public.
2.	The architecture is funded by the Ministry of Education and Culture.	
3.	The architecture is approved by the Open Science and Research Steering Group after consulting the research community.	
4.	The architecture is maintained by the research community, coordinated by the Federation.	The Federation involves the key operators of the research community in the maintenance of the architecture. CSC is responsible for technical maintenance.
5.	The update requirements are verified annually by the approver.	Technical changes may be made by the Federation or CSC.
6.	The architecture is updated under the coordination of the owner.	
7.	CSC provides advice and support in the implementation and utilisation of the architecture.	Requires dedicated resourcing.
Utilisation of and guidance by the architecture		
8.	The architecture offers recommendations.	
9.	The architecture provides an overview of the target state of infrastructures and services required by open science and research, and assesses their current state.	
10.	The architecture guides Open Science and Research monitoring together with other guiding elements (e.g. policies).	
11.	The architecture should be used when preparing enterprise architectures for organisations.	
12.	The architecture can also be used in international open science and research architecture work.	

Management model of the reference architecture		Clarifications and additional information
Validity of the architecture		
13.	The architecture will enter into force once it has been approved and will remain in force until further notice.	The 2023 version describes the target state of 2030.
Documentation of the architecture		
14.	The official version of the architecture will be published on the Edition.fi platform of the Federation of Finnish Learned Societies. The previous official versions will be stored on the same platform.	In PDF format, permanent identifier, ensuring long-term availability.
15.	The documentation will also be kept on the Eduuni-wiki (in Finnish) website. There will also be a link to the official version on the Edition.fi platform.	
16.	The architecture's diagrams, together with their descriptions, will also be published in the QPR Publications Bank (in Finnish).	The diagrams of version 1.0 have been made using the QPR EA tool. CSC maintains the models in the QPR Bank.
17.	The architecture is transformed into simplified and/or visualised documents for communication purposes.	

1.2 DESCRIBED ENTITIES AND A METAMODEL

1.2.1 Described items, i.e. enterprise architecture artefacts

The reference architecture is based on the Recommendation for the Design and Development of Enterprise Architecture (JHS 179, in Finnish), which defines the method for public administration enterprise architectures. An enterprise architecture is a structure formed by a combination of operations, processes and services, data, information systems and the services they produce. In the JHS 179 reference framework diagram below, objects described in this architecture are marked. The selected objects are diagrams, tables and verbal descriptions. This architecture focuses on the level of principles and a business architecture.



Arkkitehtuurissa kuvatut kohteet eli KA-artefaktit

1.2.2 Metamodel

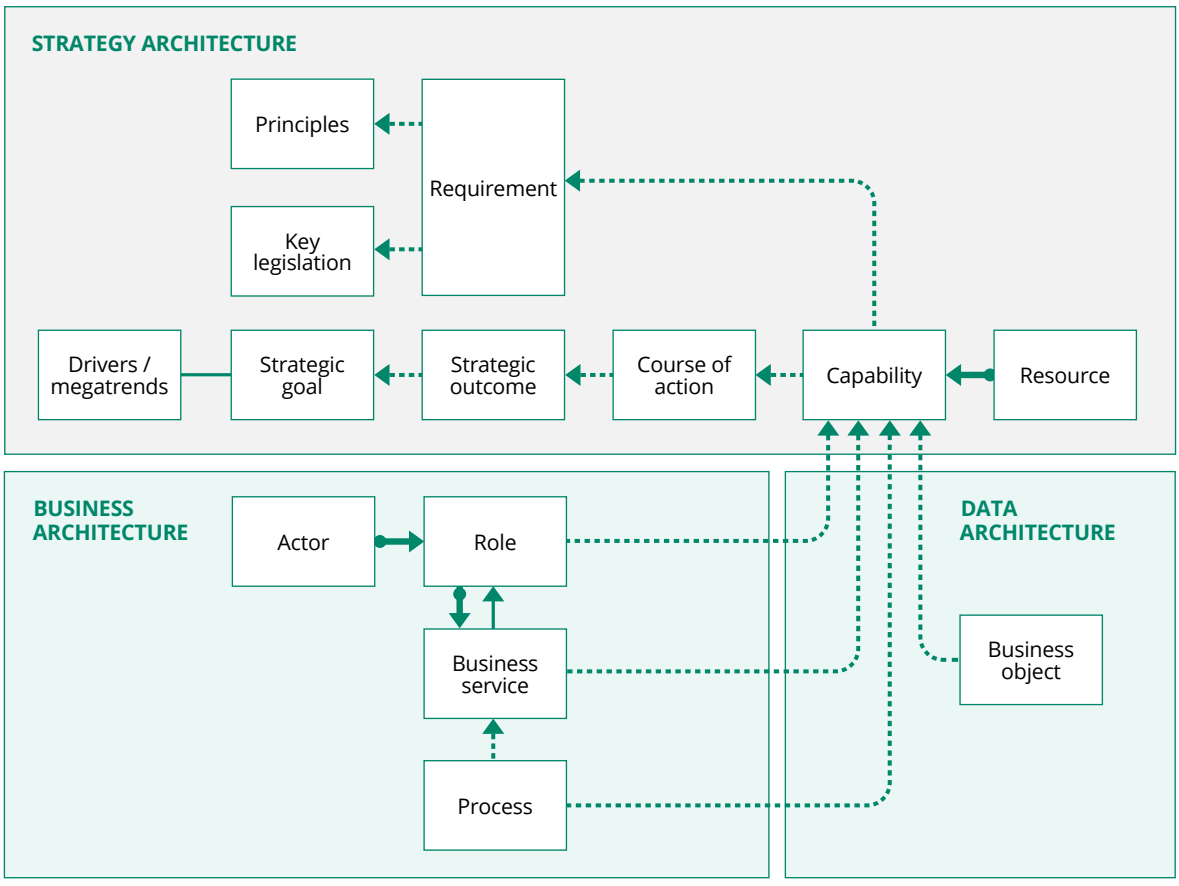
The metamodel describes the structure of the architecture. It consists of five wholes: 1) level of principles, 2) business architecture, 3) data architecture, 4) application architecture and 5) implementation of architecture. The Open Science and Research Reference Architecture focuses on the level of principles and business architecture.

The needs of the operating environment, the architectural principles, the related architectures, laws and regulations that set requirements for the architecture are identified at the level of principles. In addition, external drivers are identified, which are responded to with open science policies and their clarifying objectives. These, too, set their requirements for the architecture.

Capabilities are the answer to requirements. With capabilities, the policy objectives can be achieved, and compliance with laws and regulations ensured. Capabilities consist of resources (competence, practices, knowledge and information systems) that must be possessed, acquired or developed. Capabilities are described in business, data and application architectures.

A business architecture describes the actors that provide and use services, as well as their roles, business services and the processes that generate these services.

The necessary glossaries are described in a data architecture.



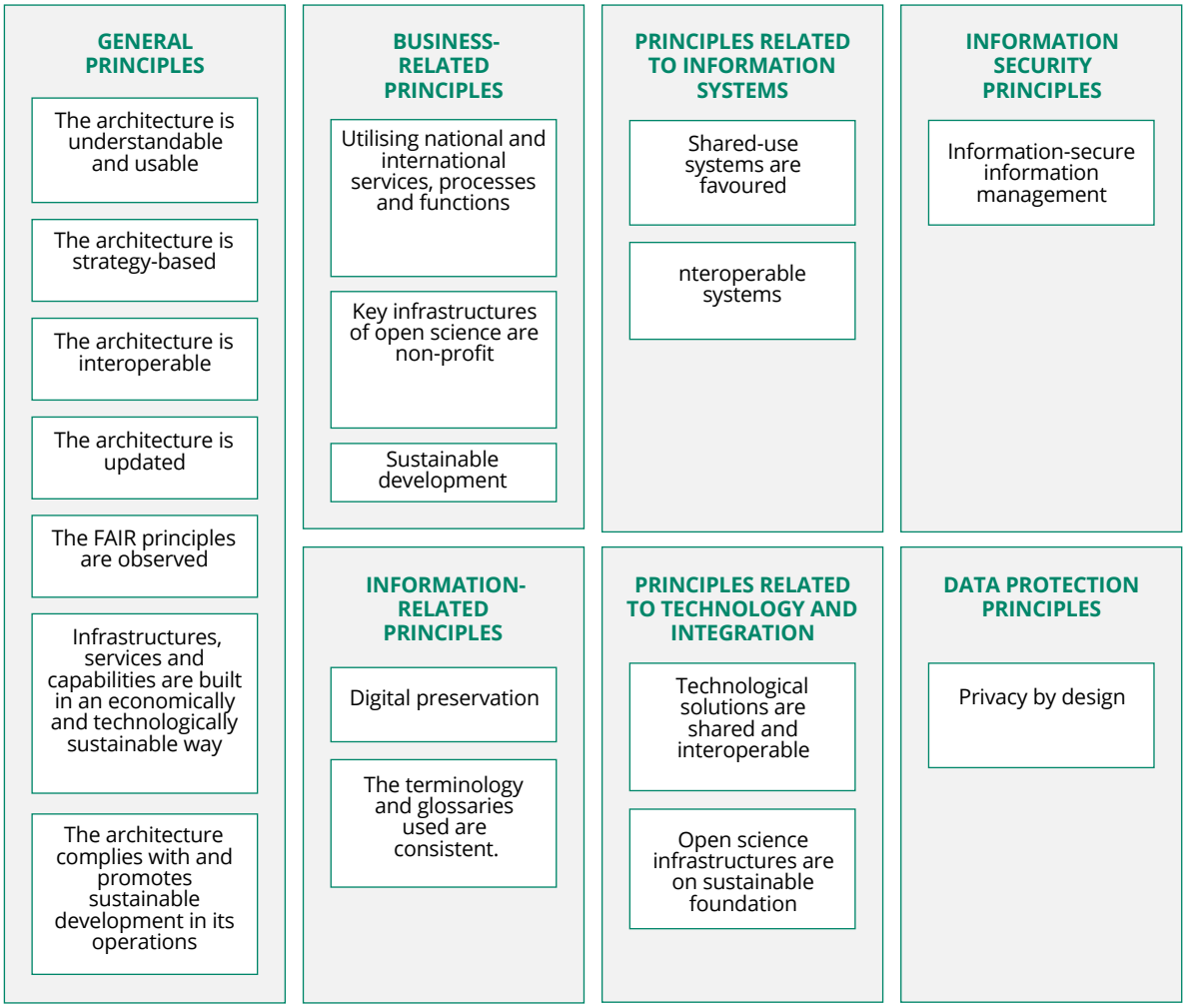
2. LEVEL OF PRINCIPLES

2.1 PRINCIPLES AND SCOPE OF THE ARCHITECTURE

2.1.1 Architectural principles

Principles are general guidelines or practices that pertain to an architecture and are intended to be long-term in nature and seldom changed. They form the basis for the development and management of the Open Science and Research Reference Architecture. The architectural principles include the objectives, policies, reference frameworks and rules, as well as potential prohibitions, that guide the development work. These principles are joint agreements on the fundamental development principles. The principles allow development measures to be directed towards a common target state. The architectural principles must be observed in all development situations.

The principles named and grouped below in the map of architectural principles are described in more detail later in the tables of this chapter.



2.1.1.1 General architectural principles					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
The architecture is understandable and usable.	The architecture documentation is understandable and brings benefits to all stakeholders.	The operators must be able to understand the architecture in order to implement the Open Science and Research Policies. The architecture must support the design and provision of services.	Capabilities can be acquired and services provided – strategic objectives are achieved. The strategy promotes the attainment of open science objectives.		
The architecture is strategy-based	The architecture is derived from the strategic objectives defined in the national policies of the Open Science and Research Reference Architecture.	The purpose of the architecture is to support the implementation. It visualises the strategy.	The architecture is limited to the development areas essential for Open Science and Research Declaration 2020–2025, and the focal points comprise the areas that are relevant for the whole. This will facilitate the achievement of the strategic objectives.		
The architecture is interoperable	The architecture takes into account related architectures that have been identified and is semantically interoperable with these related architectures	Solutions created based on the architecture must be interoperable and form an understandable whole in the fields of open science, research and higher education. The interoperability of national-level services is ensured and interoperability with the most important international services sought The Open Science and Research Reference Architecture does not describe a discrete whole, as links to elsewhere are essential. It is different from any individual organisation's architecture: the entity described is hardly the entire operating environment for any organisation and it is unlikely that anyone uses the entire entity described.	It utilises and expands the architectures of open science, research and higher education.		

2.1.1.1 General architectural principles					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
The architecture is updated	The architecture has a management model that allows it to be updated.	The architecture is created, updated and implemented in an open and participatory manner.			
The FAIR principles are observed	According to the FAIR principles, information is • findable • accessible • interoperable • reusable.	Information must be available to all those who need it. The FAIR principles enable interoperability of services. The Ministry of Education and Culture is committed to the FAIR principles.	Systems and services work together and, if necessary, data transfer between them can be done through open APIs.	Examples include metadata that supports finding information, with a focus on the openness of information, as well as ease of identification and authorisation.	Declaration for Open Science and Research 2020-2025 (avointiede.fi)
Infrastructures, services and capabilities are built in an economically and technologically sustainable way.	Infrastructures and services are supported by adequate resources throughout their lifecycle. Existing infrastructures are improved so that their technological solutions remain up-to-date.	Funding and sufficient competence must be ensured throughout the lifecycle.			
The architecture complies with and promotes sustainable development in its operations	Open science is required to achieve the objectives of sustainable development, as openness is ultimately the basis for all information.	The openness of information and science is essential to achieve the proposed objectives. The objectives are closely linked together, supporting each other. However, the openness of research-based knowledge is particularly important for the following four objectives: • Good education • Reduction of inequality • Sustainable infrastructures and innovations • Cooperation and partnerships. Responsibility, i.e. reliability, ethics, reproducibility and transparency, is a prerequisite for openness.			Transparency as Backbone of Sustainable Development Open Science (in Finnish) Culture for Open Scholarship Policy

2.1.1.2 Business-related principles					
Principle	**Description**	**Grounds**	**Effects**	**Example**	**Source**
Utilising national and international services, processes and functions	Services utilise national and the higher education sector's processes, services and solutions defined as shared.	Shared solutions improve interoperability, reduce costs and speed up development. (May mean both that they are utilised in service provision and that end users are able to use the existing services.)	Speeds up service development and reduces costs.		Policy for open research data and methods. National policy and executive plan by the higher education and research community for 2021–2025 (Also in line with UNESCO Open Science Recommendation)
Key infrastructures of open science are non-profit	The architecture takes the entire lifecycle of research and the information it generates into account.	Helps to enable the promotion of economically sustainable open science.	Reduces costs and helps ensure financial sustainability.		
Services that enhance high-quality research are offered to research and researchers.	The operations are based on the needs of organisations conducting and funding research.	The culture for open scholarship requires reciprocity, which manifests itself as interaction that benefits both the internal and external activities of an organisation for all parties.			

2.1.1.2 Business-related principles					
The ownerships and responsibilities of services, processes and functions must be described.	Ownerships and responsibilities are challenging in this context: describing them is important.				

2.1.1.3 Information-related principles					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
Digital preservation	The architecture takes the entire lifecycle of research, the information it produces and the information management into account, so that scientific and research findings can be permanently and reliably available.	The digital preservation and availability aspects are taken into account from the start when designing infrastructures, services and publishing processes. Publications are given web addresses based on persistent identifiers. A long-term approach. From ad hoc solutions to infrastructures, at least at the core. Lifecycle management of information, including digital preservation			Teknis-teknologis-luonteiset suosituk-set.docx - Google Docs (in Finnish) Viitearkkitehtuuri – Avoin tiede ja tutkimus v_1_0.pdf (in Finnish)
The terminology and glossaries used are consistent.	Things are named and described in different ways depending on the discipline. Different disciplines also have their own concepts and terminology, whose interrelationships may differ.	Making descriptions machine-readable and linking them to data, metadata and each other allows datasets to be findable and usable. These semantic artefacts should also be FAIR, i.e. described and referable. Finding the correct vocabulary is not always easy, and sometimes one may not even exist. Therefore, the working group hopes that the new Interoperable 1-2-3 guidelines will help researchers, research data experts and service providers in the application of the FAIR principles.			I for Interoperability Open Science (in Finnish)

2.1.1.4 Principles related to information systems					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
Shared-use systems are favoured	The development of shared information systems is favoured over overlapping solutions for individual services.	Overlapping functionalities/ capabilities are expensive to create and contribute to the generation of conflicting information. The architecture promotes the utilisation of what already exists. By working together to create nationwide solutions, openness will also extend beyond the research community.	Collaborative development		

2.1.1.5 Principles related to technology and integration					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
Technological solutions are shared and interoperable	Software and hardware must comply with the selected standards and, as a rule, be in line with the choices made in open science.	Standards support interoperability, increase the ability to manage systems, user satisfaction, as well as information security and protection, enable support for multiple suppliers, and are justified from an overall economic perspective. Interoperability standards and the industry standards will be complied with unless there is compelling reason to apply a different solution.	The shared use and interoperability of information, applications and technology are promoted. • Shared use (various options available: a shared service; shared system; shared technology...) • Vendor independence	Systems have open interfaces and they are compatible. In order to ensure interoperability, systems utilise technological solutions in accordance with standards and best practices, including interfaces, metadata formats, identifiers and ontologies.	

2.1.1.6 Information security principles					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
Information-secure information management	An information-secure, privacy-conscious and efficient flow of information and information management are ensured (availability, usability, integrity, confidentiality and verification).	Laws and regulations, maintaining trust, as well as administrative and technical processes (organisational and technical actions). Information security is also part of risk management.	Compliance with the requirements of the Act on Information Management in Public Administration provides a good starting point for taking the principle into account.		

2.1.1.7 Data protection principles					
Principle	**Description**	**Grounds**	**Effect**	**Example**	**Source**
Privacy by design	Data is processed using uniform (data protection) principles and privacy safeguards throughout the lifecycle of a system, from planning to the end of use. Any impact assessments and balancing tests (data protection risk management) required are also taken into account.	Compliance with laws and regulations, maintaining trust in the processing of personal data: • processed lawfully, appropriately and transparently from a data subject's perspective • collected and processed for specific, explicit and legitimate purposes • collected only to the extent necessary for the purpose of processing personal data • updated whenever necessary: inaccurate and incorrect personal data must be deleted or corrected without delay • stored in a form that makes a data subject identifiable only for as long as is necessary for the purpose of processing the data • processed in a confidential and secure manner.	All systems must be checked to ensure their compliance with the principles. An organisation's awareness of the principle must be ensured e.g. through guidance and training.		

2.1.2 Scope of the architecture

The Open Science and Research Reference Architecture is a target-state architecture and it is temporally limited to the year 2030.

The table illustrates the scope of the architecture's content. Where necessary, the second column of the table specifies the scope by excluding some entities.

The reference architecture covers:	The reference architecture does not cover:
A description of the 2030 target state	No description made of the current state.
The architecture covers the areas defined in the Open Science and Research Declaration 2020–2025.	The architecture does not describe the values/valuation of open science.
Describing national-level services (centralised) and processes, and identifying local products that are not described. Identifying all services, as well as which ones are centrally produced and which are produced by research organisations. Identifying the required new services and an implementation plan for national-level services.	No position is taken on how organisations implement the identified services and processes.
The architecture describes the relations to other, relevant architectures in this area.	The indicators are not described.
The architecture describes the relations to international, EU-level and similar architectures.	Data models/metadata models are not described (required conceptual models are described).
Identifying national infrastructures of open science, such as tiedejatutkimus.fi, aoe.fi, journal.fi and edition.fi.	The architecture does not describe the technology architecture.
Identifying the guiding laws and policies, as well as needs for legislative amendments and new policies.	Digital preservation (described in other architectures), but the need for digital preservation is taken into account.
Identifying and requiring service interfaces.	
Describing the assessment of the architecture at certain intervals in the architecture management model.	
Describing generic information sources as external data repositories, for example the population information system.	
Identifying the required capabilities, including competence, processes, information and information systems, as well as the capabilities of researchers/teachers/pupils/other community members.	

2.2 KEY LEGISLATION, STRATEGIES AND REFERENCE ARCHITECTURES

2.2.1 Laws and regulations

This chapter discusses the key pieces of legislation that pertain to the openness of science and research. Legislation governing a number of specific areas (such as national defence, crisis management and medical research) has been excluded and should be examined on a case-by-case basis when addressing these areas.

2.2.1.1 Legislation pertaining to all operators

The table below contains a list of laws applicable to all the actors in the Finnish research community and describes how they must be taken into account in open science and research.

2.2.1.1 Kaikkia toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Copyright Act 404/1961 EU Copyright Law (13 directives and 2 regulations)	The law regulates, among other things, the subjects and content of copyright, the use of works, resale compensation, the transfer of copyright, the duration of validity, the neighbouring rights of copyright and the application of the law.	Taken into account when providing services involving a copyrighted work or creation that enjoys protection by neighbouring rights, such as a database or a computer program. Consideration is given to restrictions regarding materials that are protected by neighbouring rights and have been produced in an employment relationship/in public office, and to the right of research organisations and cultural heritage institutions to reproduce copies of works.	Applied to copyrighted works and materials that enjoy protection by neighbouring rights, such as a database or a computer program. The law sets limitations to copyright and neighbouring rights differently depending on the circumstances and organisation.	
Data Protection Regulation (EU) 2016/679 Standard clauses adopted by the Commission for data transfers to third countries Data Protection Act 1050/2018	The General Data Protection Regulation and its national application, as well as the standard clauses adopted by the Commission for the transfer of personal data outside the EU/EEA regions.	The obligation to provide evidence and restrictions related to the disclosure of information. Exceptions concerning the processing and disclosure of personal data.	The obligation to provide evidence. The roles and responsibilities related to data protection and information security must be determined within organisations. Personnel must be aware of the responsibilities and obligations imposed by the EU General Data Protection Regulation, the national data protection legislation and other provisions governing the processing of personal data.	
Employment Contracts Act	This Act applies to a contract (employment contract) with which an employee or employees collectively commit to work for an employer under their management and supervision in exchange for a salary or other remuneration.	Taken into account when signing a contract.		

2.2.1.1 Kaikkia toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Provision of Digital Services 306/2019 (in Finnish) Accessibility Directive (EU) 2016/2102	The purpose of the law is to promote access to digital services, their quality, information security and accessibility to content, thereby improving everyone's equal access to digital services. The EU Accessibility Directive, implemented by law.	Must be taken into account in the development and procurement of all communications, services, infrastructures and systems. See requirements.	Public sector bodies must take action to improve the accessibility of their websites and mobile applications by making them perceptible, manageable, understandable and reliable.	A service provider must maintain an accessibility statement, which includes information about the following: 1) which content of the digital service does not meet the accessibility requirements; 2) how the service users can access the information or service in an alternative way; 3) contact details for feedback on accessibility; 4) a link to the supervising authority's website where an accessibility complaint can be lodged.
Statistics Act 280/2004 Statistical Regulation (EU) 223/2009	The purpose of the law is to ensure the availability of reliable statistics for the purpose of societal decision-making and planning, to harmonise and streamline the principles and procedures applicable to the collection, processing, use, disclosure and storage of data in order to comply with the obligations pertaining to international cooperation on statistics, to promote adherence to good statistical practices in the state statistics agency, and to ensure that the rights of those who provide information for statistics or who are subject to this information are realised. The purpose of the law is also to promote the use of data collected for the purpose of statistics in scientific studies and statistical surveys on social conditions.	Must be taken into account in the data collection, planning and compilation of statistics. See requirements.	The Statistics Act provides for the collection and processing of data, the compilation of statistics, the disclosure of data and the obligation to provide information. Statistics must primarily use data collected in other contexts.	Statistics Finland The Natural Resources Institute Finland, the Finnish Customs and the Finnish Institution for Health and Welfare when carrying out tasks related to the compilation of statistics as mandated by law. A government authority that compiles statistics on its field of activity.

2.2.1.1 Kaikkia toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Archives Act 831/1994 (in Finnish)	Regulates the organisation of archival activities, and the storage and processing of documents. The Archives Act is being updated. (in Finnish)	Taken into account in the handling and storage of documentary materials.	(1) The law defines certain records creators to whose organisation of archival activities and duties the law applies. (2) The duties of a records creator include ensuring the availability of documents and maintaining a records creation plan.	The National Archives of Finland and the regional archives have special duties in preserving documents created by other actors and making them available for use.
Act on the Protection of Privacy in Working Life 759/2004	This law regulates the processing of personal data concerning employees, tests and inspections conducted on employees and the requirements related to them, technical surveillance in the workplace, as well as retrieving and opening an employee's email messages.	The purpose of this law is to implement the protection of private life and other fundamental rights that safeguard privacy in the workplace.	An employer may only process personal data that is immediately necessary for the employment relationship of the employee.	The employer must collect the personal data primarily from the employee themselves. If data cannot be obtained from the person themselves, consent is required. Among other things, the law restricts the processing of employees' health records and work emails in the workplace.

2.2.1.2 Legislation pertaining to public administration and authorities

The table below contains a list of laws applicable to public administration and authorities, in particular, and describes how the legislation must be taken into account in open science and research.

2.2.1.2 Legislation pertaining to public administration and authorities				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on Information Management in Public Administration 906/2019	The Act on Information Management in Public Administration provides for the adherence to the principle of publicity and requirements of good governance in the information management carried out by the authorities. The law includes provisions applicable to the entire public administration regarding the organisation and description of information management, interoperability of data repositories, implementation of interoperability of information systems, establishment of technical interfaces and viewing connections, and the implementation of information security. Pursuant to the act, a public administration information management board is established under the Ministry of Finance to assess and guide the implementation of information management by state and municipal authorities. This enables the safe and efficient utilisation of the authorities' datasets, so that the authorities are able to carry out their duties and provide their services to administration clients in accordance with good governance in an effective and high-quality manner. It also promotes the interoperability of information systems and data repositories.	Taken into account in the operations.	Creating and maintaining a data management model. Keeping in mind the information management map. Ensuring information security.	An information management model.

2.2.1.2 Legislation pertaining to public administration and authorities				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Openness of Government Activities 1999/621 Decree on the Openness of Government Activities and on Good Practice in Information Management 1999/1030	The law provides for the right to access information from public documents held by authorities, the duty of confidentiality of officials, the confidentiality of documents and other necessary restrictions to protect general and private interests related to the acquisition of information. It also outlines the obligations of authorities with regard to implementing this law. The decree specifies how the Act on the Openness of Government Activities should be implemented.	Taken into account as necessary.	A) Authorities' documents are public, unless otherwise decreed. B) Authorities have an obligation to promote access to information and the openness of their activities. C) In terms of the confidentiality of documents, authorities must comply with the confidentiality laws. C1) An authority may deviate from document confidentiality, and it ceases under certain conditions.	
Act on the Evaluation of Government Information Systems and Data Transfer Arrangements 1406/2011 (in Finnish)	The law provides for the evaluation of the information security of the authorities' information systems and data transfer arrangements. The law defines the duties and rights of the Finnish Transport and Communications Agency, Traficom, and the criteria it may use for the evaluation.	When assessing the information security of the state authorities' information systems and data transfer arrangements.	Only procedures or an assessment body referred to in the law and approved by Traficom may be used in the evaluation. A certificate issued by Traficom on the level of information security is a decision that can be appealed against.	Traficom is responsible for promoting and ensuring the information security of the authorities' information systems and data transfer arrangements, assessing the level of information security and carrying out reviews.

2.2.1.3 Legislation pertaining to individual operators

The table below contains a list of laws applicable to individual actors in the Finnish research community and descriptions of how they must be taken into account in open science and research.

2.2.1.3 Yksittäisiä toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Universities Act 558/2009	Universities are tasked with promoting independent science, as well as scientific and artistic education, providing the highest level of research-based education and educating students to serve their country and humanity. While carrying out their operations, universities must offer opportunities for continuous learning, interact with the rest of society, and promote the societal impact of research findings and artistic activities. Universities must organise their operations in such a way that ensures a high international level in research, artistic activities, education and teaching in accordance with ethical principles and good scientific practice. Universities may engage in business that supports the fulfilment of their statutory duties.	Taken into account in all activities. See requirements.	Applicable to universities that fall within the remit of the Ministry of Education and Culture. In addition to this law, Aalto University and Tampere University are governed by the Foundations Act 487/2015 (in Finnish). The organisation of the activities and administration of universities is determined in each university's rules of procedure and other similar internal regulations.	Universities must define which tasks involve the processing of sensitive data. Sensitive data is stored separately from other personal data and deleted immediately when a statutory obligation to store it no longer exists (last four years). In its field, the National Library of the University of Helsinki is responsible for preserving and maintaining the national cultural heritage, as well as its accessibility. The Natural History Museum of the University of Helsinki is responsible for the preservation, augmentation and exhibition of the national collections of natural science.

2.2.1.3 Yksittäisiä toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Universities of Applied Sciences Act 932/2014	The purpose of a university of applied sciences is to provide higher education based on the requirements of working life and its development, as well as research, artistic and educational aspects, for the purpose of professional specialist tasks and to support the professional growth of students. Additionally, universities of applied sciences are tasked with carrying out applied research, development, innovation and artistic activities that serve the education they provide, promote working life and regional development, and reform the local economic structures. While conducting their operations, universities of applied sciences must offer opportunities for continuous learning. Universities of applied sciences may engage in business derived from the fulfilment of their statutory duties.	Taken into account in all activities. See requirements.	Applicable to universities of applied sciences that fall within the remit of the Ministry of Education and Culture. A university of applied sciences is a legal entity in the form of a limited liability company (a university of applied sciences limited liability company), to which the Limited Liability Companies Act 624/2006 (in Finnish) applies unless otherwise stated in this law. Operating as a university of applied sciences requires an operating permit, which is granted by the government.	Universities of applied sciences must define which tasks involve the processing of sensitive data. Sensitive data is stored separately from other personal data and deleted immediately when a statutory obligation to store it no longer exists (last four years).

2.2.1.3 Yksittäisiä toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Specific laws apply to state research institutes.	Act on the Geological Survey of Finland (in Finnish) Act on the Finnish Meteorological Institute (in Finnish) Act on the Natural Resources Institute Finland Act on the National Land Survey of Finland (in Finnish) Food Authority Act (in Finnish) Act on the Finnish Environment Institute (in Finnish) Act on the Radiation and Nuclear Safety Authority (in Finnish) Act on a Limited Liability Company called VTT Technical Research Centre of Finland (in Finnish) Act on the National Institute for Health and Welfare Act on the Operation and Financing of the Institute of Occupational Health (in Finnish) Act on the Finnish Institute of International Affairs (in Finnish) Act on the VATT Institute for Economic Research (in Finnish)	Taken into account in the activities of research institutes, in cooperation, and in the further use and archiving of datasets.		
Research Information Hub Act (in Finnish)	A research data repository accumulates data that describes research and operators that carry out research in one place, and shares data for use by research operators and other users of research data. Its content consists mainly of data submitted by research operators in Finland. The law also provides for the establishment of a researcher profile service in connection with the repository.	Research actors may disclose data specified by legislation to a research data repository. Actors must ensure that the data they provide is accurate before it is stored.	The Ministry of Education and Culture may modify and combine the stored data in order to improve its quality and usability. A research actor has the right to obtain data from the repository in order to carry out its core duties. A researcher may consent to the disclosure of data to third parties.	The Ministry of Education and Culture is the controller of the research data repository.

2.2.1.3 Yksittäisiä toimijoita koskeva lainsäädäntö				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Academy of Finland	The law regulates the tasks of the Research Council of Finland (formerly the Academy of Finland). The Research Council of Finland is an expert organisation in science and research and falls within the remit of the Ministry of Education and Culture.	Taken into account in matters concerning the Research Council of Finland. See requirements.	The law regulates the administrative status of the Research Council of Finland. A research funder within the scope of the Ministry of Education and Culture, which also has national and international tasks related to scientific and research policy.	1) Promoting scientific research and its utilisation. 2) Development and implementation of scientific policy. 3) Other expert tasks.
Act on the Federation of Finnish Learned Societies (in Finnish)	The law regulates the tasks of the Federation of Finnish Learned Societies. The Federation of Finnish Learned Societies promotes collaboration between scientific communities and the provision of scientific information.	Taken into account in matters concerning the Federation of Finnish Learned Societies.	The law contains provisions regarding the administrative status of the Federation of Finnish Learned Societies.	The federation is responsible for: 1) promoting cooperation between the member communities of the Federation and supporting their operating conditions; 2) improving the distribution and publication of scientific information, and managing the international exchange of scientific literature; 3) increasing awareness of research information and its use in society; and 4) carrying out other duties specified in the Federation's rules.
Laws concerning other operators in the research community.	Act on the Innovation Funding Agency Business Finland and a Limited Liability Company called Business Finland (in Finnish) Act on Sitra, the Finnish Innovation Fund (in Finnish)	Taken into account in matters concerning the operators in question.		

2.2.1.4 Legislation on research, culture and datasets

The table below contains a list of laws applicable to research, culture and datasets, in particular, and describes how they must be taken into account in open science and research.

2.2.1.4 Legislation on research, culture and datasets				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on Collecting and Preserving Cultural Materials 1433/2007 (in Finnish)	Regulates the digital preservation of cultural materials. The purpose of the law is to preserve national cultural materials made available to the public in Finland for future generations and make them accessible to researchers and other users.	Taken into account in the preservation and research use of publications, recordings, TV and radio programmes, and online material. Taken into account when making data available to researchers.	Obligation to disclose Obligation to archive television and radio programmes Obligation to record films Obligation to archive distribution copies and publicity material of films Technical requirements of materials	National Library of Finland National Audiovisual Institute (KAVI)

2.2.1.4 Legislation on research, culture and datasets				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
EU Regulation on a Single Market For Digital Services (Digital Services Act)	The regulation confirms rules for the operations of digital online service providers, clarifies the responsibilities and obligations of these service providers and the authorities, and safeguards the rights and consumer protection of the service users. Its purpose is to promote the functioning of the single market for intermediary services and facilitate innovation. The objective of harmonised rules is to create a proportionate, predictable, responsible and reliable online environment that addresses the spread of illegal content and disinformation. Stricter regulatory and guiding requirements will be imposed on very large online platforms and search engines. On the other hand, the activities of small platforms and businesses will be promoted through lighter regulation, imposing fewer obligations on them.	Authorities will observe this in the monitoring of sanctions and enforcement, and legislators as required by the regulation. Obliges information intermediary services.	According to the regulation, intermediary services must: (1) Strive towards openness and transparency. (2) Comply with due diligence obligations. (3) Prevent the publication of illegal content and remove such content. (4) Adopt means with which users can report illegal content. (5) Comply with specific obligations when representing large online platforms and search engines. Member states must (6) work together, monitor enforcement, establish sanctions for breaches of the regulation, and appoint an authority to oversee and coordinate digital services.	

2.2.1.4 Legislation on research, culture and datasets				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Regulation on Data Governance (EU) 2022/868	The purpose of the regulation is to create a legal framework for data governance, so that protected data held by the public sector can be reused. The regulation also provides a framework for information intermediaries to help share data between different parties.	The objective of the working group supporting the national implementation of the EU Data Governance Regulation (valtioneuvosto.fi) (in Finnish) is to assist ministries in ensuring compliance with EU law within their administrative branches and forming a shared understanding of the content, requirements, impacts and need for legislative amendments.	The regulation requires some additional regulations to be issued by the national authority. Once the application period of the regulation has begun, the member states must have one or more competent authorities appointed to support public sector entities in their task of granting access to specific classes of data for reuse.	Official duties are assigned to the Finnish Transport and Communications Agency, Traficom: Government proposal to Parliament on amending the Act on Electronic Communications Services (implementation of the Regulation on Data Governance) (valtioneuvosto.fi) (in Finnish)
Directive (EU) 2019/1024 on open data and the reuse of public sector information Implementing Regulation (EU) 2023/138 for a list of specific high-value datasets and the arrangements for their publication and re-use	The directive applies to documents and data held by the public sector and public enterprises, as well as publicly funded research data. The purpose of the directive is to increase the supply and reuse of public data for commercial and non-commercial purposes, as well as to enhance and harmonise regulation on opening up information resources.	Taken into account when making data available for research purposes. Valuable datasets and their availability are regulated in more detail by a government decree in accordance with the provisions set out in European Union legislation or unless otherwise specified in other legislation. The Commission's Implementing Regulation for "a list of specific high-value datasets and the arrangements for their publication and reuse" specifies the directive concerning the publication and reuse requirements for these datasets.	(1) Documents must be available electronically in a commonly used format. (2) Dynamic data must be available via an API and, if necessary, as files that can be downloaded at once. (3) Research datasets produced with public funding must be available free of charge. (4) Valuable datasets must be available for free, in machine-readable format, via an API and, if necessary, as files that can be downloaded at once. (5) The terms of reuse must be objective, proportionate and justified according to the public interest.	

2.2.1.4 Legislation on research, culture and datasets				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Reuse of Research Data Generated with Public Funding 713/2021 (in Finnish)	This law applies to research data that is publicly funded and made publicly available through a data repository by researchers, research organisations or organisations that fund research.	Taken into account in the reuse of research datasets. See requirements.	The publisher of a research dataset must allow the use of the data for both commercial and non-commercial purposes. The use must be free of charge. The publisher must make the data available in all existing file formats and language versions. In addition to this, research datasets must be made available in an electronic and commonly used machine-readable form, together with their metadata, where appropriate and possible without undue effort.	

2.2.1.4 Legislation on research, culture and datasets				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Reuse of Data Held by Publicly Owned Companies 712/2021 (in Finnish)	This law applies to documents of companies referred to in section 1 of this law, the production of which is part of a service provided in an industry defined in section 1, paragraph 1, which the authorities consider to be of general interest and for which specific public service obligations have therefore been imposed by law, regulation or other binding means on the company.	Taken into account when making data available for research purposes. Valuable datasets and their availability are regulated in more detail by a government decree in accordance with the provisions set out in European Union legislation or unless otherwise specified in other legislation. The Commission's Implementing Regulation for "a list of specific high-value datasets and the arrangements for their publication and reuse" specifies the directive concerning the publication and reuse requirements for these datasets.	(1) Documents must be available electronically in a commonly used format. (2) Dynamic data must be available via an API on request and, if necessary, as files that can be downloaded at once. (3) Valuable datasets must be available on request, in machine-readable format, via an API and, if necessary, as files that can be downloaded at once. (4) Fees collected must not exceed the cost of and reasonable profit from data generation.	

2.2.1.5 Legislation pertaining to innovation

The table below contains the key pieces of legislation that must be observed in connection with innovation, in particular.

2.2.1.5 Legislation pertaining to innovation				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Patents Act 550/1967	A patent is an industrial property right that protects intellectual property. A patent is a prohibition right. A patent holder has the right to prohibit others from professionally exploiting the invention covered by their patent. A prohibition right is geographically and temporally limited. It is only valid in countries where a patent has been granted. The period of validity of a patent is usually no more than 20 years from the date of application, but varies from country to country. In order to remain in force, a maintenance fee, or a so-called annual fee, must be paid.	A patent offers legal protection, which guarantees the holder exclusive rights to use, manufacture and sell the invention for a limited period of time. A patent may be granted for a product, method or innovation that is usable, creative and inventive.	A patent application is a legal process that follows carefully timed, fixed deadlines.	The Finnish Patent and Registration Office (PRH) serves as the authority for patents. Appeals against PRH's decisions can be lodged with the Market Court.

2.2.1.5 Legislation pertaining to innovation				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Registered Designs Act 221/1971	The law regulates the way in which the creator of a design can obtain exclusive rights to it (design right) by registering the design. In this context, a design refers to the appearance of a product or its part as expressed through features such as lines, contours, colours, shape, surface structure or material.	See requirements.	Registration applications for designs are submitted in writing to the PRH. Design right is granted if a design is new and unique. The application must indicate the creator of the design. If a registration application is made by someone other than the creator of the design, the applicant must prove that the design right has been transferred to them. The application must be accompanied by illustrations of the design.	The PRH serves as the registration authority. The registration authority may issue more detailed technical regulations on registration applications. Appeals against PRH's decisions can be lodged with the Market Court.
Act on Utility Model Rights 800/1991	The creator of an invention or the person to whom the inventor's right has been transferred may, on application, obtain the utility model rights to an invention and thereby an exclusive right to its professional exploitation, as provided for in this law. In this law, an invention refers to a technical solution that can be used industrially.	See requirements.	Applications for utility model rights are submitted in writing to the PRH. The invention must be new. The application must indicate the inventor's name. If a utility model right is applied for by someone other than the inventor, the applicant must prove their right to the invention. The application must contain an explanation of the invention, the necessary images and a precisely expressed statement of what is intended to be protected (protective claim).	The PRH serves as the registration authority. The registration authority may issue more detailed technical regulations on utility model right applications. Appeals against PRH's decisions can be lodged with the Market Court.

2.2.1.5 Legislation pertaining to innovation				
Act	**Description**	**Effects, i.e. how the act is observed**	**Legal requirements**	**Statutory duties**
Act on the Right in Employee Inventions 656/1967	The purpose of the law is to guarantee certain rights to the employer to an invention made by an employee, thereby limiting the employee's corresponding right in a situation where the employer has the right to the invention.	The law applies to employees and individuals in public office. On the other hand, individuals working in a Finnish higher education institution or in a research position in the Research Council of Finland are subject to the Act on the Right in Inventions made at Higher Education Institutions.	(1) The employer is entitled to an employee's invention. (2) When an invention falls within the scope of the employer's sector, negotiations must be conducted with the employee regarding the employer's rights to the invention. (3) The employee is entitled to compensation if the employer makes use of the invention.	The government appoints an employee invention committee for a fixed term to resolve disputes concerning inventions and act as an arbitrator.
Act on the Right in Inventions made at Higher Education Institutions 369/2006	The purpose of the law is to promote the recognition, protection and utilisation of inventions created in Finnish higher education institutions in a manner appropriate to inventors, higher education institutions and society.	The law applies to inventions that are made at any Finnish higher education institution and protected by a patent in Finland. Also applicable to individuals holding office as researchers in the Research Council of Finland. Research conducted at higher education institutions is divided into two main types: 1) open research and 2) contract research, depending on the involvement of third parties in a study.	Higher education institutions must establish procedures for processing invention notifications and compensation for inventions, as well as for the transfer of rights. In open research, rights and costs related to the invention generally belong to the inventor. In contract research, the university may acquire rights and bear the costs related to an invention. The inventor must give an account of the conditions under which an invention was created if the invention was created in close contact with a contract research project.	Inventors must submit a written notification of inventions created at universities, the National Defence University and universities of applied sciences. The transfer of rights related to an invention to a high education institution must always be compensated for. The inventor's right to publish a presentation of their research results may only be restricted when such restriction is necessary to safeguard the absolute novelty of the invention required for a patent.

2.2.1.6 Legislation under preparation

The table below contains the main laws and regulations under preparation that must be observed when updating the reference architecture.

Law under preparation	Description
Regulation on electronic identification and trust services for electronic transactions in the internal market (eIDAS Regulation) (EU) 910/2014 The European Digital Identity Wallet application will change	The availability of reliable and secure digital identity solutions for all EU citizens, residents and legal entities.
Regulation concerning harmonised rules on artificial intelligence (Artificial Intelligence Act)	The EU will become a favourable environment for the development and application of artificial intelligence, based on EU values on a high level of protection against risks to citizens. Certain harmful artificial intelligence practices are prohibited. Specific requirements are set for high-risk artificial intelligence systems.
Data Act: Proposal for a Regulation on harmonised rules on fair access to and use of data	Facilitates access to data, particularly for users and smaller businesses, ensures fairness in data-based value chains, promotes competition in data markets and enables data-driven innovations. The objective of the Data Act, which supplements the Data Governance Act, is to maximise the value of data in the economy by ensuring that a wider group of stakeholders can manage their data and that more data is available for innovative use while maintaining incentives to invest in the production of data.

2.2.2 Key strategies

The Declaration for Open Science and Research and policies form the main strategic basis for the Open Science and Research Reference Architecture. This table contains the other key strategies, policies and international projects from which the architecture is derived.

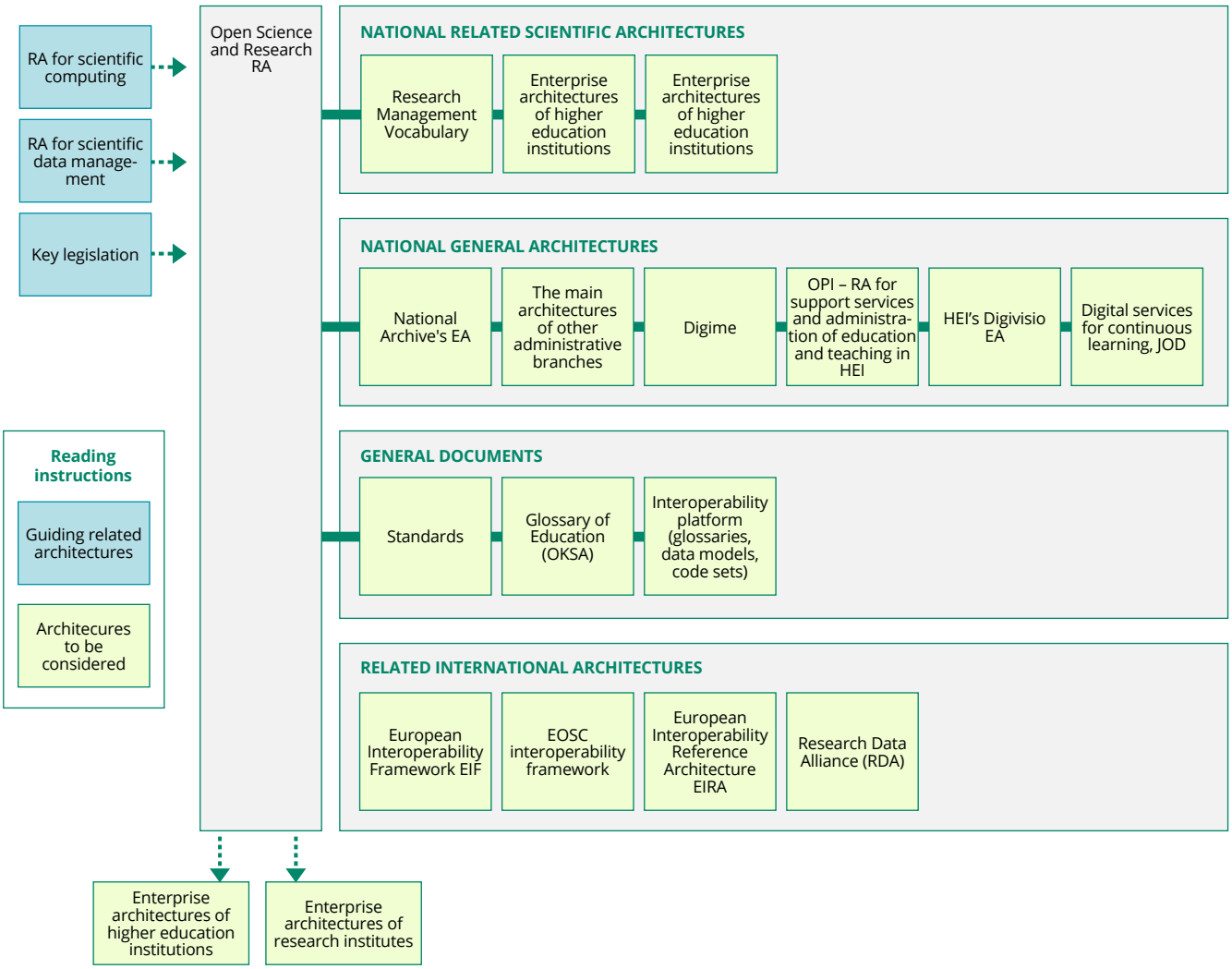
Strategy/Policy	Description	Year of publication	Notes
The EU's open science policy	The EU Commission guides and supports the development of open scientific practices through the funding of working group publications, working groups and events, to name a few.	Strategy 2020–2024.	
RDA policies and recommendations	Key policies and recommendations for datasets.	In 2024, the work is still ongoing, but should be monitored.	
The European Code of Conduct for Research Integrity REVISED EDITION 2023	An extensive recommendation on good scientific practice covering the entire academic environment.	2023	
Research Integrity and Procedures for Handling Allegations of Misconduct in Finland. Guidelines of the Finnish National Board on Research Integrity TENK, 2023 (in Finnish)	Guidelines to good academic practice for all open science.	2023	
Science Europe	Recommendations, statements and policies by the association of research-performing organisations regarding open science and responsible evaluation.	2023	
UNA	An EU document on learning and theses.	2023	Based on UNESCO guidelines.
UNESCO Recommendation on Open Science and other UNESCO open science documents, such as: • Recommendation on Open Educational Resources (OER) | UNESCO • UNESCO Open Science Toolkit	A description of various areas of open science and supplementary documents. A widely accepted international document that is used for support in architecture work. Forms an international framework for open science policies and practices, recognising the differences between disciplines and regions when it comes to open science.	2022	UNESCO also has working groups for recommendations and policies.
EUA	Recommendations and policies of the European University Association regarding open science and responsible evaluation.	2022	Based on UNESCO guidelines.
Agreement on reforming research assessment (CoARA)	Four core commitments and six supporting commitments connected to responsible evaluation of research.	2022	

Strategy/Policy	Description	Year of publication	Notes
A LERU Framework for the Assessment of Researchers	A framework for researcher evaluation.	2022	In line with other international policies, but other frameworks should also be monitored.
'Plan S' and 'cOAlition S' – Accelerating the transition to full and immediate Open Access to scientific publications (coalition-s.org)	A consortium of large research funders that supports the openness of scholarly publishing and a reform of publication practices.	2021	A reference is made to this in the publications section.
Hong Kong Principle	Six principles whose objective is to transform researcher evaluation towards being more sustainable and higher in quality.	2019	
ETINED Council of Europe	International recommendations and statements related to good academic practice in higher education, linking to open education.	2016	In line with the policies of open education.
EU Science Hub – Open Educational Resources (OER)	EU copyright, recommendations on licences.	2016	
Leiden Manifesto	Ten principles that guide the evaluation of research and responsible use of metrics. (2015)	2015	
The Metric Tide	An international policy concerning responsible evaluation of research on the responsible use of metrics. (2014) Lists the main elements of responsible use of metrics.	2014	
DORA	Eighteen recommendations for various target groups for the evaluation of research outputs. Responsible evaluation of research.	2012	

Key international project	Description	Term of office	Notes
GraspOS	In the context of open science, an international project related to the mapping of infrastructures.	2023–2025	An EU-funded project involving the Federation of Finnish Learned Societies.
CraftOA	Promotes favourable conditions for non-profit open scholarly publishing in Europe. The aim is to improve the visibility and findability of open publications, strengthen the community of open scholarly publishing in Europe and develop open publication platforms, in particular the Open Journal Systems used by the Federation of Finnish Learned Societies.	2023–2025	The project involves roughly twenty European organisations and is coordinated by the Georg-August University in Göttingen, Germany. The project is funded by the European Union's Horizon Europe programme.
OPUS	An EU project connected to responsible evaluation and career paths.	2022–2025	An EU-funded project focusing on the perspective of doctoral students.
PATHOS and OS-Indicator Handbook	An EU project and a document whose aim is to promote the effects and impact of open research.	2022–2025	An EU-funded project.
DIAMAS	An extensive international project that issues statements on scholarly publishing, creates better publishing practices, produces support materials, organises events and creates surveys. Its objective is to promote equality in open scholarly publishing.	2022–2025	An EU-funded project involving the Federation of Finnish Learned Societies and the Publication Forum.
ROSiE	A project combining open science and research ethics which, in cooperation with the stakeholders, develops practical tools for promoting responsible open science and citizen science.	2021–2024	The three-year project was launched in March 2021 and receives its funding from the EU's Horizon 2020 programme. The Federation of Finnish Learned Societies is participating in several segments.
SPARC Europe	A network connected to open science and, in particular, open education.	2021–2024	
SuperMORRI	The project aims to support the transformation processes in the field of RDI, taking into account societal assessments, needs and concerns, and encouraging societal actors to cooperate throughout the entire responsible RDI cycle.	2019–2023	The funding comes from the EU's Horizon 2020 programme.

2.2.3 Reference and related architectures

The diagram and the table illustrate the main reference and related architectures of this architecture. The colours indicate how they are observed. This reference architecture specifically guides the enterprise architectures of higher education institutions and research institutes in open science and research.



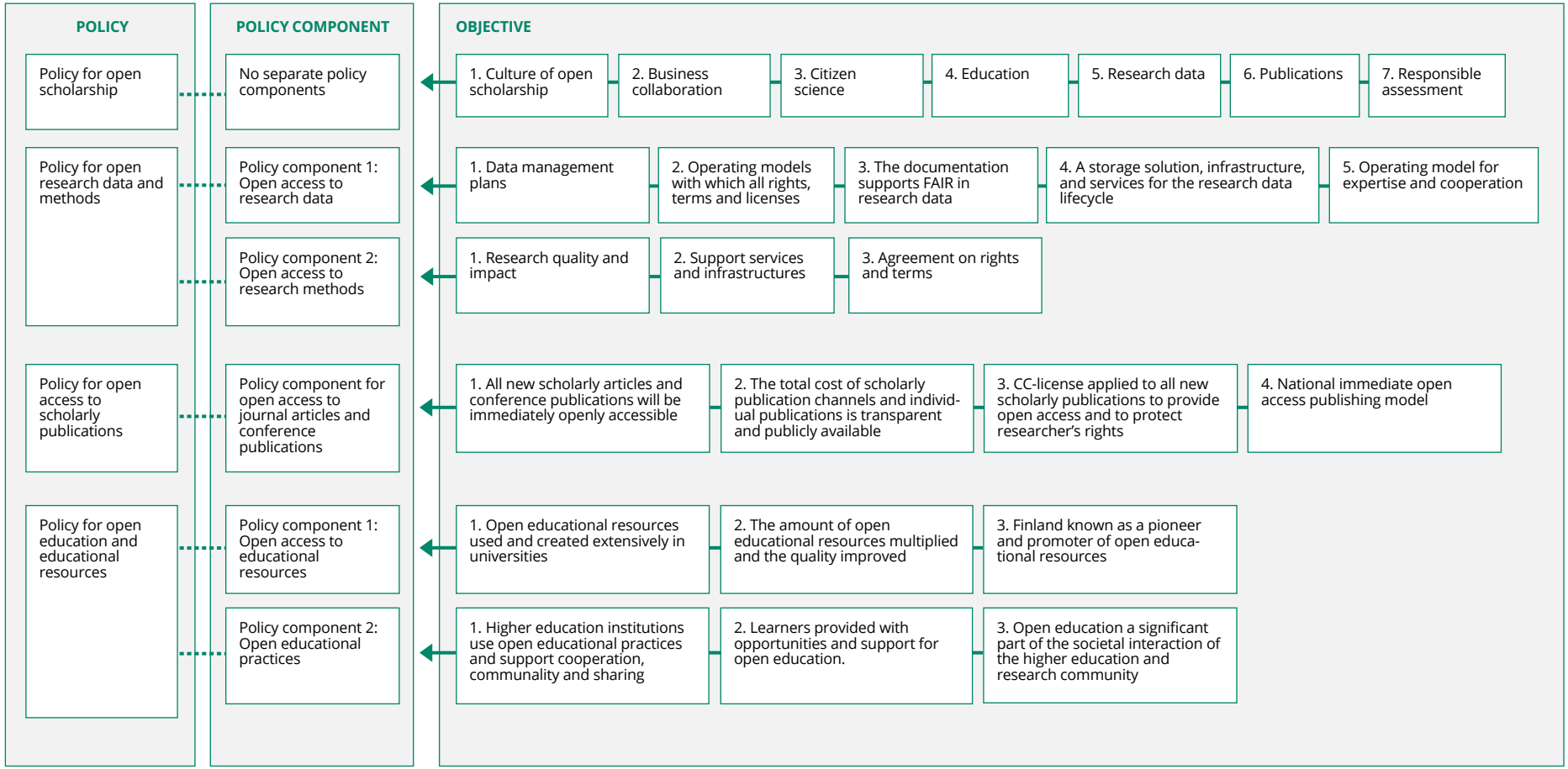
Related architecture	Description	How it is observed in the Open Science and Research Reference Architecture	Note
Guiding related architectures			
Reference architecture for scientific computing (in Finnish)	The purpose of the reference architecture is to map and identify a reference architecture for scientific computing resources, data management and their ancillary services for the next five years (2021–2025). Furthermore, the aim is to promote the development and quality of services, and propose policies and actions that improve the IT interoperability and overall architecture work.	Guides the management of scientific data computation and related services, in particular.	
Reference architecture for scientific data management	The drafting of a reference architecture that covers the entire lifecycle management of scientific data must be initiated. This must also include the digital preservation of large masses of data and a plan for the necessary long-term funding.	The architecture will be created in 2023–2024. It will guide the development of services for managing scientific data, in particular. Ensuring that architectures are compatible and avoiding the creation of unnecessary overlapping descriptions.	
National related scientific architectures			
Research Management Vocabulary	Research Management Vocabulary	The aim is to comply with it.	The glossary requires an update.
Enterprise architectures of higher education institutions		The Open Science and Research Reference Architecture provides direction in its own area.	
Enterprise architectures of research institutes		The Open Science and Research Reference Architecture provides direction in its own area.	
General documents			
Standards		Standards identified in the architecture work will be taken into account in accordance with the requirements of different standards.	
Glossary of Education (OKSA)	The Glossary of Education serves those in need of terminology information in educational organisations and other administrative sectors. OKSA is intended for education specialists, legislative drafters, IT specialists, communicators, journalists, translators and anyone who requires information about the recommended terms and their definitions in education.	Observed and utilised whenever possible.	
Interoperability platform (in Finnish); glossaries, data models, code sets	The interoperability platform contains various ways to define interoperable data content. The platform consists of glossaries, code sets and data models needed for flows of information and other information management.	Glossaries, data models and code sets are observed and utilised whenever possible, and input for them is provided.	

Related architecture	Description	How it is observed in the Open Science and Research Reference Architecture	Note
National general architectures			
National Library's enterprise architecture			
National Archive's enterprise architecture			
The main architectures of other administrative branches			
Digime	In the context of digital cultural heritage, services are maintained to enhance the accessibility and digital preservation of data repositories. In addition, the collaboration and know-how of archives, libraries and museums is promoted, and the interoperability of information and information systems is improved.		
OPI – Reference architecture for support services and administration of education and teaching in higher education institutions (in Finnish)	The OPI reference architecture is a joint means of discussing the support and administrative services and processes concerning studies and teaching, developed collaboratively by operators responsible for higher education support services for studies and teaching.	No overlapping descriptions between architectures must be made.	
Higher education institutions' Digivisio enterprise architecture (in Finnish)	In the Digivisio 2030 project, all Finnish universities collaboratively build the future of learning. The aim is a new era of learning, centred around a continuous development of digital pedagogy, where each of us can more easily learn and accumulate skills in a changing world.	Observed where necessary. The architecture provides input to the requirements of Digivisio's architecture.	The architecture work is still ongoing. The architecture is not yet public.
Digital services for continuous learning, JOD (in Finnish)	The main objective of the project is to build a set of nationwide digital services for continuous learning, available throughout the entire lifecycle of individuals, to help people make smooth transitions between education and working life. The services are customer-oriented, flexible and cross-administrative, and they support individual education and career decisions. Link to project page	Observed where necessary. The architecture provides input to the requirements of JOD's architecture.	The architecture work is still ongoing. The architecture is not yet public.

Related architecture	Description	How it is observed in the Open Science and Research Reference Architecture	Note
Related international architectures			
European Interoperability Framework (EIF)	The European Interoperability Framework is a jointly negotiated approach to the interoperable provision of European public services. It defines the basic interoperability guidelines in the form of common principles, models and recommendations. Contains 12 principles and 19 recommendations.	Ensuring semantic and technological interoperability.	
EIRA	European Interoperability Reference Architecture	Observed, if it contains a research reference architecture.	
EOSC Interoperability framework	Advancing Open Science in Europe | EOSC Association	Ensuring legal, organisational, semantic and technological interoperability.	
Research data alliance (RDA)	RDA | Research Data Sharing without barriers (rd-alliance.org)		

2.3 DECLARATION FOR OPEN SCIENCE AND RESEARCH 2020–2025 AND OPEN SCIENCE AND RESEARCH POLICIES AS A STRATEGY MAP

The Open Science and Research Reference Architecture is based on the Open Science and Research Policies, derived from the Declaration for Open Science and Research 2020–2025, which are described here as a map. The policy set consists of main policies, their component policies and objectives divided according to the component policies.



2.3.1 Policies, policy components, objectives and actions

This chapter describes the strategic principles, objectives and actions with which the objectives can be achieved for each policy.

2.3.1.1 Policy for a Culture for Open Scholarship

STRATEGIC PRINCIPLES

Principle 1: Responsibility, i.e. reliability, ethics, repeatability and transparency, is a precondition for openness.

Principle 2: The openness of the culture requires reciprocity, which is manifested in interaction that benefits both internal and external activities of the organisation.

Principle 3: The realisation of a culture of open scholarship requires transparency, services and incentives.

POLICY	POLICY COMPONENT	OBJECTIVE	ACTION							
Policy for open scholarship	No separate policy components	1. Culture of open scholarship	a. Services	b. Interaction	c. Data protection	d. Cooperation				
		2. Business collaboration	a. Awareness	b. Guidelines	c. Ownership and utilisation	d. Agreement	e. Support services	f. Publication and communication plan	g. Training	h. Responsible conduct of research
		3. Citizen science	a. Raising awareness	b. Guidelines	c. Training	d. Data management	e. Communication	f. Publication and communication plan	g. Responsible conduct of research	h. Systems
		4. Education	a. Competence requirements for open education	b. Copyright, licenses and agreements	c. Resource findability	d. Resource accessibility	e. Communication	f. E-education tools	g. Quality criteria and editorial support	h. Use of open materials in teaching
		5. Research data	a. Local support for data management.	b. Training	c. Data management plans	d. IPR and agreement services	e. Data protection and information security services	f. Persistent identifiers	g. Publication of data	h. Digital preservation
		6. Publications	a. Local support for open publication	b. Open access repository	c. Use of open publications	d. New open publication forms, practices and publishing platforms	e. Open theses	f. Scholarly publishing	g. Persistent identifiers	h. Digital preservation	i. Monitoring the costs of openness
		7. Responsible assessment	a. Responsible practices	b. Incentives	c. Knowledge base	d. Qualitative evaluation support	e. Transparency and monitoring	f. Guidelines and local support	g. Responsible party	

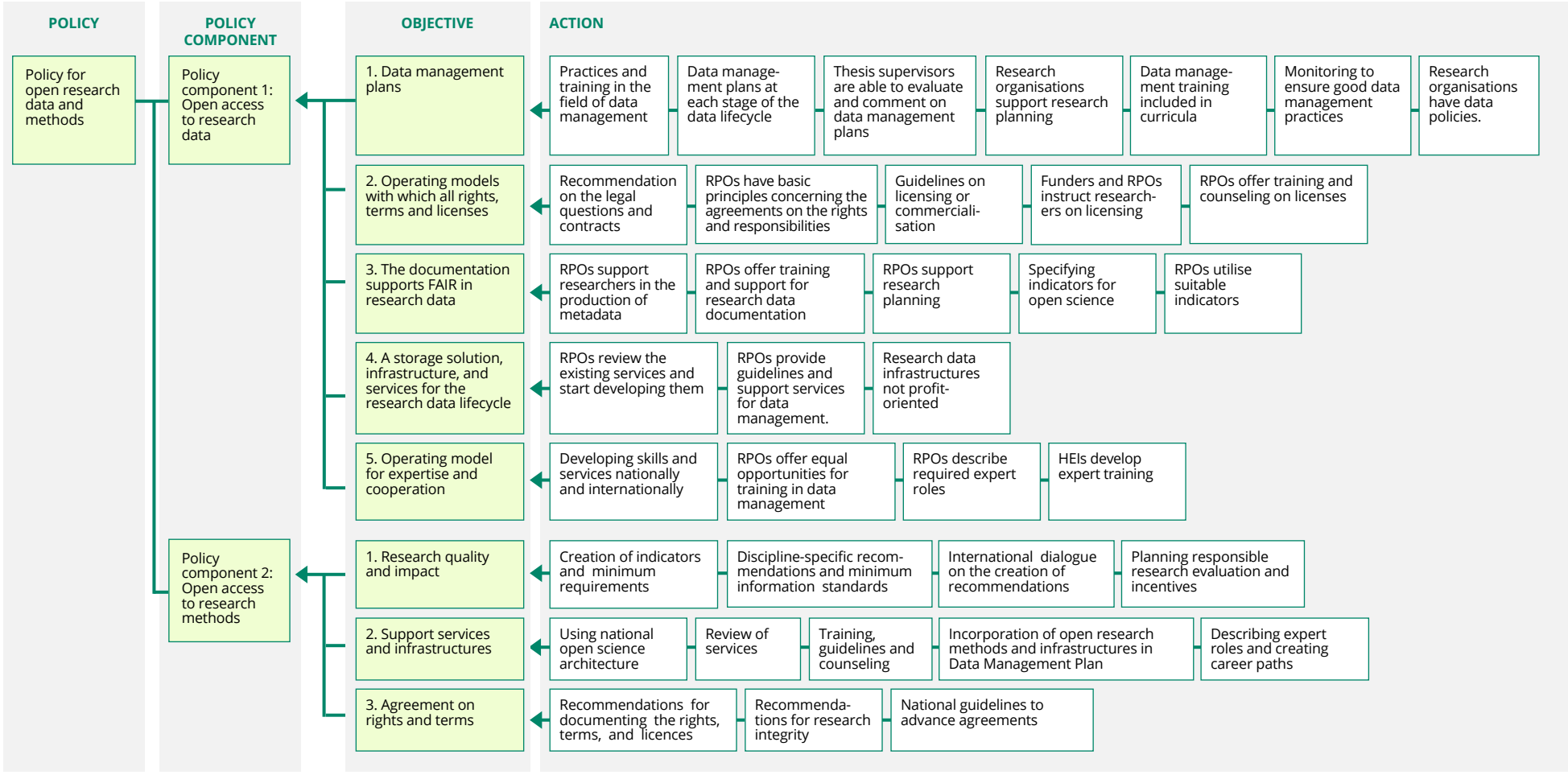
2.3.1.2 Policy for Open Access to Research Datasets and Methods

STRATEGIC PRINCIPLES

Principle 1: Research data, methods and infrastructures shall be managed, opened and used responsibly and appropriately.

Principle 2: Researchers have access to infrastructures and services that enable responsible management of data and methods, and these are developed further in an economically sustainable way, taking into account the researchers' needs.

Principle 3: The researcher's merits in the promotion of good data management, work related to research data and methods, and the appropriate opening of research data and methods are valued and can support the researcher's career.



2.3.1.3 Policy for Open Access to Research Publications

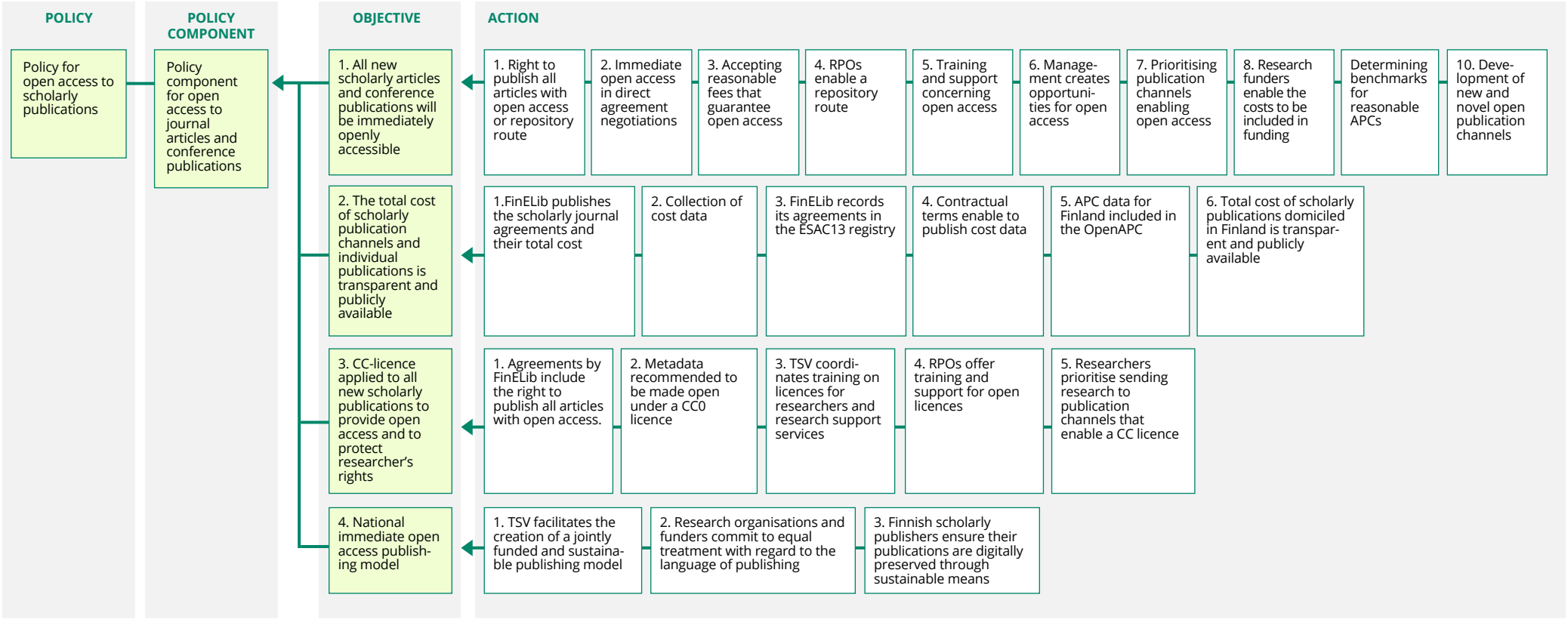
STRATEGIC PRINCIPLES

Principle 1: The total cost for scholarly publications will not exceed the current overall cost when transitioning to open access. The estimate of overall costs reflects all present costs and the total volume of research.

Principle 2: All researchers have an equal opportunity to publish their research through open access, regardless of field of research, funding basis, or career stage.

Principle 3: When assessing scholarly publications, the quality and openness of individual research publications are considered independently.

Principle 4: The assessment of researchers and research takes into account new and changing forms of publishing reflecting open science.



2.3.1.4 Policy for Open Education and Educational Resources

STRATEGIC PRINCIPLES

Principle 1: When evaluating education and open educational resources developed with it, the reliability of their content and other elements defining their quality are considered in addition to their openness.

Principle 2: In the development and utilisation of open education and open educational resources copyright, data protection and ethical practices are respected.

Principle 3: The development of open education and open educational resources takes into account their accessibility and applicability to a diversity of learners.

Principle 4: Work for developing open education and educational resources is evaluated in the merit criteria and in the planning of duties.

POLICY	POLICY COMPONENT	OBJECTIVE	ACTION
Policy for open education and educational resources	Policy component 1: Open access to educational resources	1. Open educational resources used and created extensively in universities	a. FAIR recommendation of open educational resources b. Open online course c. Determining the competence requirements for open educational resources d. Organisations' own guidelines on open educational resources e. Support and training for licences and openness f. Regular monitoring
		2. The amount of open educational resources multiplied and the quality improved	a. Open Science Coordination develops a prize b. Open Science Coordination studies the funding mechanisms c. Recommendation to provide metadata of the open educational resources for the Library of Open Educational Resources. d. Methods for storing open educational resources in the Library of Open Educational Resources e.Cost model f. Positive consideration in funding decisions g. Joint development of high quality open educational resources h. Cooperation projects with other levels of education. i. Monitoring the quality and quantity of open educational resources
		3. Finland known as a pioneer and promoter of open educational resources	a. Promoting and researching the use and valuation of open educational resources b. Open Science Coordination provides information on open educational resources c. Disseminating information on open educational resources d. Development of open educational resources in international cooperation projects e. Research on open educational resources
	Policy component 2: Open educational practices	1. Higher education institutions use open educational practices and support cooperation, communality and sharing	a. Open education policies of organisations b. Openness in the organisation of services that support education c. Expertise in open educational practices d. Sharing the expertise in teaching
		2. Learners provided with opportunities and support for open education.	a. HEIs recognise competence gained through open education. b. Availability and accessibility of education c. Involving learners d. Support skills in open science and education e. Encouragement to share the products of learning f. Encouragement to share teaching materials g. Digivision 2030 MyData plan
		3. Open education a significant part of the societal interaction of the higher education and research community	a. HEIs provide more teaching that is open to everyone b. HEIs grant open badges in accordance with the standards c. Implementing scientific communication and science education d. HEIs plan the open sharing of educational data e. National and international development

2.4 CAPABILITIES AND RESOURCES OF OPEN SCIENCE AND RESEARCH

Capabilities mean a set of features and resources that allow an individual to carry out a specific task. A synonym for the concept is ability.

In general, combinations of three sub-entities, such as operating models and processes, personnel and competence, as well as information and systems, are needed to realise the capabilities of organisations.

The capabilities of the Open Science and Research Reference Architecture are derived from the Declaration for Open Science and Research and, in particular, the objectives and actions defined therein. The capabilities described in the reference architecture include elements such as competence, procedures, knowledge and information systems which the Open Science and Research ecosystem must possess in order to achieve the strategic objectives set out in the policies. The Open Science and Research capabilities have been divided into three capability areas: operational, supporting and strategic capabilities. These capabilities may be either national or an organisation's own capabilities. The capabilities are described in more detail later in this chapter's tables.

The Higher Education Reference Model (HERM) was used to name the Open Science and Research capabilities. The capabilities according to the HERM model are indicated in the capability tables.

Open Science and Research capability area	Definition of capability area
Operational capabilities	Capabilities required for practical research and teaching.
Supporting capabilities	Capabilities that organise, develop and support activities. Also includes administrative capabilities.
Strategic capabilities	Capabilities to transform and steer the Open Science and Research ecosystem towards greater openness and responsibility in accordance with the national Open Science and Research policy framework.

OPERATIONAL CAPABILITIES

Open educational resources	Responsible conduct of research	Digital pedagogy	Research infrastructure management	Management of publishing processes	Repository route mgt.	Open learning environments
Metadata management	Mgt. of research data and its life cycle	Production of educational resources	Research process management	Responsible assessment	Accessibility management	Learner and research driven approach
Cooperation with stakeholders	Understanding of the disciplines in research and art	Understanding of the education field	Management of open publishing	Management of commercialising research	Digital preservation	Management of research methods

SUPPORTING CAPABILITIES

Recognition and accreditation of prior learning	MyData management	Communication	Staff / HR development	HR management	Learning analytics management	Budget management
Licenses and authorship	Mgt. of the planning and implementation of teaching	Copyright and contract management	Information system management	Interoperability	Service management	Learning badges / micro credentials
Data security management	Data protection management	Open Science and Research training	Interaction skills	Information management	Working life skills	

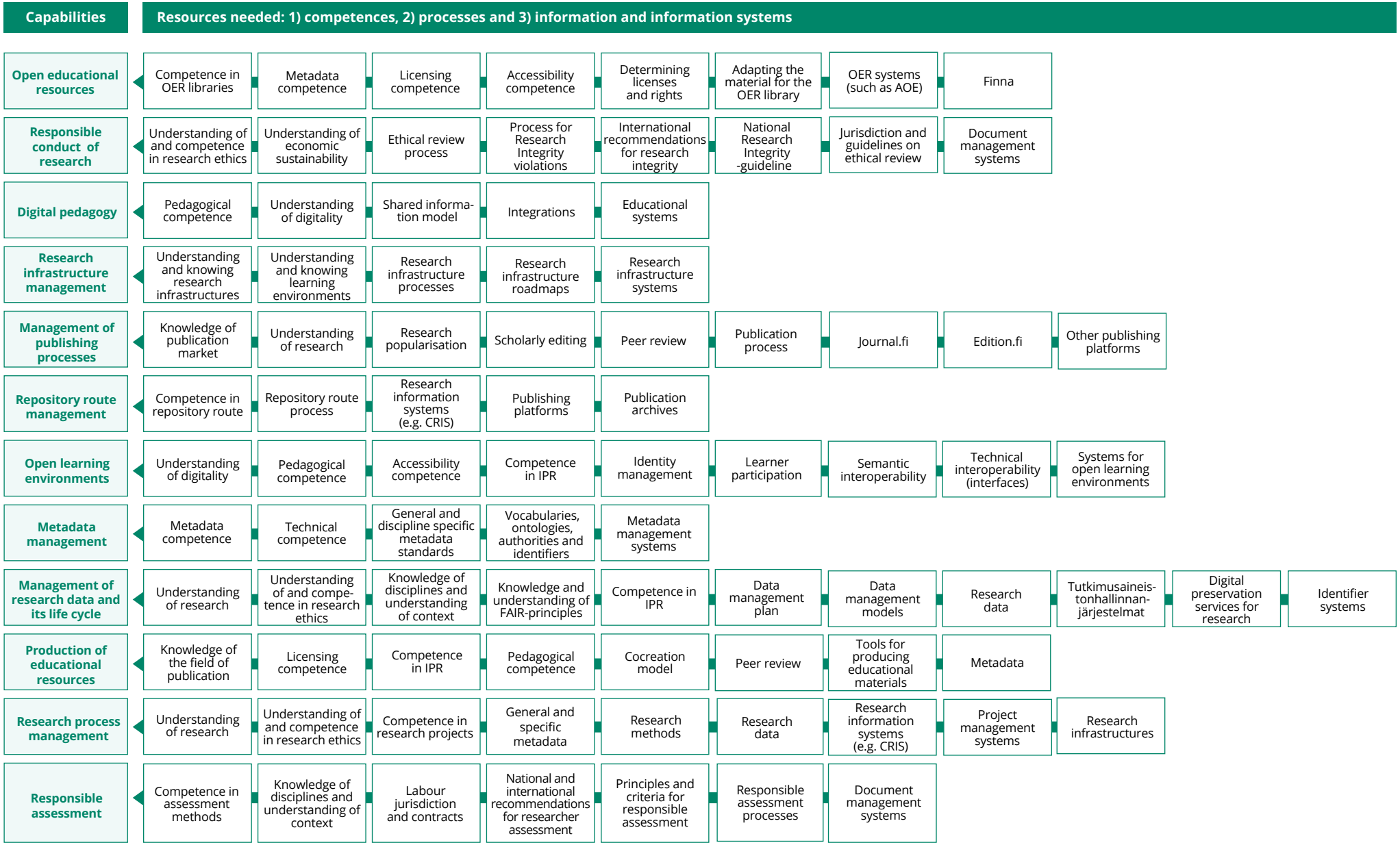
STRATEGIC CAPABILITIES

Open Science and Research monitoring	Mgt. of incentives and merits	Open science and research mgt.	Strategic competence	Open Science and Research understanding and knowledge	Understanding of the operational environment	Mgt. of national and international collaboration
Understanding and management of funding	Legal affairs management	Quality management	Enterprise architecture	Sustainable development	Management of cultural change	

In addition to the capabilities map, this chapter describes the resources of which the capabilities consist and which are required to achieve capability. These include skills, operating models, processes, knowledge and information systems. Descriptions of resources help to understand the content and purpose of capabilities.

2.4.1 Resources for operational capabilities

Functional capabilities are capabilities required in practical research and teaching. The diagram below and the associated table illustrate operational capabilities and related resources.


Capabilities
Resources needed: 1) competences, 2) processes and 3) information and information systems
Open educational resources
Competence in OER libraries
Metadata competence
Licensing competence
Accessibility competence
Determining licenses and rights
Adapting the material for the OER library
OER systems (such as AOE)
Finna
Responsible conduct of research
Understanding of and competence in research ethics
Understanding of economic sustainability
Ethical review process
Process for Research Integrity violations
International recommendations for research integrity
National Research Integrity -guideline
Jurisdiction and guidelines on ethical review
Document management systems
Digital pedagogy
Pedagogical competence
Understanding of digitality
Shared informa-tion model
Integrations
Educational systems
Research infrastructure management
Understanding and knowing research infrastructures
Understanding and knowing learning environments
Research infrastructure processes
Research infrastructure roadmaps
Research infrastructure systems
Management of publishing processes
Knowledge of publication market
Understanding of research
Research popularisation
Scholarly editing
Peer review
Publication process
Journal.fi
Edition.fi
Other publishing platforms
Repository route management
Competence in repository route
Repository route process
Research information systems (e.g. CRIS)
Publishing platforms
Publication archives
Open learning environments
Understanding of digitality
Pedagogical competence
Accessibility competence
Competence in IPR
Identity management
Learner participation
Semantic interoperability
Technical interoperability (interfaces)
Systems for open learning environments
Metadata management
Metadata competence
Technical competence
General and discipline specific metadata standards
Vocabularies, ontologies, authorities and identifiers
Metadata management systems
Management of research data and its life cycle
Understanding of research
Understanding of and compe-tence in research ethics
Knowledge of disciplines and understanding of context
Knowledge and understanding of FAIR-principles
Competence in IPR
Data management plan
Data management models
Research data
Tutkimusaineis-tonhallinnan-järjestelmat
Digital preservation services for research
Identifier systems
Production of educational resources
Knowledge of the field of publication
Licensing competence
Competence in IPR
Pedagogical competence
Cocreation model
Peer review
Tools for producing educational materials
Metadata
Research process management
Understanding of research
Understanding of and competence in research ethics
Competence in research projects
General and specific metadata
Research methods
Research data
Research information systems (e.g. CRIS)
Project management systems
Research infrastructures
Responsible assessment
Competence in assessment methods
Knowledge of disciplines and understanding of context
Labour jurisdiction and contracts
National and international recommendations for researcher assessment
Principles and criteria for responsible assessment
Responsible assessment processes
Document management systems

Capabilities	Resources needed: 1) competences, 2) processes and 3) information and information systems									
Accessibility management	Accessibility competence	Web accessibility law and directive	Accessibility Act	Understanding of digitality	Process of evaluation	Accessibility and evaluation of built environment	Accessibility tools	Evaluation tools		
Learner and research driven approach	Competence for actor orientedness	Human-centred approach	Learner and researcher participation	MyData approach	Peer learning models					
Cooperation with stakeholders	Understanding of the Open Science and Research framework	Management of sensitive data	Competence in communication	Competence in IPR	Innovation	Models for commercialising the products of the open science and research	Customer-driven approach	Collaboration platforms		
Understanding of the disciplines in research and art	Competence in research	Knowledge of disciplines and understanding of context	Discipline standards							
Understanding of the education field	Knowledge of education and research system	Knowledge of disciplines and understanding of context	Discipline standards							
Management of open publishing	Knowledge of the field of publication	Licensing competence	Funding sources	Management of publication processes and channels	Competence in repository route	Management of research materials and products	Publishing platforms	Publication archives	Research information systems	Metadata
Management of commercialising research	Business understanding	Licensing competence	Innovation	Models for commercialising the products of the Open Science and Research	National copyright register (does not exist yet)	National research information system	AOE.fi			
Digital preservation	Competence in digital preservation	Digital preservation agreements	Interoperable architectures	Version control	Interoperability of file formats	Digital preservation services for cultural heritage	Digital preservation services for research			
Management of research methods	Competence in research	Knowledge of disciplines and understanding of context	Research methods	Assessment of research methods	Research method platforms	Tools for research methods	Educational resources for research methods			

2.4.1 Resources for operational capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Open educational resources	Preparedness for publishing and using open educational resources	Competence in OER libraries, metadata competence, licensing competence, accessibility competence	As an overarching capability determining licenses and rights, adapting the material for the OER library	OER systems (such as AOE), Finna	No
Responsible conduct of research	Preparedness to act in accordance with a responsible conduct of research	Understanding of and competence in research ethics, understanding of economic sustainability	Ethical review process, process for Research Integrity violations	International recommendations for research integrity, national research integrity -guideline, jurisdiction and guidelines on ethical review, document management systems	No
Digital pedagogy	Preparedness to use digital tools in education	Pedagogical competence, understanding of digitality	Shared information model, integrations	Educational systems	No
Research infrastructure management	Preparedness to manage research infrastructures and to ensure their interoperability	Understanding and knowing research infrastructures, understanding and knowing learning environments	Research infrastructure processes	Research infrastructure roadmaps, research infrastructure systems	Yes
Management of publishing processes	Preparedness to publish scholarly publications, including commercial publishing	Knowledge of publication market, understanding of research	Research popularisation, scholarly editing, peer review, publication process	Journal.Fi, edition.Fi, other publishing platforms	No
Repository route management	Preparedness to find out possibilities for parallel publishing and to self-archive research publications	Competence in repository route	Repository route process	Research information systems (e.G. Cris), publishing platforms, publication archives	No
Open learning environments	Preparedness for using open learning environments	Understanding of digitality, pedagogical competence, accessibility competence, competence in IPR	Identity management, learner participation	Semantic interoperability, technical interoperability (interfaces), systems for open learning environments	No

2.4.1 Resources for operational capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Metadata management	Preparedness to manage metadata	Metadata competence, technical competence	General and discipline specific metadata standards	Vocabularies, ontologies, authorities, identifiers, metadata management systems	No
Management of research data and its life cycle	Preparedness to manage research data during its whole life cycle	Understanding of research. Understanding of and competence in research ethics, knowledge of disciplines and understanding of context, knowledge and understanding of fair-principles, competence in ipr	Data management plan, data management models	Research data, research data management systems, digital preservation services for research, identifier systems	No
Production of educational resources	Preparedness to produce open, accessible educational resources	Knowledge of the field of publication, licensing competence, competence in ipr, pedagogical competence	Cocreation model, peer review	Tools for producing educational materials, metadata	No
Research process management	Preparedness to do research and to manage the research process	Understanding of research. Understanding of and competence in research ethics, competence in research projects, competence in data management	Research methods	Research data, research information systems (e.G. Cris), project management systems, research infrastructures, general and specific metadata	No
Responsible assessment	Preparedness to assess research and education in a responsible manner	Competence in assessment methods knowledge of disciplines and understanding of context, labour jurisdiction and contracts	Responsible assessment processes	Document management systems, national and international recommendations for researcher assessment, principles and criteria for responsible assessment	No
Accessibility management	Preparedness to follow accessibility regulations	Accessibility competence, understanding of digitality	Process of evaluation, accessibility and evaluation of built environment	Accessibility tools, evaluation tools	No
Learner and research driven approach	Preparedness to ensure that education is learner driven and research is research driven	Competence for actor orientedness	Human-centred approach, learner and researcher participation, mydata approach, peer learning models		No

2.4.1 Resources for operational capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Cooperation with stakeholders	Preparedness to cooperate with stakeholders (e.g. companies) in research, in accordance with the principles of open science	Understanding of the open science and research framework, management of sensitive data, competence in communication, competence in ipr	Innovation, models for commercialising the products of the open science and research, customer-driven approach	Collaboration platforms	No
Understanding of the disciplines in research and art	Preparedness to understand the research context and individual disciplines in research and art and their practices	Competence in research, knowledge of disciplines and understanding of context		Discipline standards	No
Understanding of the education field	Preparedness to understand the education field and its practices	Knowledge of education and research system, knowledge of disciplines and understanding of context		Classifications of education (e.G. Isced)	No
Management of open publishing	Preparedness for open publishing	Knowledge of the field of publication, licensing competence, competence in repository route	Funding sources, management of publication processes and channels, management of research materials and products	Publishing platforms, publication archives, research information systems, metadata	No
Management of commercialising research	Preparedness to commersialise the research results	Business understanding, licensing competence	Innovation, models for commercialising the products of the open science and research	National copyright register (does not exist yet), national research information system, aoe.Fi	No
Digital preservation	Preparedness to digitally preserve research data and research products	Competence in digital preservation, digital preservation agreements	Interoperable architectures, version control, interoperability of file formats	Digital preservation services for cultural heritage, digital preservation services for research	Yes
Management of research methods	Preparedness to use and to open research methods	Competence in research, knowledge of disciplines and understanding of context	Research methods, assessment of research methods	Research method platforms, tools for research methods, educational resources for research methods	No

2.4.2 Resources for supporting capabilities

Capabilities	Resources needed: 1) competences, 2) processes and 3) information and information systems								
Recognition and accreditation of prior learning	Competence in recognition and accreditation of prior learning	University specific processes	Learning management systems (e.g. Peppi and Sisu)						
MyData management	Competence in MyData management	Processing and management of personal data	Management of sensitive data	MyData management system	Systems for identity and accessibility management				
Communication	Competence in scholarly communication	Research popularisation	Competence in marketing	Communication tools and platforms	Multilingualism tools	Content production tools			
Staff / HR development	Understanding of the Open Science and Research framework	Development of the Open Science and Research expertise	Pedagogical competence	Development of the Open Science and Research expertise					
HR management	Understanding of the Open Science and Research framework	Understanding or meriting	Recruitment	Responsible assessment processes	Career guidance	Work orientation			
Learning analytics management	Pedagogical competence	Competence in analytics	Ethical competence	Competence in MyData management	Development of standards	Data collection for analysis	Management of sensitive data	Analytics tools	Educational systems
Budget management	Financial management	Competence in negotiations	Competence in cost accounting	Cost models	Analysing and reporting	Cost information	Cost accounting systems		
Licenses and authorship	Licensing competence	Competence in IPR	Creative Commons -licenses	Contract templates					
Management of the planning and implementation of teaching	Pedagogical competence	Cooperative curriculum development (local, national and international)	Learner participation	Understanding of Universities Act and Universities of Applied Sciences Act					
Copyright and contract management	Competence in law and contracts	Ethical competence	Contract process	Contract templates	Register for contracts and rights	National copyright register (does not exist yet)			
Information system management	Competence in information systems	Strategic competence	Competence in planning	System usability management	Competence in development and maintenance	Interoperability of systems			

Capabilities	Resources needed: 1) competences, 2) processes and 3) information and information systems							
Interoperability	Legal interoperability	Organisational interoperability	Semantic interoperability	Technical interoperability	European Interoperability Framework (EIF)			
Service management	Service modeling	System usability management	Development models (e.g. agile, lean)	Service management models	Process management	Productisation	Development systems	Collaboration platforms
Management of learning badges or micro credentials	Pedagogical competence	Understanding of digitality	Competence in recognition and accreditation of prior learning	Competence in MyData management	National microcreden-tialisation process	Learning badge standard	Learning badge platform	
Data security management	Competence in data security	Shared data security practices and guidelines	Auditing	Data security systems	Systems for identity and accessibility management			
Data protection management	Competence in data protection	Shared data protection practices and guidelines	Impact assessment tools					
Open Science and Research training	Pedagogical competence	Knowledge of disciplines and understanding of context	Understanding of the Open Science and Research framework	Competence in IPR	Competence in coordination	National training provision		
Interaction skills	Competence in networking	Negotiation skills	Communication tools and platforms					
Information management	Understanding of the Open Science and Research framework	Understanding of research	Competence in information management process	Act on Information Management in Public Administration	Information management model	Information management systems		
Working life skills	Competence in networking	Understanding of international context	Lifelong learning	Competence in communication	Competence in cooperation	Financial competence		

Supporting capabilities organise, develop and support activities. They also include administrative capabilities. The diagram below and the associated table illustrate supporting capabilities and related resources.

2.4.2 Resources for supporting capabilities

Capability	Description of capability	Competence resources related to capability	Process resources related to capability	Information and system resources related to capability	Is it a HERM-capability?
Recognition and accreditation of prior learning	Preparedness to recognise and to accredit prior learning	Competence in recognition and accreditation of prior learning	University specific processes	Learning management systems (e.G. Peppi and sisu)	No
MyData management	Preparedness to manage personal data according to MyData -principles	Competence in mydata management	Processing and management of personal data, management of sensitive data	Mydata management system, systems for identity and accessibility management	No
Communication	Preparedness to communicate of the products and services of open science and research	Competence in scholarly communication, competence in marketing	Research popularisation	Content production tools, communication tools and platforms, multilingualism tools	No
Staff / HR development	Preparedness to develop the staff competence and expertise in open science and research	Understanding of the open science and research framework, pedagogical competence, understanding and knowing learning environments	Development of the open science and research expertise		Yes
HR management	Preparedness to use human resources for reaching the objectives of open science and research	Understanding of the open science and research framework, understanding or meriting	Recruitment, career guidance, work orientation, responsible assessment processes		Yes
Learning analytics management	Preparedness to use learning analytics in developing open education	Pedagogical competence, competence in analytics, competence in mydata management, ethical competence	Development of standards, data collection for analysis, management of sensitive data	Educational systems, analytics tools	No

2.4.2 Resources for supporting capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Budget management	Preparedness to manage and steer costs involving open science and research	Competence in negotiations, competence in cost accounting	Financial management, cost models, analysing and reporting	Cost information, cost accounting systems	No
Licenses and authorship	Preparedness to use and apply licenses and to agree on authorship of research products	Licensing competence, competence in ipr	Creative commons -licenses, contract templates		No
Management of the planning and implementation of teaching	Preparedness to plan and implement teaching in accordance with the principles of open science and research	Pedagogical competence	Local, national and international cooperative curriculum development, learner participation, understanding of universities act and universities of applied sciences act		No
Copyright and contract management	Preparedness to manage copyrights and related contracts in open science and research	Competence in law and contracts, ethical competence	Contract process, contract templates	Register for contracts and rights, national copyright register (does not exist yet)	No
Information system management	Preparedness to develop and maintain information systems for the needs of open science and research	Competence in information systems, strategic competence, competence in planning, competence in development and maintenance	System usability management, interoperability of systems		No
Interoperability	Preparedness to ensure the interoperability of the open science and research ecosystem in all respects		Legal interoperability, organisational interoperability, semantic interoperability, technical interoperability, european interoperability framework (eif)		No
Service management	Preparedness to develop and produce services for open science and research and their management		Service modeling, system usability management, development models (e.G. Agile, lean), service management models, process management, productisation	Development systems, collaboration platforms	Yes

2.4.2 Resources for supporting capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Management of learning badges or micro credentials	Preparedness to create and use learning badges or micro credential in open education	Pedagogical competence, understanding of digitality, competence in recognition and accreditation of prior learning, competence in mydata management	National microcredentialisation process	Learning badge standard, learning badge platform	No
Data security management	Preparedness to ensure data security in open science and research	Competence in data security	Shared data security practices and guidelines, auditing	Data security systems, systems for identity and accessibility management	Yes
Data protection management	Preparedness to ensure data protection in open science and research	Competence in data protection	Shared data protection practices and guidelines	Impact assessment tools	No
Open Science and Research training	Preparedness to offer training on the principles and practices of open science and research	Pedagogical competence, knowledge of disciplines and understanding of context, understanding of the open science and research framework, competence in ipr, competence in coordination	National training provision		No
Interaction skills	Preparedness to create open science and research networks and to negotiate on open science and research questions	Competence in networking, negotiation skills		Communication tools and platforms	No
Information management	Preparedness to manage information in open science and research	Understanding of the open science and research framework, understanding of research, competence in information management process	Act on information management in public administration, information management model	Information management systems	Yes
Working life skills	Preparedness to use working life skills in open science and research	Competence in networking, understanding of international context, lifelong learning, competence in communication, competence in cooperation, financial competence			No

2.4.3 Resources for strategic capabilities

Strategic capabilities transform and steer the ecosystem of open science and research towards greater openness and responsibility in accordance with the national policy framework. The diagram below and the associated table illustrate strategic capabilities and related resources.

Capabilities	Resources needed: 1) competences, 2) processes and 3) information and information systems						
Open Science and Research monitoring	Understanding of the Open Science and Research framework	Competence in assessment methods	Competence in indicators	Competence in analysis of monitoring data	Process of producing monitoring data	Open Science and Research policies	Evaluation tools
Management of incentives and merits	Understanding of the Open Science and Research framework	Knowledge of disciplines and understanding of context	Competence in human resources management	Understanding or meriting	Career guidance uraohjaus	Incentive models	Principles and criteria for responsible assessment
Open science and research management	Understanding of the Open Science and Research framework	Understanding of operating culture and structures	Competence in knowledge management	Change management	Open Science and Research policies	Open Science and Research reference architecture	Open Science and Research web services
Strategic competence	Understanding of the Open Science and Research framework	Understanding of operational environment	Anticipation	Models for strategy work	Resource management	Risk management	Implementation of strategy
Open Science and Research understanding and knowledge	Understanding of the Open Science and Research framework	Understanding of open education	Understanding of digitality	Sustainable development	Diversity and inclusion	Anticipation	
Understanding of the operational environment	Understanding of internal and external operational environment	Knowledge-based management	Understanding of operating culture and structures	Monitoring of the Open Science and Research operating environment	Open Science and Research situational pictures		
Management of national and international collaboration	Knowledge of education and research system	Understanding of international context	Coordination of cooperation	Interoperability (EIF)	Collaboration platforms	Renewal and development operating models	
Understanding and management of funding	Understanding of funding	Cost models	Funding models	rahoitustiedot	National funding register		
Legal affairs management	Competence in law and contracts	Competence in IPR	Licensing competence	Legislative lobbying process	Contract process	Copyright register (national)	
Quality management	Competence in quality management	Quality criteria	Process of evaluation	Benchmarking	Quality management tools		
Enterprise architecture	Understanding of the Open Science and Research framework	Competence in enterprise architecture method	Competence in communication	Enterprise architecture modeling tools	Open Science and Research vocabulary	Open Science and Research Reference Architecture wikipages	
Sustainable development	Ecological sustainability	Financial sustainability	Social and cultural sustainability	UN Sustainable Development Goals	Process of evaluation for sustainability		
Management of cultural change	Understanding of the Open Science and Research framework	Understanding of international context	Competence in communication	Change management	Involvement	Communication tools and platforms	

2.4.3 Resources for strategic capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Open Science and Research monitoring	Preparedness to monitor the development of open science and research in the research community	Understanding of the open science and research framework, competence in assessment methods, competence in indicators, competence in analysis of monitoring data	Process of producing monitoring data	Open science and research policies, evaluation tools,	No
Management of incentives and merits	Preparedness to incentivise to open science and research, for example, through meriting	Understanding of the open science and research framework, knowledge of disciplines and understanding of context, competence in human resources management, understanding or meriting	Career guidance, incentive models	Principles and criteria for responsible assessment	No
Open science and research management	Preparedness to promote open science and research in individual organisations	Understanding of the open science and research framework, understanding of operating culture and structures, competence in knowledge management	Change management	Open science and research policies, open science and research reference architecture, open science and research web services	No
Strategic competence	Preparedness to develop and implement the Open Science and Research policies and other strategies	Understanding of the open science and research framework, understanding of operational environment	Anticipation, models for strategy work, resource management, risk management, implementation of strategy	-	No
Open Science and Research understanding and knowledge	Preparedness to understand the context for open science and research and general principles affecting it and to be able to apply these principles	Understanding of the open science and research framework, understanding of digitality, understanding of open education	Sustainable development, anticipation, diversity and inclusion	-	No
Understanding of the operational environment	Preparedness to understand the operational environment in which an individual organisation promotes open science and research	Understanding of internal and external operational environment, understanding of operating culture and structures	Knowledge-based management, monitoring of the open science and research operating environment, open science and research situational pictures	-	No

2.4.3 Resources for strategic capabilities					
Capability	**Description of capability**	**Competence resources related to capability**	**Process resources related to capability**	**Information and system resources related to capability**	**Is it a HERM-capability?**
Management of national and international collaboration	Preparedness to use national and international collaboration in promoting open science and research	Knowledge of education and research system, understanding of international context	Coordination of cooperation, interoperability (eif), renewal and development operating models	Collaboration platforms	No
Understanding and management of funding	Preparedness to understand funding of research and education and to use it in promoting open science and research	Understanding of funding	Cost models, funding models	Funding data, national funding register	No
Legal affairs management	Preparedness to follow the existing legislation in promoting open science and research and to lobby for legislation promoting open science and research	Competence in law and contracts, competence in ipr, licensing competence	Legislative lobbying process, contract process	Copyright register (national)	No
Quality management	Preparedness to manage the quality of the services and processes of the Open Science and Research	Competence in quality management, quality criteria	Process of evaluation, benchmarking	Quality management tools	Yes
Enterprise architecture	Preparedness to promote open science and research with enterprise architecture	Understanding of the open science and research framework, competence in enterprise architecture method, competence in communication		Enterprise architecture modeling tools, open science and research vocabulary, open science and research reference architecture wikipages	Yes
Sustainable development	Preparedness to follow principles of sustainable development in promoting open science and research	Ecological sustainability, financial sustainability, social and cultural sustainability	Un sustainable development goals, process of evaluation for sustainability		No
Management of cultural change	Preparedness to steer and promote the cultural change leading to open science and research	Understanding of the open science and research framework, understanding of international context, competence in communication	Change management, involvement	Communication tools and platforms	No

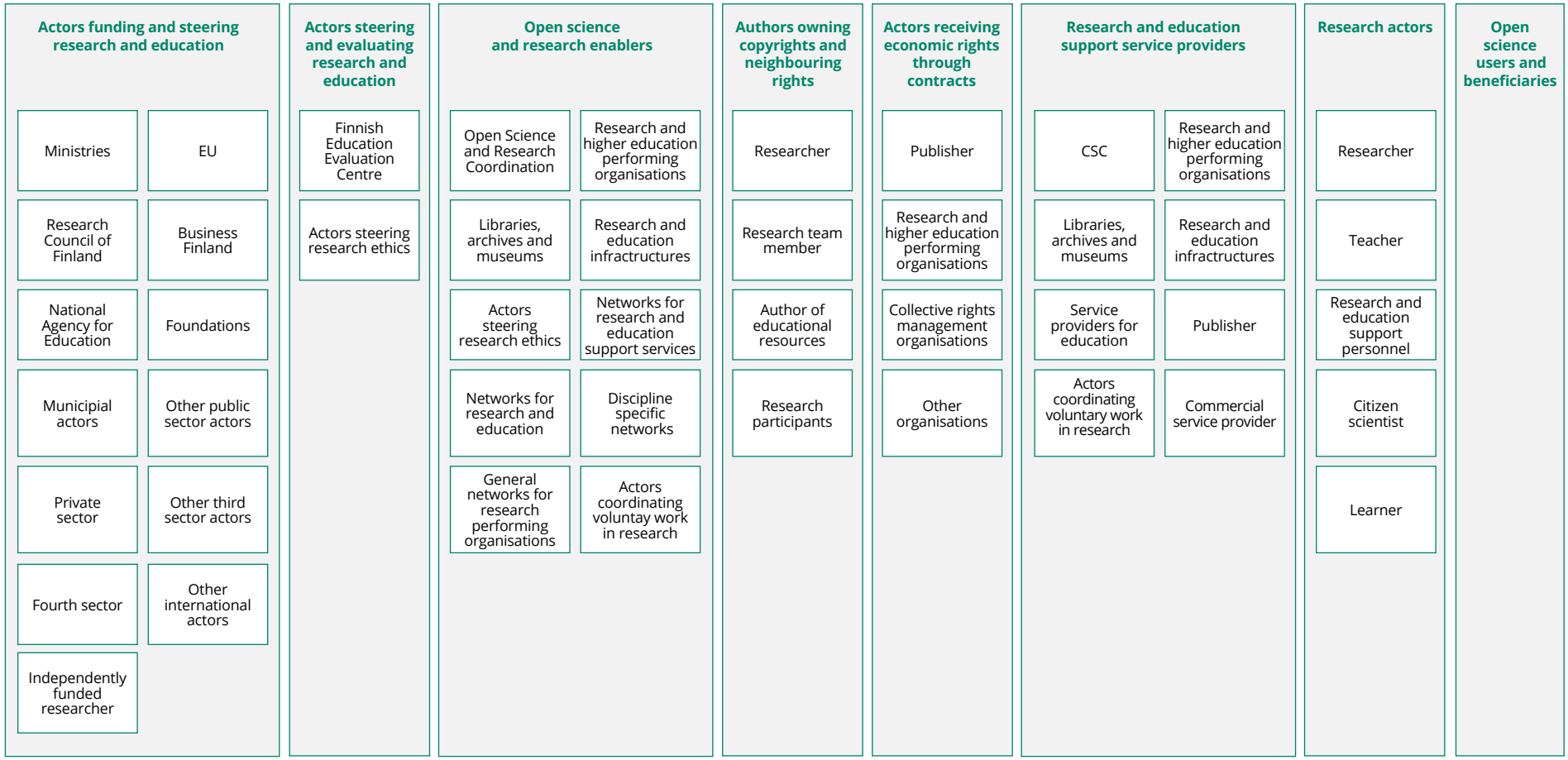
3 BUSINESS ARCHITECTURE

A business architecture is part of an enterprise architecture and describes the operational structures of organisations. It also describes the key actors, their roles and interaction, as well as the business services and processes.

3.1 ACTORS AND ROLES

3.1.1 Diagram on actors and roles

This chapter identifies the key actors, i.e. stakeholders, in open science and research activities. The actors have been divided into eight main groups according to their roles. The actors have been placed in the diagram so that individual actors perceived to be central are at the top of each role, while actor groups and/or actors considered to be less central are further down.


Actors funding and steering research and education
Ministries
EU
Research Council of Finland
Business Finland
National Agency for Education
Foundations
Municipial actors
Other public sector actors
Private sector
Other third sector actors
Fourth sector
Other international actors
Independently funded researcher
Actors steering and evaluating research and education
Finnish Education Evaluation Centre
Actors steering research ethics
Open science and research enablers
Open Science and Research Coordination
Research and higher education performing organisations
Libraries, archives and museums
Research and education infractructures
Actors steering research ethics
Networks for research and education support services
Networks for research and education
Discipline specific networks
General networks for research performing organisations
Actors coordinating voluntay work in research
Authors owning copyrights and neighbouring rights
Researcher
Research team member
Author of educational resources
Research participants
Actors receiving economic rights through contracts
Publisher
Research and higher education performing organisations
Collective rights management organisations
Other organisations
Research and education support service providers
CSC
Research and higher education performing organisations
Libraries, archives and museums
Research and education infractructures
Service providers for education
Publisher
Actors coordinating voluntary work in research
Commercial service provider
Research actors
Researcher
Teacher
Research and education support personnel
Citizen scientist
Learner
Open science users and beneficiaries

3.1.2 Definitions of main roles

Role (main groups)	Description
Actors funding and steering research and education	Actors funding and steering research and education enable research and higher education through funding and steer them by deciding where the funding is allocated.
Actors steering and evaluating research and education	Actors steering and evaluating research and education steer them through other means than funding, for instance, by evaluating the quality and integrity of research and education.
Open science and research enablers	Open science and research enablers provide for the conditions of open science, research and education in the research and higher education community. They take part in the national coordination of open science and research.
Authors owning copyrights and neighbouring rights	Authors have a copyright for their works. Author retains inalienable moral rights to their works Author can wholly or partially alienate economic rights. Owner and holder of them has a right to make decisions concerning the work. Neighbouring rights are treated similarly to copyright.
Actors receiving economic rights through contracts	These actors receive economic rights to use work, data or educational resource through a contract.
Research and education support service providers	Research and education support service providers provide the services required in open science and research.
Research actors	Research actors do or organise science, research or higher education, for example, as researchers, teachers, support personnel or citizen scientists. All science and research should be open in principle: as open as possible, as restricted as necessary. The author (or holder of rights) decides the level of openness.
Open science users and beneficiaries	Open science users and beneficiaries use the outputs of open science, such as open research data and open educational resources. They do not necessarily know whether some output is so extensively open that they can use it. All actors are open science users and beneficiaries.

3.1.3 Operator descriptions

Actor	Descriptions	Roles of the actor (in addition to Open science users and beneficiaries)
Ministries	The current Finnish Government comprises 12 ministries. Each ministry is responsible for the preparation of matters within its mandate and for the proper functioning of administration.	Actors funding and steering research and education
EU	European union and EU bodies, agencies, organisations and interinstitutional services.	Actors funding and steering research and education
Research Council of Finland	The Research Council of Finland is an expert organisation in science and research that funds high-quality scientific research, provides expertise in science and science policy and strengthens the position of science and research. Council is a government agency within the administrative branch of the Finnish Ministry of Education, Science and Culture.	Actors funding and steering research and education
Business Finland	Business Finland (BF) is structured as a combination of an agency and a special purpose vehicle. It consists of the Innovation Funding Centre Business Finland, which is a state authority, and Business Finland Ltd, a special purpose vehicle wholly owned by the state. In addition, Business Finland Venture Capital Oy, which makes venture capital investments under the guidance of Business Finland, is closely linked to Business Finland.	Actors funding and steering research and education
National Agency for Education	The task of the Finnish National Agency for Education is to anticipate the needs for knowledge and education, to promote the internationalisation of society and the recognition of Finnish education and cooperation abroad, to prepare and implement programmes and agreements in its field, to provide information and advice and guidance concerning its field, maintaining the information resources, registers and systems necessary for the tasks prescribed or assigned to it, providing services for the selection of students and carrying out tasks related to the recognition of studies and professional qualifications completed abroad and to language and translator examinations. The Service Centre for Continuous Learning and Employmen is a separate unit of the Finnish National Agency for Education, which analyses the skills and labour needs of working life, funds training for working age people, develops information, guidance and counselling services, supports regional and other cooperation and contributes to the development of the digital service package for lifelong learning.	Actors funding and steering research and education
Foundations	Each foundation has its own purpose, which determines why it exists. By setting up a foundation, funds are allocated to achieve a useful purpose as defined in the statutes. For example, it may be to support science or the arts, or to maintain a museum. Finnish foundations support science, art and civic activities to the tune of more than half a billion euros every year.	Actors funding and steering research and education
Municipial actors	Municipialities and actors subordinate to them.	Actors funding and steering research and education

Actor	Descriptions	Roles of the actor (in addition to Open science users and beneficiaries)
Other public sector actors	The public sector is made up of the state, municipalities and their administrative bodies (e.g. the Social Insurance Institution of Finland and state-owned enterprises). Other public sector actors include those public sector actors not listed separately.	Actors funding and steering research and education
Private sector	The part of the society run my companies.	Actors funding and steering research and education
Other third sector actors	The third sector of the society differs from the private sector and the public sector and is characterised by a non-profit economy and the social objectives of organisations or groups. Third sector actors include associations, cooperatives and foundations. The third sector economy differs from the private (business) economy in that it is non-profit making. If third sector organisations make a profit each year, they reinvest it in their activities. The tax treatment is also different from that of private companies. Third sector organisations are based on a social or ethical objective and on democracy (member/vote principle, not voting rights based on ownership). The objectives of the organisation are stated in its statutes.	Actors funding and steering research and education
Fourth sector	Citizens are rebuilding their municipalities and social system as they did a hundred years ago when Finland built its nation state – but in the digital age, municipalities have the tools to do this themselves, as activists, without government or organisations as intermediaries. Alongside the third sector, a fourth sector of society, the sector of activism, is growing. The phenomenon is concentrated in urban areas, like municipalities, but not confined to them.	Actors funding and steering research and education
Other international actors	International actors funding research other than the EU, such as NATO.	Actors funding and steering research and education
Independently funded researcher	A researcher who conducts most of their research without receiving funding from any other source, for example a freelance researcher or a researcher working on a doctoral thesis alongside other work.	Actors funding and steering research and education
Finnish Education Evaluation Centre	Finnish education evaluation centre.	Actors steering and evaluating research and education
Actors steering research ethics	Includes, for example, the Finnish National Board on Research Integrity TENK and other ethics advisory boards and ethics committees of research performing organisations.	Actors steering and evaluating research and education, Open science and research enablers
Open Science and Research Coordination	The Open Science and Research Coordination promotes the implementation of open science and research and the discussion of its opportunities, challenges and solutions in Finland. The coordination is based on cooperation between working groups, expert panels and a steering group. It is managed by the Secretariat for Open Science and Research, which operates within the Finnish Federation of Learned Societies, with funding from the Ministry of Education and Culture.	Open science and research enablers

Actor	Descriptions	Roles of the actor (in addition to Open science users and beneficiaries)
Research and higher education performing organisations	Universities, universities of applied sciences, state research institutes, municipal research institutes, private research institutes and any other organisations performing research or higher education.	Open science and research enablers, Actors receiving economic rights through contracts, Research and education support service providers
Libraries, archives and museums	Libraries, archives and museums preserve cultural heritage and documented information for future generations and make it available to researchers and other users.	Open science and research enablers, Research and education support service providers
Research and education infractructures	Research and education are enabled by national and international infrastructures such as the Finnish Social Science Data Archive, Findata, the Digital and Population Data Services Agency, the Helsinki Term Bank for the Arts and Sciences, the European Open Science Cloud, OpenAIRE and the Library of Open Educational Resources.	Open science and research enablers, Research and education support service providers
Networks for research and education support services	Networks developing support services for research and/or higher education, such as the Fucio network of IT managers in Finnish universities, the AAPA network of IT managers in Finnish universities of applied sciences, the Finn-ARMA network of research management, research support and research services in universities, the Finnish network of university education experts OHA-Forum and the cooperation network of heads of study affairs in universities of applied sciences AMK-OHA.	Open science and research enablers
Networks for research and education	Networks that promote and develop research and/or higher education.	Open science and research enablers
Discipline specific networks	National and international networks of researchers and teachers from specific disciplines and research fields.	Open science and research enablers
General networks for research performing organisations	UNIFI, Arene and Tulanet.	Open science and research enablers
Actors coordinating voluntary work in research	Learned societies and other associations or organisations whose activities are based, at least in part, on voluntary work by researchers and other participants.	Open science and research enablers, Research and education support service providers
Researcher	A person who carries out research using scientific methods. A researcher may work in the public, private or third sector or as a freelance researcher.	Authors owning copyrights and neighbouring rights, Research actors
Research team member	A research team is a group of researchers, research support staff and other research participants organised around the same research topic.	Authors owning copyrights and neighbouring rights
Author of educational resources	The person who created or made the educational material. Educational material may have several authors.	Authors owning copyrights and neighbouring rights

Actor	Descriptions	Roles of the actor (in addition to Open science users and beneficiaries)
Research participants	People involved in research, who are not researchers, such as citizen scientists or research informants.	Authors owning copyrights and neighbouring rights
Publisher	Actor responsible for publishing.	Actors receiving economic rights through contracts, Research and education support service providers
Collective rights management organisations	Collective copyright management organisations (APFI, Gramex, Kopiosto, Kuvasto, Sanasto and Teosto), which represent authors, artists and companies in their respective fields, collect the royalties due to them, manage licensing issues and promote national culture.	Actors receiving economic rights through contracts
Other organisations	Other organisations that have received economic rights through contracts.	Actors receiving economic rights through contracts
CSC	CSC – IT center for science LTD. is a Finnish non-profit centre of information technology, owned by the state and universities.	Research and education support service providers
Service providers for education	Publicly funded actors developing support services for higher education, such as the Digivisio 2030 -project.	Research and education support service providers
Publisher	Actor responsible for publishing.	Actors receiving economic rights through contracts, Research and education support service providers
Collective rights management organisations	Collective copyright management organisations (APFI, Gramex, Kopiosto, Kuvasto, Sanasto and Teosto), which represent authors, artists and companies in their respective fields, collect the royalties due to them, manage licensing issues and promote national culture.	Actors receiving economic rights through contracts
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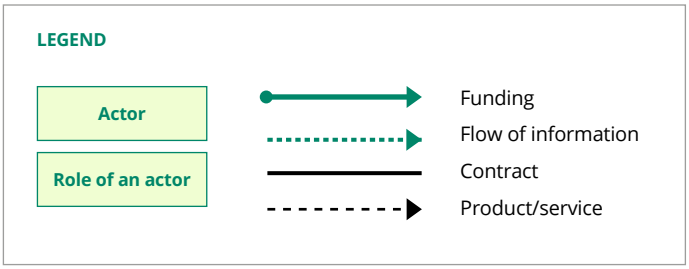
Service providers for education	Publicly funded actors developing support services for higher education, such as the Digivisio 2030 -project.	Research and education support service providers

3.2 OPERATOR INTERACTION DIAGRAMS

3.2.1 Cash flows and service flows at a general level



The diagrams below illustrate the main interactions between the actors: the red connectors indicate a flow of funding, the blue a flow of services and the grey a flow of information. Instead of all forms of interaction, the diagrams only include the main ones, in order to provide a general understanding of the overall provision of open science and research services. Most of the contractual relationships have not been described in this diagram, but as a rule it can be concluded that whenever money changes hands between actors, a contract always exists.

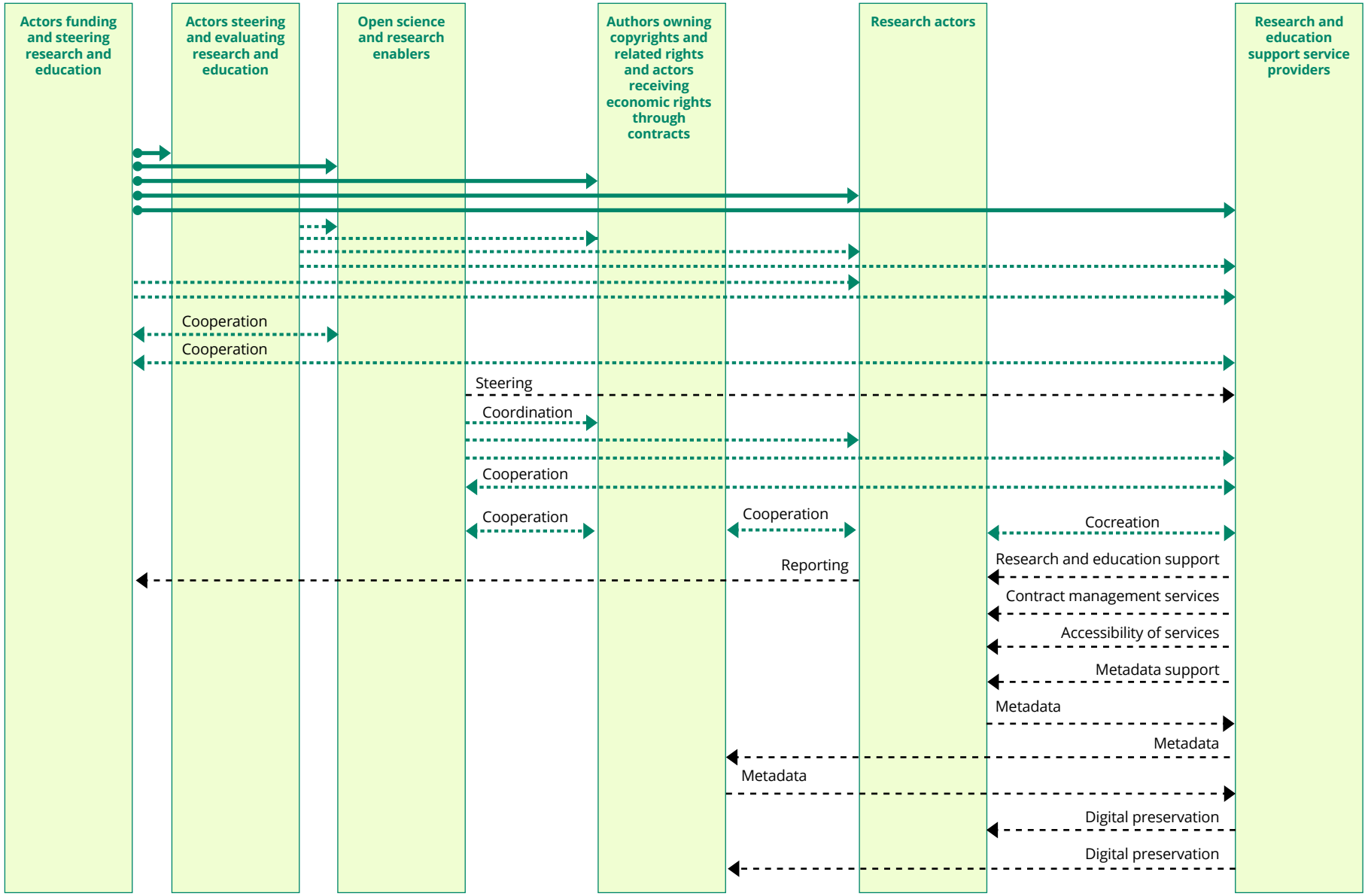
3.2.1.1 Interaction diagram of open science governance

This diagram describes the main interaction relationships between the actors, particularly in terms of actors that steer research and education. Descriptions of interaction:

- Actors funding and steering research and education:
    - Fund actors steering and evaluating research and education, open science and research enablers, authors owning and other actors holding copyrights and neighbouring rights (e.g. scholarly publishers), research actors, as well research and education support service providers.
    - Steer the operations of actors and support services through the terms and conditions of funding.
    - Cooperate with enablers and support services to promote open science and research.
    - Receive reports from research actors on the use of funding.
- Actors steering and evaluating research and education:
    - Receive funding from actors that fund research and education.
    - Guide enablers of open science and research, owners or holders of copyrights or neighbouring rights, research actors, and well research and education support service providers through their evaluations.

- Open science and research enablers:
  - Receive funding from actors that fund research and education.
  - Receive steering from actors that evaluate research and education.
  - Coordinate open science and research activities by informing those involved in science and research about the common policies and recommendations agreed upon in Open Science and Research Coordination.
  - Guide the operations of their own support services in a more open direction.
  - Cooperate with the owners and holders of research outputs (e.g. scholarly publishers) and support services to promote open science and research.
- Owners of copyrights and neighbouring rights to research outputs, and holders of financial rights (e.g. scholarly publishers):
  - Receive funding from actors that fund research and education.
  - Receive steering from actors that evaluate research and education.
  - Receive information about national and local open science and research policies from open science and research enablers.
  - Cooperate with enablers and research actors in order to make science and research open.
  - Provide metadata, i.e. descriptions of research outputs, to support services and receive it from them.
  - Utilise support services to store research outputs.
- Research actors:
  - Receive funding from actors that fund research and education.
  - Receive steering from actors that evaluate research and education.
  - Receive information about national and local open science and research policies from open science and research enablers.
  - Report to funders on the use of funding.
  - Cooperate with scholarly publishers and support services, among others, to make science and research open.

    - Utilise accessible support services to conduct research, handle contractual matters, create metadata and store research outputs.
    - Provide metadata, i.e. descriptions of research outputs, to the support services.
- Research and education support service providers:
    - Receive funding from actors that fund research and education.
    - Receive steering from actors that evaluate research and education.
    - Receive information about national and local open science and research policies from open science and research enablers.
    - Cooperate with the funders, enablers and research actors in order to make science and research open.
    - Provide accessible support services to research actors for conducting research, handling contractual matters and creating metadata.
    - Offer services for storing research outputs to research actors, as well as other owners of copyrights and neighbouring rights and holders of financial rights.
    - Receive metadata, i.e. descriptions of research outputs, from research actors, owners of copyrights and neighbouring rights, and holders of financial rights (e.g. scholarly publishers), and in turn provide metadata to be used by the former.

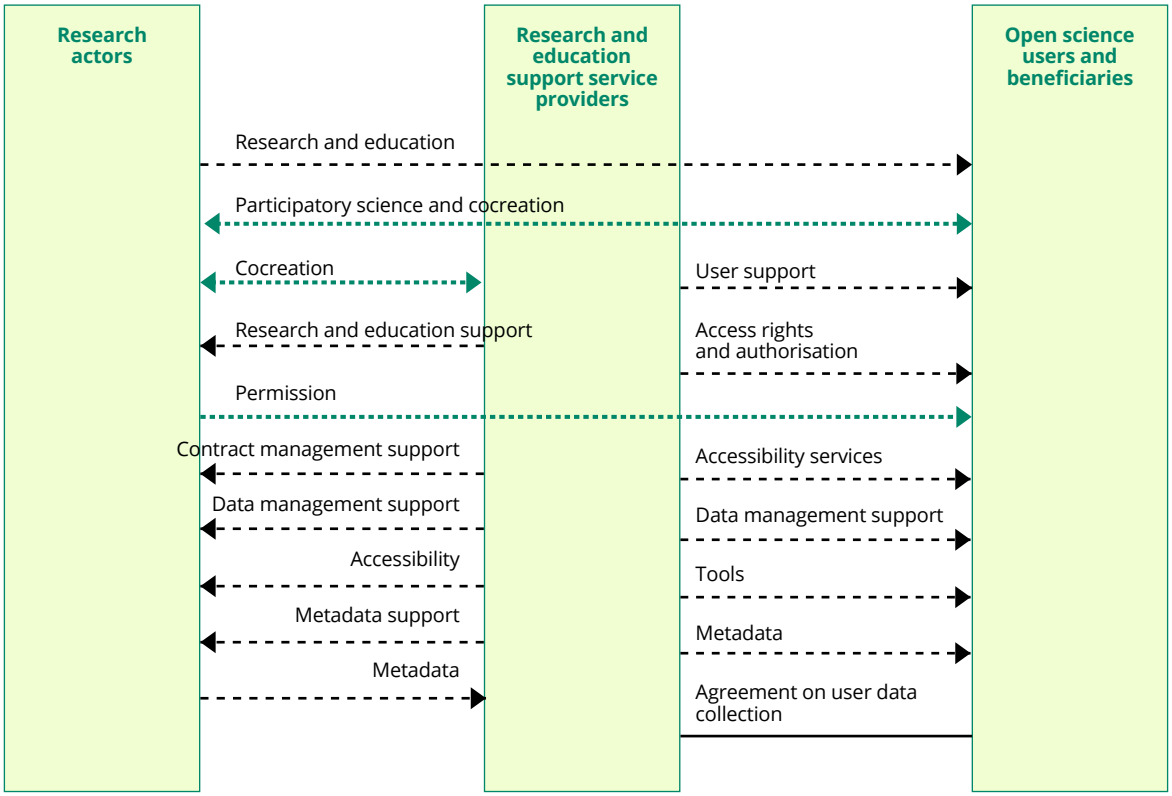

Actors funding and steering research and education
Actors steering and evaluating research and education
Open science and research enablers
Authors owning copyrights and related rights and actors receiving economic rights through contracts
Research actors
Research and education support service providers
Cooperation
Cooperation
Steering
Coordination
Cooperation
Cooperation
Cooperation
Cocreation
Reporting
Research and education support
Contract management services
Accessibility of services
Metadata support
Metadata
Metadata
Metadata
Digital preservation
Digital preservation

3.2.1.2 Interaction in utilising open science

This diagram illustrates the main interaction relationships between actors, particularly in terms of open science and research users and beneficiaries. Descriptions of interaction:

- Research actors:
    - Serve the open science and research users and beneficiaries through research and education.
    - Engage users to contribute to science and research through participatory science.
    - Permit the use of their own research outputs.
    - Cooperate with the support services to make science and research open.
    - Utilise accessible support services to conduct research, handle contractual matters, manage data and create metadata.
    - Provide metadata, i.e. descriptions of research outputs, to the support services.
- Support services for research and education:
    - Cooperate with research actors to make science and research open.
    - Provide accessible support services to research actors for conducting research, handling contractual matters and creating metadata.
    - Receive metadata, i.e. descriptions of research outputs, from research actors.
    - Support the use of open science and research outputs through accessible services.
    - Grant user rights to research outputs.
    - Make research outputs available to users in an accessible manner.
    - Offer tools to research actors and users for managing research data, for example.
    - Provide metadata, i.e. descriptions of research outputs, to the users.
    - Ask the users for consent to a collection of usage data.

- Open science users and beneficiaries:
  - Utilise research and education.
  - Take part in conducting science and research through participatory science.
  - Obtain the consent of research actors to use research outputs.
  - Receive user rights to research outputs from the support services.
  - Receive accessible services and tools from the support services, e.g. for the use of open science and research outputs and the management of research data.
  - Receive metadata, i.e. descriptions of research outputs, from the support services.
  - Give consent to the support services to the collection of usage data.

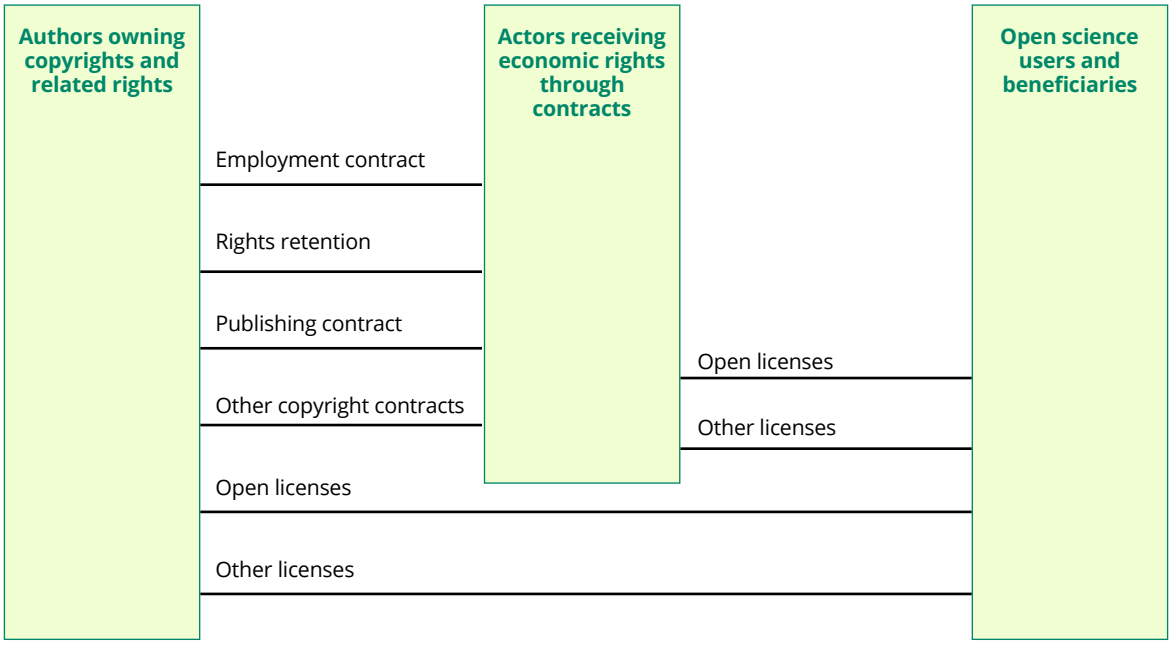


3.2.2 Agreements on copyright and neighbouring rights

The original owners of copyright or a neighbouring right to research outputs (e.g. the author of a research publication or compiler of a research dataset) may make research outputs available to users either through open or other licences.

Alternatively, the owners of the original rights to research outputs may, through a copyright agreement, transfer the financial rights to another actor, who may make the research outputs available to users either through open or other licences. Financial rights may be granted through employment contracts, publishing agreements and usage agreements, to name a few.

In particular, employment contracts may include a rights retention clause to ensure that e.g. the author of a research publication or the author's employer always retains the necessary rights to make the publication openly available, regardless of any other agreements made by the author regarding the publication.



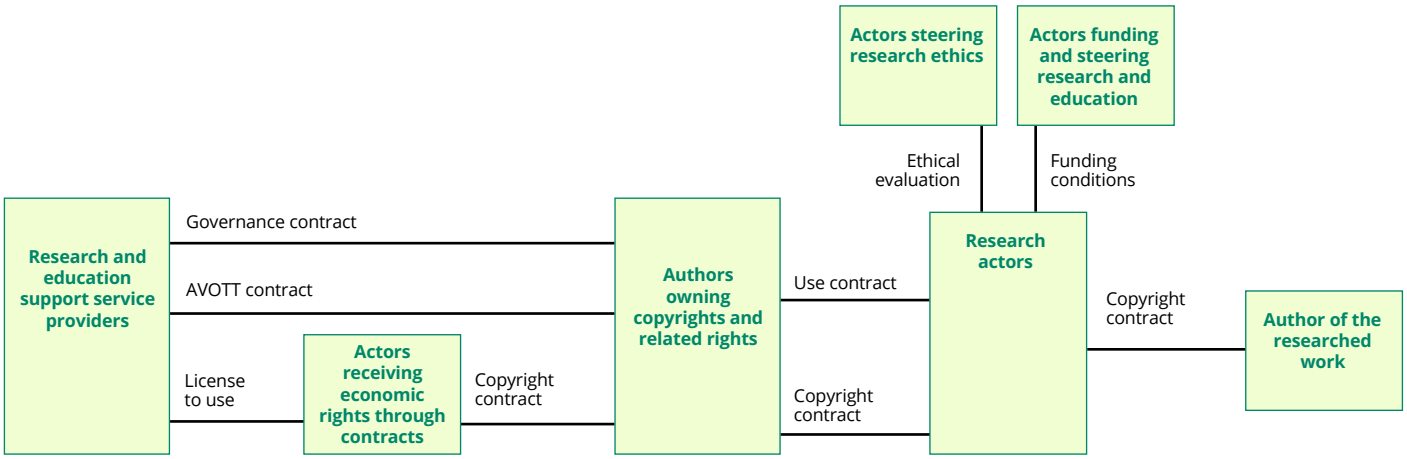
3.2.3 Agreements on creating works and publications

Conducting research described in a project plan is conditional on obtaining a research permit. A research permit is granted by the research organisation, based on a statement by the ethics committee. Additionally, many research funders set conditions for conducting research and publishing the results of that research.

If the intention is to include material subject to copyright in a research publication (e.g. artworks or workshop outputs), an agreement is required for the use of this material for publishing it as part of the research publication.

The members of a research team may be co-authors of a research publication. In that case, the team members must come to an agreement on the authorship and usage rights to the research publications.

The original copyright owners of research publications must agree on their management (e.g. digital preservation) with support service providers. The original owners of the rights may make a research publication openly available to the extent made possible by legislation, research ethics and funding, among other elements. Making a publication openly available may require other agreements with support services in connection with open science and research. Alternatively, an original rights owner may transfer their financial rights to a publication to another party (e.g. a scholarly publisher), who may further transfer rights to use the research publication.



3.2.4 Agreements on creating datasets and metadata

Conducting research described in a project plan is conditional on obtaining a research permit. A research permit is granted by the research organisation, based on a statement by the ethics committees. In addition, many research funders require a plan on the management of the research data.

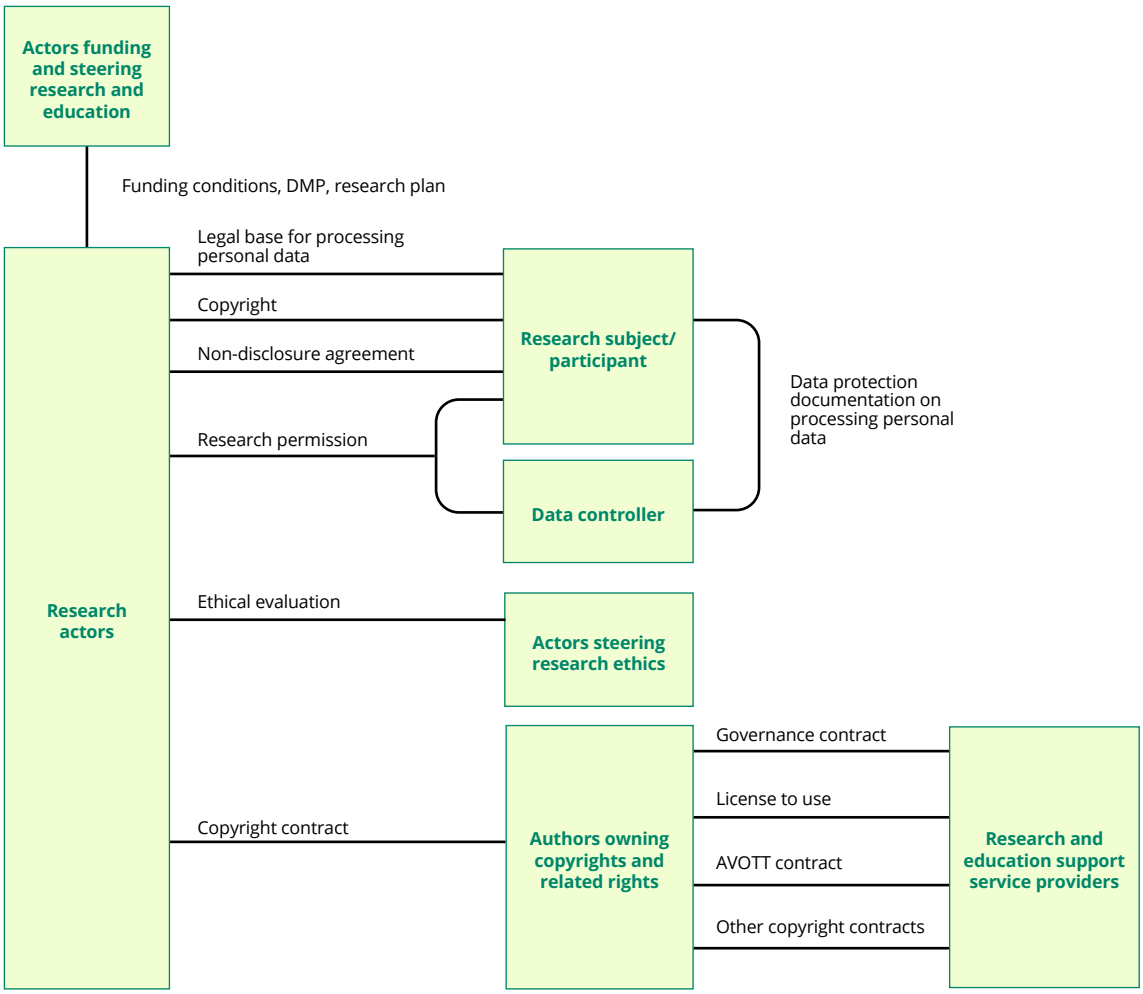
If the subject of a study or its participant is a person, the processing and potential opening of the research data requires that personal data is processed on justifiable grounds. Research data can only be opened to the extent to which the subject or participant of the study has consented. If the collected data exceeds the threshold of originality, the copyright of the research subject or participant must also be taken into account.

For example, if the subject of a study is an organisation, a research permit may be required from the organisation and, in some cases, a non-disclosure agreement may be necessary.

The data controller must provide the research subject or participant with data protection documentation regarding the processing of their personal data. The controller may be e.g. an individual researcher or their background organisation. If research involves the use of registry data, the researchers must request permission from the data controller to use the data.

Research teams must negotiate amongst themselves and with their respective organisations on the copyright and neighbouring rights to datasets, as well as usage rights. Furthermore, the processing of datasets may be subject to terms and conditions determined by research funders.

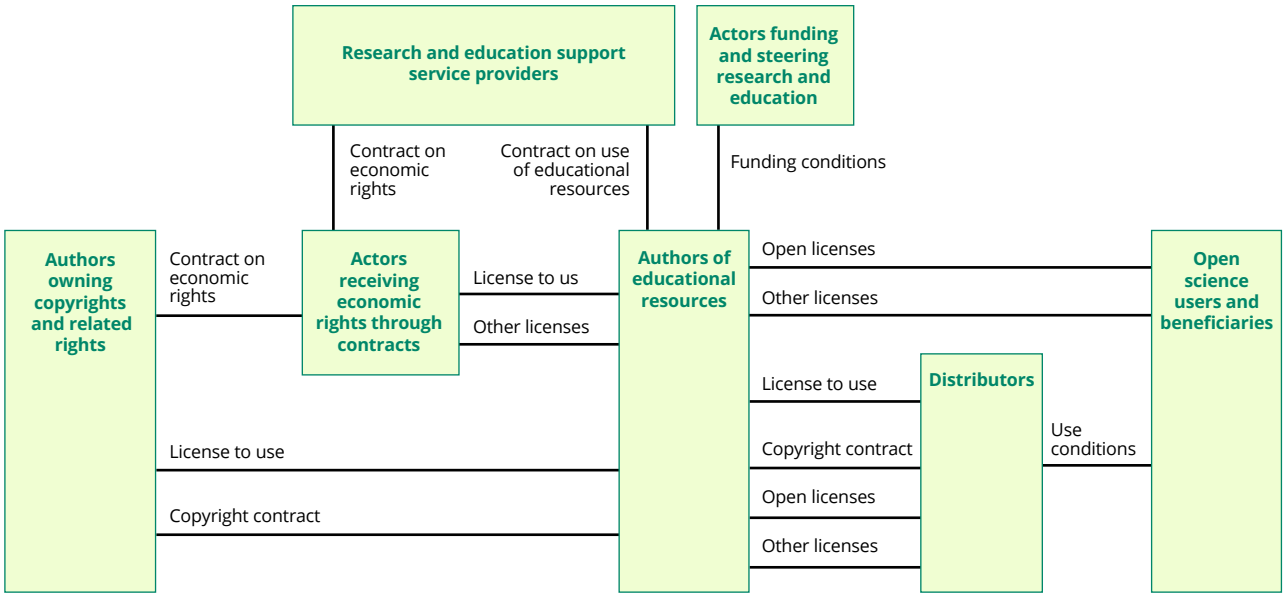
The original owners of copyrights and neighbouring rights (individual researchers, research team members or other research participants) of research data must agree on the use and management (e.g. digital preservation) of the data with support service providers. The original owners of the rights may make a dataset openly available to the extent made possible by legislation, research ethics and funding, among other elements. Making datasets openly available may require various agreements pertaining to open science and research.


Actors funding and steering research and education
Funding conditions, DMP, research plan
Legal base for processing personal data
Copyright
Non-disclosure agreement
Research permission
Research subject/ participant
Data protection documentation on processing personal data
Data controller
Research actors
Ethical evaluation
Actors steering research ethics
Governance contract
License to use
AVOTT contract
Other copyright contracts
Copyright contract
Authors owning copyrights and related rights
Research and education support service providers

3.2.5 Agreements on creating educational resources

Authors or creators of educational resources may make their own creations openly available to users under either open or other licences. Creators can also make educational resources available to users through a distributor by transferring rights to the distributor, granting usage rights to the material or licensing it with an open or other licence. The distributor may have conditions related e.g. to the usage time of educational resources. Additionally, the funder may have certain conditions on the distribution of educational resources it funds.

If an author of educational resources uses materials created by third parties in creating their own resource, they may only make their own resource available to users if the original owner of the copyright and neighbouring rights, or a party that has acquired financial rights to the material through agreements (e.g. a publisher or copyright organisation), has granted the creator the necessary rights, e.g. through a general agreement signed with the background organisation or under an open licence.



3.3 BUSINESS SERVICES

3.3.1 Map of business services

A service map provides a comprehensive overview of the services provided in the field of open science. The services are divided into six service areas: overarching services, services for the open access of scholarly publications, services for the management of research data and methods, services for education and educational resources, services for responsible evaluation and support, and services for participatory science. The services derive from the open science and research policies described in chapter 2 and the capabilities that implement them.

OVERARCHING SERVICES

- Steering, cooperation and support
- Open Science and Research funding and resourcing
- Incentives
- Legislative lobbying
- Service development steering
- Quality management of Open Science and Research
- Marketing and communication
- Open science training
- Open Science and Research counseling
- Support for responsible conduct of research
- Accessibility support
- Legal and contract support, copyright and licensing support
- Industrial property rights support
- Open innovations
- Interoperability support
- Data security
- Support for data protection
- Support for infrastructures
- MyData services
- Identity and access management (IAM)
- Preregistration of research plan
- System development and maintenance
- Storing
- Medium-term storing
- Digital preservation

SERVICE AREA FOR OPEN ACCESS OF RESEARCH PUBLICATIONS

- Information retrieval support
- Research writing support
- Publishing support
- Open access publishing infrastructures
- Publishing
- Self-archiving and reporting publications
- Training for publishing support and open access publishing

SERVICE AREA FOR THE MANAGEMENT OF RESEARCH DATA AND METHODS

- National research data management coordination
- Training for support service experts
- Research data production, preparation, curation, opening and removal
- Training for research data management
- Research data management planning support
- Research data opening and publishing support and findability support
- Onsite support in research data production and use
- Research method development, management and opening
- Research method use support
- System development and maintenance for data and methods
- Computing services
- Anonymisation and pseudonymisation

SERVICE AREA FOR EDUCATION AND EDUCATIONAL RESOURCES

- Training for educational experts
- Use and findability of open educational resources
- Creation of open educational resources
- Ensuring the quality of educational resources
- Publishing of and support for educational resources and products of learning
- Educational resources metadata support
- Educational resources lifecycle management
- Teacher and learner networking support
- Findability of and registration to open education
- Recognition of prior learning
- Open educational platforms
- Pedagogical support
- Learner analytics support
- Teaching open to everyone
- Evaluation of learning
- Open learning badges
- Education exports
- Science education

RESPONSIBLE EVALUATION AND ITS SUPPORT

- Training of responsible assessment experts
- Knowledge base production and support
- Assessment criteria and processes support
- Research assessment and support
- Education assessment and support
- Impact assessment and support
- Researcher assessment and support
- Career services
- Open science monitoring

SERVICE AREA OF PARTICIPATORY SCIENCE

- Support for research participation
- Support for citizen science
- Support for cooperation with private, public or third sector
- Support for crowdsourcing
- Crowdresourcing

3.3.2 Business services and processes

The services included in the service map are described in more detail in this chapter. In addition to the service name, the table includes a service description, the service type (local, national, international), the service providers and users, as well as the processes through which the services are carried out. Furthermore, the services and the provision processes have been described in diagrams. A process is a sequence of events that is systematically described, repeatable and results in a pre-defined outcome. Processes are functions that implement services. The processes have been described from the perspective of service providers, i.e. service owners. The processes have been named, but their more detailed functionalities have not been described. A separate table and diagram has been created for each of the six service areas.

The analysis of the current state of services was carried out in spring 2023. It used a three-tier metric: the service is currently 1) implemented well, 2) implemented for some or partially or 3) implemented poorly.

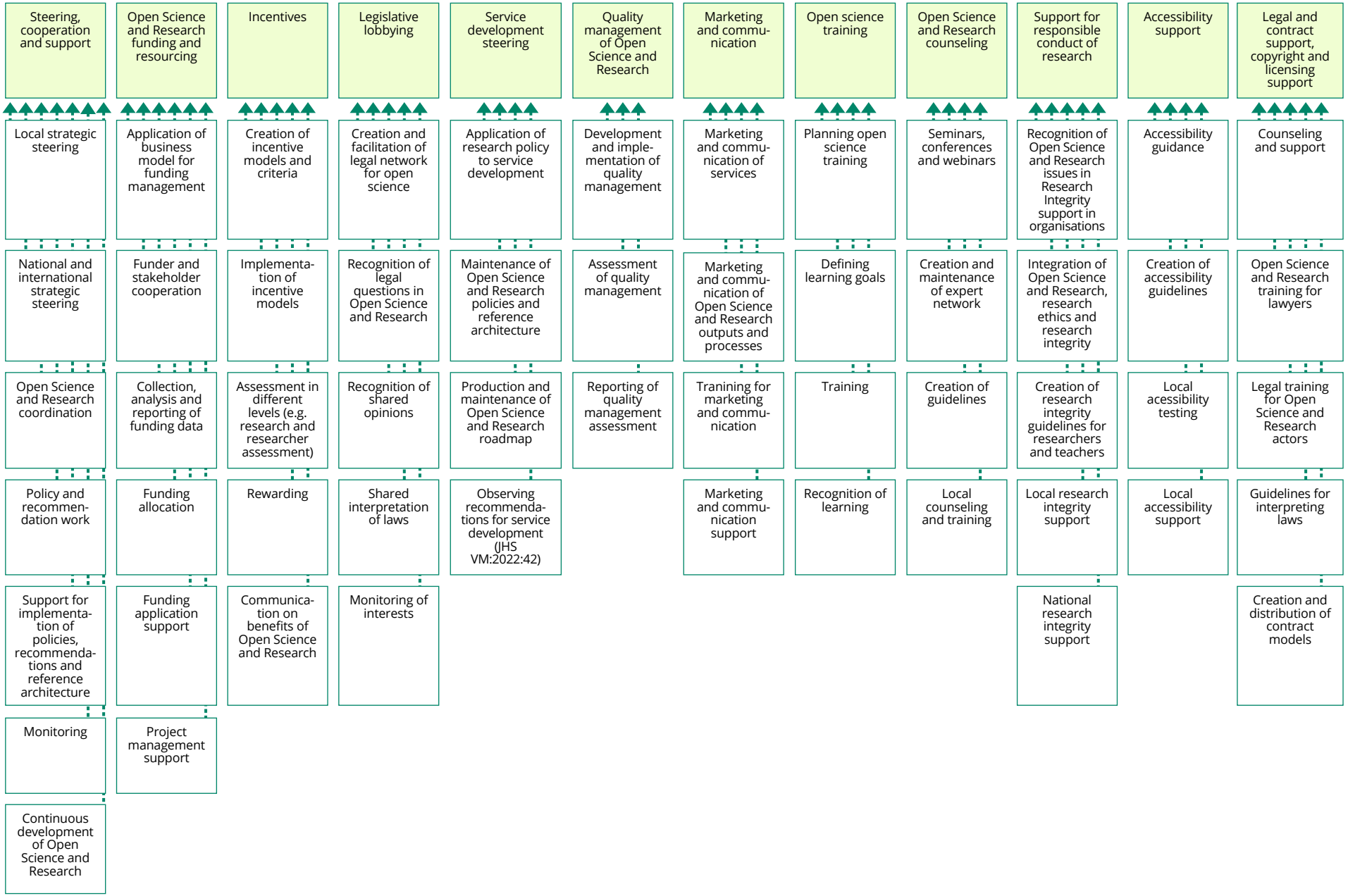
WELL = implemented well

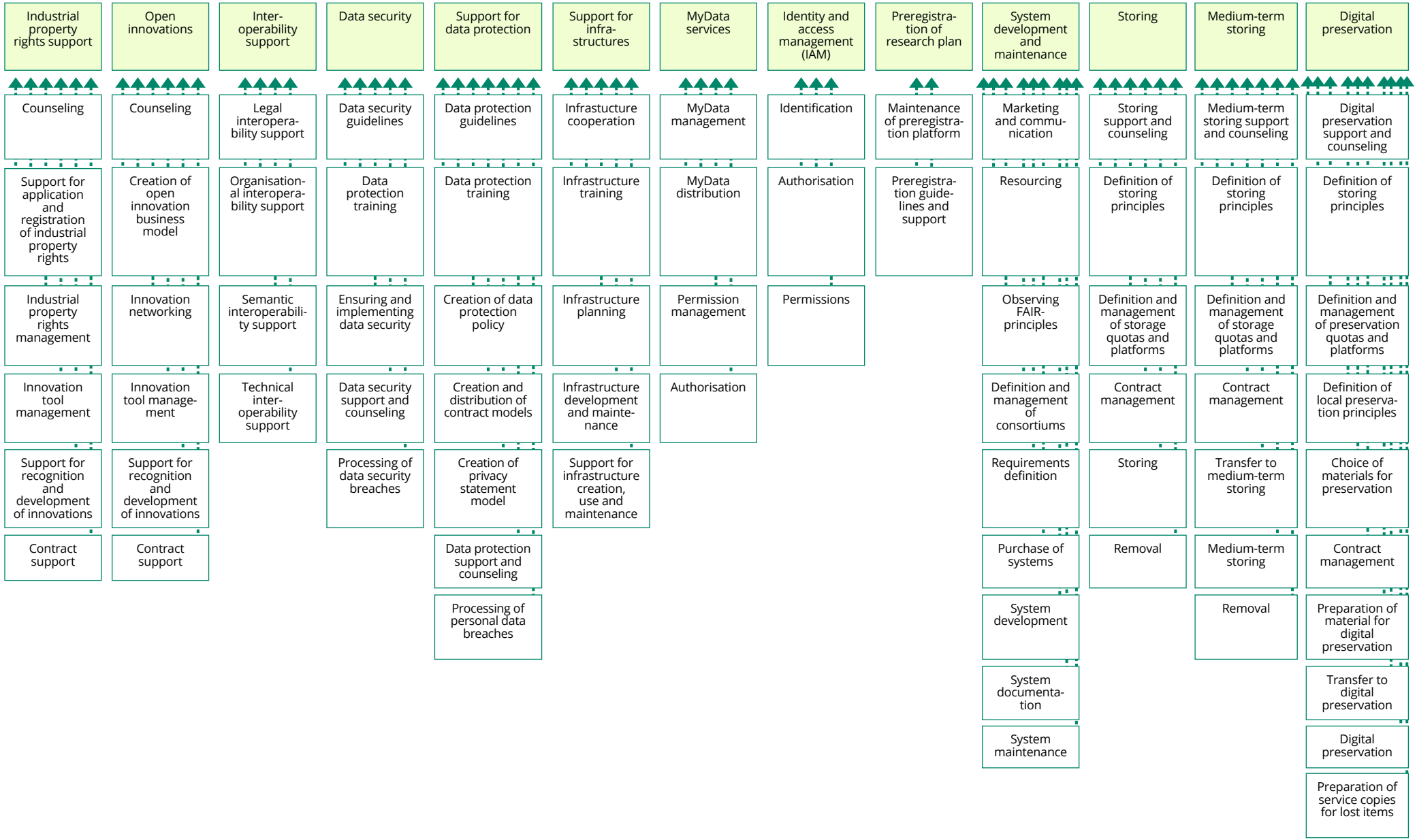
PARTIALLY = implemented for some or partially

POORLY = implemented poorly

3.3.2.1 Overarching services

Service area description: The area of overarching services consists of services that concern more than one Open Science and Research service area. It includes services used to coordinate and guide Open Science and Research activities. The services can be provided locally, nationally and/or internationally. The services and processes of the service area have been divided into two diagrams to improve readability.


Steering, cooperation and support
Open Science and Research funding and resourcing
Incentives
Legislative lobbying
Service development steering
Quality management of Open Science and Research
Marketing and commu-nication
Open science training
Open Science and Research counseling
Support for responsible conduct of research
Accessibility support
Legal and contract support, copyright and licensing support
Local strategic steering
Application of business model for funding management
Creation of incentive models and criteria
Creation and facilitation of legal network for open science
Application of research policy to service development
Development and imple-mentation of quality management
Marketing and commu-nication of services
Planning open science training
Seminars, conferences and webinars
Recognition of Open Science and Research issues in Research Integrity support in organisations
Accessibility guidance
Counseling and support
National and international strategic steering
Funder and stakeholder cooperation
Implementa-tion of incentive models
Recognition of legal questions in Open Science and Research
Maintenance of Open Science and Research policies and reference architecture
Assessment of quality management
Marketing and commu-nication of Open Science and Research outputs and processes
Defining learning goals
Creation and maintenance of expert network
Integration of Open Science and Research, research ethics and research integrity
Creation of accessibility guidelines
Open Science and Research training for lawyers
Open Science and Research coordination
Collection, analysis and reporting of funding data
Assessment in different levels (e.g. research and researcher assessment)
Recognition of shared opinions
Production and maintenance of Open Science and Research roadmap
Reporting of quality management assessment
Tranining for marketing and commu-nication
Training
Creation of guidelines
Creation of research integrity guidelines for researchers and teachers
Local acessibility testing
Legal training for Open Science and Research actors
Policy and recommen-dation work
Funding allocation
Rewarding
Shared interpretation of laws
Observing recommenda-tions for service development (JHS VM:2022:42)
Marketing and commu-nication support
Recognition of learning
Local counseling and training
Local research integrity support
Local accessibility support
Guidelines for interpreting laws
Support for implementa-tion of policies, recommenda-tions and reference architecture
Funding application support
Communica-tion on benefits of Open Science and Research
Monitoring of interests
National research integrity support
Creation and distribution of contract models
Monitoring
Project management support
Continuous development of Open Science and Research


Industrial property rights support
Counseling
Support for application and registration of industrial property rights
Industrial property rights management
Innovation tool management
Support for recognition and development of innovations
Contract support
Open innovations
Counseling
Creation of open innovation business model
Innovation networking
Innovation tool manage-ment
Support for recognition and development of innovations
Contract support
Inter-operability support
Legal interopera-bility support
Organisation-al interopera-bility support
Semantic interoperabili-ty support
Technical inter-operability support
Data security
Data security guidelines
Data protection training
Ensuring and implementing data security
Data security support and counseling
Processing of data security breaches
Support for data protection
Data protection guidelines
Data protection training
Creation of data protection policy
Creation and distribution of contract models
Creation of privacy statement model
Data protection support and counseling
Processing of personal data breaches
Support for infra-structures
Infrastucture cooperation
Infrastructure training
Infrastructure planning
Infrastructure development and mainte-nance
Support for infrastructure creation, use and maintenance
MyData services
MyData management
MyData distribution
Permission management
Authorisation
Identity and access management (IAM)
Identification
Authorisation
Permissions
Preregistra-tion of research plan
Maintenance of preregistra-tion platform
Preregistra-tion guide-lines and support
System development and maintenance
Marketing and commu-nication
Resourcing
Observing FAIR-principles
Definition and management of consortiums
Requirements definition
Purchase of systems
System development
System documenta-tion
System maintenance
Storing
Storing support and counseling
Definition of storing principles
Definition and management of storage quotas and platforms
Contract management
Storing
Removal
Medium-term storing
Medium-term storing support and counseling
Definition of storing principles
Definition and management of storage quotas and platforms
Contract management
Transfer to medium-term storing
Medium-term storing
Removal
Digital preservation
Digital preservation support and counseling
Definition of storing principles
Definition and management of preservation quotas and platforms
Definition of local preserva-tion principles
Choice of materials for preservation
Contract management
Preparation of material for digital preservation
Transfer to digital preservation
Digital preservation
Preparation of service copies for lost items

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Steering, cooperation and support	The service produces strategic the polices and guides the Open Science and Research activities through strategic and information steering. The service is produced in expert panels under the guidance of the steering group of the Open Science and Research Coordination. The service develops and manages various models and agreements for action, cooperation and information production, including cooperation tools. The service will support joint activities between organisations and provide common approaches to enhance cooperation and community. The service also includes monitoring.	National WELL	National Open Science and Research Coordination is an established actor.	Federation of Finnish Learned Societies, Finn-Arma, Open science and research enablers, Actors funding and steering research and education, Copyright owners and holders, Research and education support service providers, Research actors	Actors funding and steering research and education, Oikeuksien omistajat, Copyright owners and holders, Research and education support service providers, Research actors	Local strategic steering, national and international strategic steering, open science and research coordination, policy and recommendation work, support for implementation of policies, recommendations and reference architecture, monitoring, continuous development of open science and research
Open Science and Research funding and resourcing	Support for funding applications and project management (pre- and post-award), taking into account the requirements of open science set by funders. Adequate allocation of resources to ongoing and new tasks arising from open science and research data management (APC management, data management and opening, new support and training needs).	Local PARTIALLY National POORLY International PARTIALLY	Too little earmarked funding for open science at all levels. At national level, mainly the indicator for the open publications.	Actors funding and steering research and education Management of research performing organisations Research and education support service providers	Research and education support service providers Research actors	Application of business model for funding management, funder and stakeholder cooperation, collection, analysis and reporting of funding data, funding allocation, funding application support, project management support

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Incentives	The service encourages the performance and promotion of open science, for example, through evaluation criteria, recognition or rewards.	Local PARTIALLY National PARTIALLY International PARTIALLY	Locally, some organisations have made good progress, but there is wide variation in results. Nationally, there is movement in the right direction (e.g. the development of responsible evaluation), but there is still a long way to go. In the EU there are actos like COARA who speak for responsible assessment, but otherwise incentives are still very underdeveloped.	Actors funding and steering research and education, Open science and research enablers	Open science and research enablers, Research and education support service providers, Research actors	Creation of incentive models and criteria, implementation of incentive models, assesment in different levels (e.G. Research and researcher assessment), rewarding, communication on benefits of open science and research
Legislative lobbying	The service aims to promote legislation enabling open science at national and EU level.	National POORLY Local POORLY International POORLY	No common national legislative lobbying activity. Very little legislative lobbying activity locally. No joint lobbying internationally.	Open science and research enablers	Research and education support service providers, Research actors	Creation and facilitation of legal network for open science, recognition of legal questions in open science and research, recognition of shared opinions shared interpretation of laws, monitoring of interests
Service development steering	The service will guide the development of services in the national area of Open Science and Research in line with the Open Science and Research roadmap and science policy.	National PARTIALLY	The architecture is the first step towards service management, but we are still in the very early stages.	Open science and research enablers, Actors funding and steering research and education	Research and education support service providers, Research actors	Application of research policy to service development, maintenance of open science and research policies and reference architecture, production and maintenance of open science and research roadmap, observing recommendations for service development

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Quality management of Open Science and Research	The service assesses the quality of the Open Science and Research activities. The framework for the assessment is provided by the policies, recommendations and reference architecture. The Open Science and Reference self-evaluation tool can be used for the assessment. For example, the implementation of the FAIR principles can be evaluated.	National PARTIALLY Local PARTIALLY	At national level, the Open Science and Research monitoring is ongoing and a self-evaluation tool exists, but is still in its early stages. The self-evaluation tool is already used to some extent by organisations, but needs further dissemination.	Research and education support service providers	Research and education support service providers	Development and implementation of quality management, assessment of quality management, reporting of quality management assessment
Marketing and communication	The service promotes and markets open science services. It also promotes markets open science outputs and processes. It provides training and support for marketing and communication.	Local PARTIALLY National WELL	Nationally, open science is promoted extensively. In some organisations and in some areas, open science is promoted, but not extensively.	Research and education support service providers, Open science and research enablers, Research actors	Research actors Open science users and beneficiaries Research and education support service providers	Marketing and communication of services, marketing and communication of open science and research outputs and processes, tranining for marketing and communication, marketing and communication support
Open science training	Service provides training in open science and its different areas (e.g. data management and publishing open educational resources).	Local PARTIALLY National PARTIALLY	Some areas have training at both local and national level (e.g. data management), others less so (e.g. open education).	Research and education support service providers (usually libraries)	Research actors Research and education support service providers	Planning open science training, defining learning goals, training, recognition of learning
Open Science and Research counseling	The service provides guidance and advice on questions and problems related to open science. National and local services are provided on a one-stop shop basis.	National PARTIALLY Local WELL	Local counselingis readily available. No clear national one-stop shop for counseling. Advice is available from the Federation of Finnish Learned Societies if you know how to ask.	Research and education support service providers	Research actors	Seminars, conferences and webinars, creation and maintenance of expert network, creation of guidelines, local counseling and training

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Support for responsible conduct of research	The service provides support, advice and training in responsible conduct of research in the Open Science and Research context. Guidelines on good practices are drawn up and support is provided in resolving suspected cases of infringement. The service will provide ethical pre-evaluations, support responsible openness and steer the conduct of research. Responsible conduct of research is defined as the practice of conducting research in a manner recognised by the research community: responsible openness and honesty, general diligence and rigour in the conduct of research, in the recording and presentation of results, and in the evaluation of research and its results.	National WELL Local PARTIALLY	TENK provides national support for responsible conduct of research. Locally, there is support for responsible conduct of research in many organisations.	TENK, Open science and research enablers	Research actors	Recognition of open science and research issues in research integrity support in organisations, integration of open science and research, research ethics and research integrity, creation of research integrity guidelines for researchers and teachers local research integrity support, national research integrity support
Accessibility support	The service provides support to ensure accessibility of digital and physical services and products. The service includes accessibility testing when purchasing new systems. Service provides support for the preparation of an accessibility report.	National WELL Local PARTIALLY International PARTIALLY	National accessibility support centralised in the Celia library. Locally, accessibility support services are being developed. International standards on accessibility exist.	Research and education support service providers, Regional State Administrative agency (monitorin)	Research and education support service providers, Research actors	Accessibility guidance, creation of accessibility guidelines, local acessibility testing, local accessibility support

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Legal and contract support, copyright and licensing support	Advice on intellectual property rights (in particular copyright of publications, research data and educational resources), data protection and other legal restrictions on openness. Drawing up model contracts, coordinating their use and providing support for the maintenance of contracts and, for example, standard terms and conditions.	National POORLY Local PARTIALLY	No centralised national advice on legal questions related Open Science and Research. Legal services exist in organisations, but more are needed.	Open science and research enablers Together with Finnish copyright organisations (Teosto, Kopiosto, Sanasto, Gramex, Kuvasto, APFI, Effi, AVATE), Finnish Competition and Consumer Authority and Copyright Council	Research actors	Counseling and support open science and research training for lawyers, legal training for open science and research actors, guidelines for interpreting laws, creation and distribution of contract models
Industrial property rights support	The service provides support and advice on applying for, registering and managing trademarks, patents, utility models and design rights.	National PARTIALLY Local PARTIALLY International PARTIALLY	Finnish Patent and Registration Office advises at national level, but not in great depth. Locally, innovation services, etc. of organisations provide varying degrees of support to researchers on industrial property rights. At EU level, the European Union Intellectual Property Office (EUIPO) handles industrial property rights, but does not provide advice.	Research and education support service providers Together with Finnish Patent and Registration Office	Research actors	Counseling, support for application and registration of industrial property rights, industrial property rights managementi, innovation tool management, support for recognition and development of innovations, contract support

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Open innovations	The service will create a business model for open innovation, support networking and partnerships and their use. The service provides innovation tools and supports in creating and making contracts. Support and counseling is also provided in identifying and refining innovations. National services could be provided by Business Finland.	National PARTIALLY Local PARTIALLY	Business Finland requires, for example, openness of results in its funding, but does not yet clearly steer towards open innovation. At local level, organisations are promoting open innovation to varying degrees.	Research and education support service providers	Research actors	Counseling, creation of open innovation business model, innovation networking, innovation tool management, support for recognition and development of innovations, contract support
Interoperability support	The service supports interoperability (including legal and organisational interoperability, e.g. EIF and EIRA) and use of information by providing and recommending reference architectures, vocabularies, ontologies, metadata formats, concept and information models and interface descriptions.	National PARTIALLY Local PARTIALLY International PARTIALLY	At national level, the CSC and the Federation of Finnish Learned Societies are partly responsible for interoperability services, but legal interoperability, for example, is in its infancy. Locally, interoperability is being promoted to some extent. The Commission has provided models for interoperability.	Actors funding and steering research and education, Open science and research enablers Research and education support service providers	Research actors Research and education support service providers	Legal interoperability support, organisational interoperability support, semantic interoperability support, technical interoperability support

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Data security	The service provides data security and related training and support. Data security involves administrative and technical measures to ensure that the data is only accessible to those who have the right to access it, that it cannot be modified by anyone other than those who have the right to access it, and that the data and information systems are accessible to those who have the right to access it.	National WELL Local WELL	CSC handles data security (access management) nationally. Locally, data security is provided by the IT services of the organisations.	Research and education support service providers CSC	Research actors, Open science users and beneficiaries Research and education support service providers	Data security guidelines, data security training, ensuring and implementing data security, data security support and counseling, processing of data security breaches
Support for data protection	The service provides training and support on compliance with data protection legislation. The service will produce a privacy statement (policy) that defines the responsibilities, guiding principles and practices that the organisation will follow when processing personal data. The service will produce model templates for data protection notices and support for their preparation and for the preparation of DPIAs (Data Protection Impact Assessments).	National POORLY Local WELL	At national level, the Data Protection Ombudsman monitors and provides guidance on data protection. No central service for coordinating research data protection. Research data protection is ensured locally by organisations.	Research and education support service providers Data Protection Ombudsman and Data Protection Officers	Research actors, Open science users and beneficiaries	Data protection guidelines, data protection training, creation of data protection policy, creation and distribution of contract models, creation of privacy statement model, data protection support and counseling, processing of personal data breaches

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Support for infrastructures	The service designs, develops and maintains research and education infrastructures. It provides training and support for the production and use of infrastructures, in particular from an open science perspective. Research infrastructures are the tools, equipment, hardware, networks, databases, data, materials, software and related services that enable high quality research, foster collaborative research, support researcher training and skills, and strengthen research and innovation capacities. Research infrastructures can be centralised, distributed or virtual entities, or interoperable combinations of these. Europe has many large supranational research infrastructures that are used on a multinational basis.	National PARTIALLY Local POORLY International PARTIALLY	The development of national infrastructures is in some cases well advanced, in others it is in its infancy. Even metadata on infrastructures are not systematically collected locally. EOSC, for example, has promoted research infrastructures.	Research and education support service providers,	Research actors Open science users and beneficiaries Research and education support service providers	Infrastucture cooperation, infrastructure training, infrastructure planning, infrastructure development and maintenance, support for infrastructure creation, use and maintenance

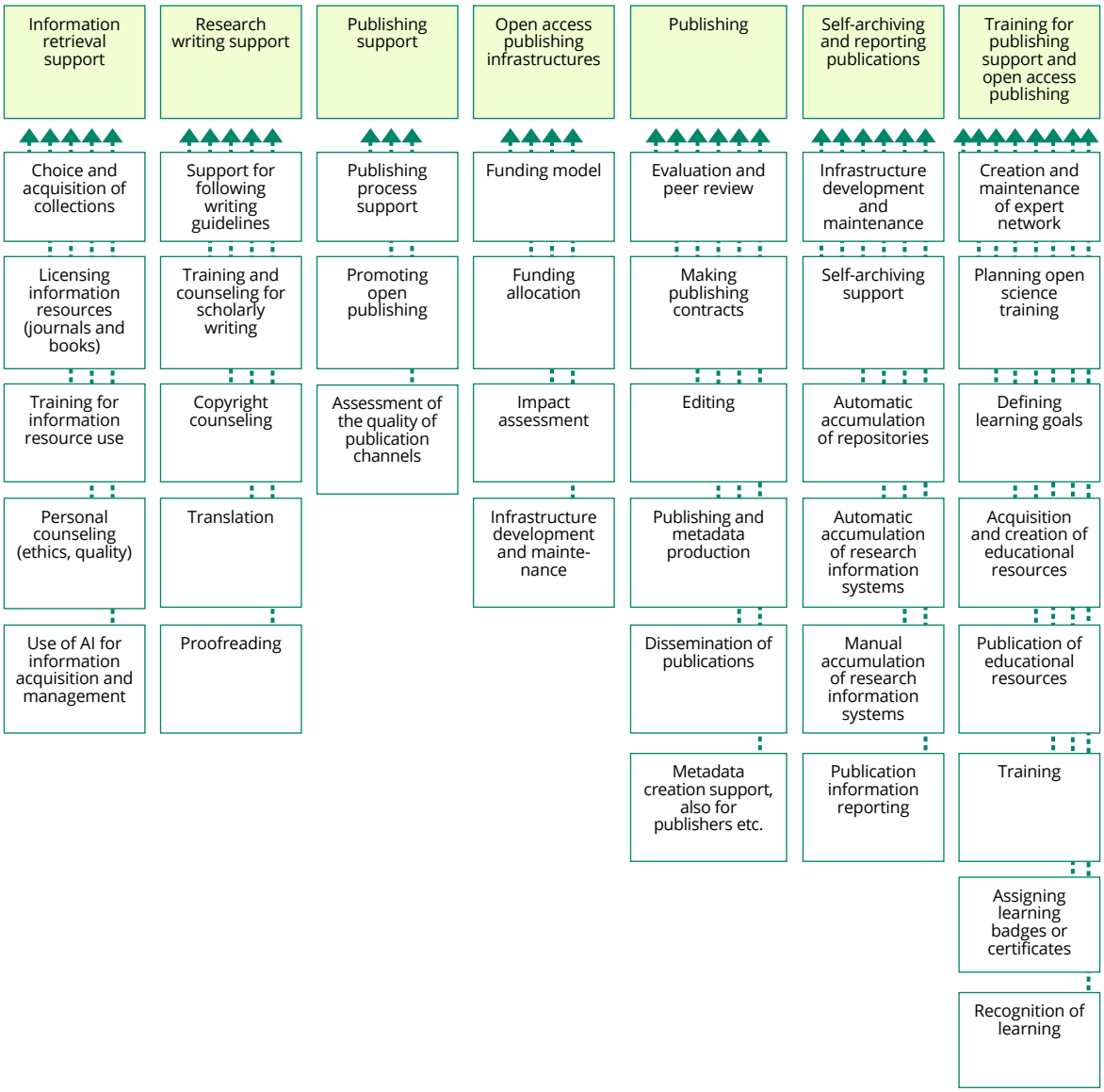
3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
MyData services	The service will ensure that open science users and beneficiaries can manage their personal information, such as their researcher profile, and give consent and authorisation for the use and sharing of their personal data. MyData is the management of personal data. It provides people (e.g. researchers and learners) the right to decide on the transfer and further use of the data that is collected about them in an interoperable and machine-readable way.	National POORLY Local POORLY International POORLY	MyData services are in their infancy at national, local and international level.	Research and education support service providers	Open science users and beneficiaries, Research actors	MyData management, MyData distribution, permission management, authorisation
Identity and access management (IAM)	The service provides secure and strong user authentication. Users are granted access to the material or service according to their role. The customer is granted access to the material and services for a limited period of time. The service grants or denies access to the material and services. The authorisation is based on a decision on a request for a limited time. Each person has an identity that allows access to the materials opened. Authorization is based on either a role or a permission. The service is based on the principles of MyData management.	National PARTIALLY Local PARTIALLY International POORLY	Nationally, identity management works (e.g. Haka login), but for example authorisation does not work for all services (such as Findata). Locally, IAM works well in higher education institutions, for example, but there are still gaps in archives and museums. National IAM systems are not very interoperable.	Research and education support service providers	Research actors Open science users and beneficiaries Research and education support service providers	Identification, authorisation, permissions

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Preregistration of research plan	Provides a service for the preregistration of research plan. The service also provides support for registration,	National POORLY Local International POORLY	There is no national service for preregistration of research plans.	Research and education support service providers	Research actors	Maintenance of preregistration platform, preregistration guidelines and support
System development and maintenance	The service builds, develops and maintains technical systems for processing, storing, accessing and sharing research outputs, associated metadata and documentation and other information relevant to their understanding.	Local PARTIALLY National PARTIALLY International PARTIALLY	It has been recognised that there should, for example, be more services where sensitive data can be reused (e.g. interview data and surveys that are not "worth" anonymising).	Research and education support service providers (often local ICT, library and research services)	Research actors Research and education support service providers	Marketing and communication, resourcing, observing fair-principles, definition and management of consortiums, requirements definition, purchase of systems, system development, system documentation, system maintenance
Storing	The service provides for the storage of publications, educational resources, research data and methods, as well as related metadata, documentation and other information relevant to the understanding of research outputs.	National PARTIALLY Local PARTIALLY International PARTIALLY	Nationally, there are some storing services (e.g. aoe.fi for educational resources), but not for all types of outputs (e.g. research methods). Storing services vary locally. Internationally, some services exist.	Research and education support service providers	Research actors	Storing support and counseling, definition of storing principles, definition and management of storage quotas and platforms, contract management, storing, removal

3.3.2.1 Overarching services						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Medium-term storing	Service ensures the medium-term storing of publications, open educational resources, research data and methods, as well as related metadata, documentation and other information relevant to the understanding of research outputs. E.g. Ida, Theseus and MOOCs.	National PARTIALLY Local PARTIALLY International PARTIALLY	Nationally, locally and internationally, some medium-term storage services exist.	Research and education support service providers	Research and education support service providers Research actors	Medium-term storing support and counseling, definition of storing principles, definition and management of storage quotas and platforms, contract management, transfer to medium-term storing, medium-term storing, removal
Digital preservation	The service ensures the preservation and availability of all publications by researchers affiliated to Finnish research organisations, as well as of open educational resources , research data and related metadata, documentation and other information essential for understanding research outputs, for a very long time, beyond technological and organisational changes.	National PARTIALLY	Nationally some digital preservation services exist.	CSC, National Archives of Finland, National Library of Finland, Finnish Social Science Data Archive	Research and education support service providers Research actors	Digital preservation support and counseling, definition of storing principles, definition and management of preservation quotas and platforms, definition of local preservation principles, choice of materials for preservation, contract management, preparation of material for digital preservation, transfer to digital preservation, digital preservation, preparation of service copies for lost items

3.3.2.2 Services for open access of research publications

Service area description: The services support scholarly publishing, and the findability and accessibility of publications.



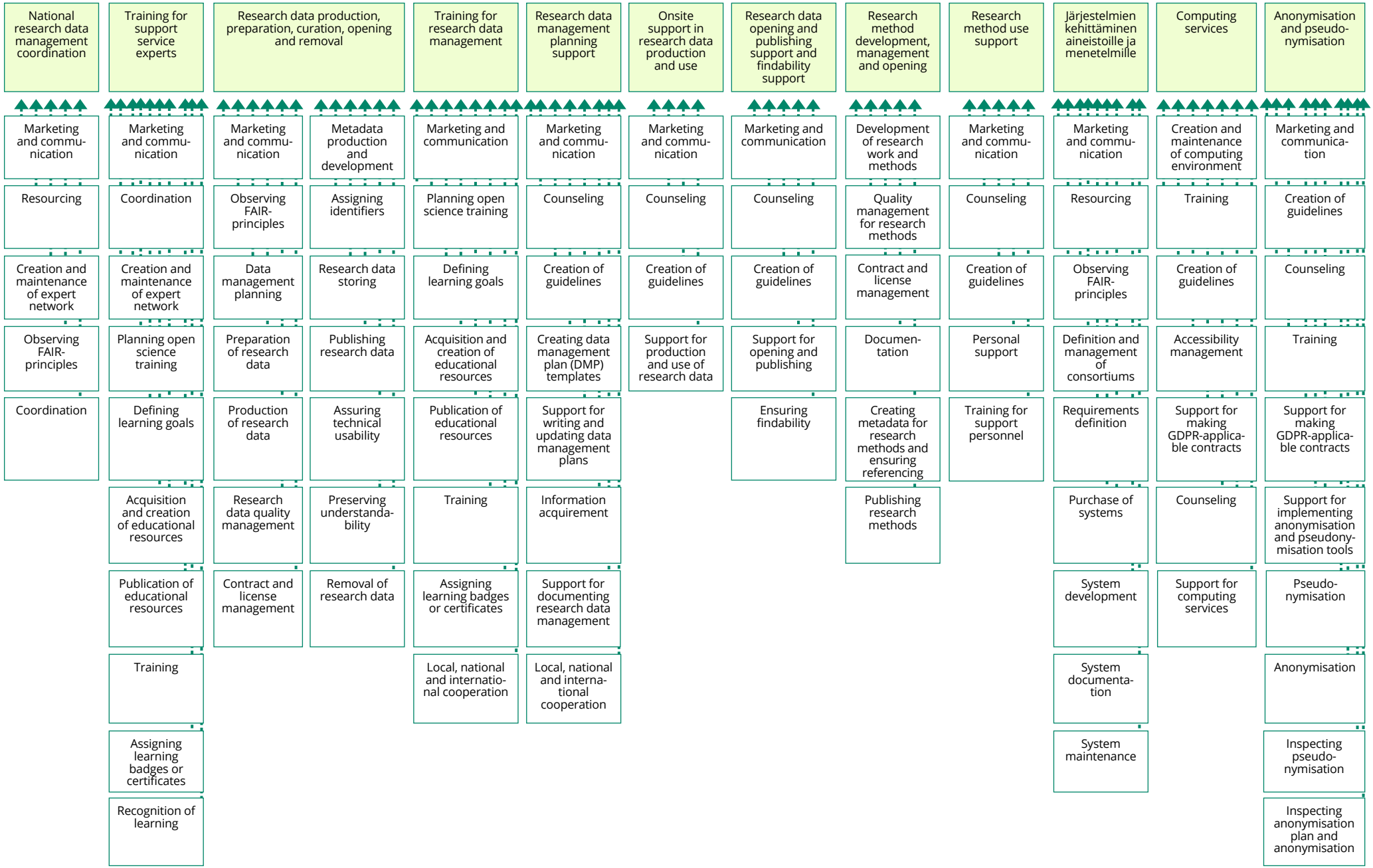
3.3.2.2 Services for open access of research publications						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Information retrieval support	Service provides access to information resources for researchers, supports users in the use of search services and databases (technical access, information retrieval, reference management software, etc.). Service supports information retrieval from freely available online resources.	Local WELL	Basic activities of research libraries.	Research and education support service providers (often libraries)	Open science users and beneficiaries	Choice and acquisition of collections, licensing information resources (journals and books), training for information resource use, personal counseling (ethics, quality), use of ai for information acquisition and management
Research writing support	The service provides support and guidance for research integrity and quality publication. Consideration is given to copyright and plagiarism, writing and citation practices in the discipline. Service supports authors in producing a publication that is linguistically acceptable and of high quality.	Local WELL Translation and proofreading PARTIALLY		Research and education support service providers	Research actors	Support for following writing guidelines, training and counseling for scholarly writing, copyright counseling, translation, proofreading

3.3.2.2 Services for open access of research publications						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Publishing support	The service helps researchers and others to choose publication channels and to finance publication fees. The service is closely linked to metadata production support service, self-archiving service and reporting service. The service also includes support for the use of publication channels and support for the selection of publication licences.	National PARTIALLY	There is not enough national support.	Research and education support service providers (often libraries) Federation of Finnish Learned Societies/ Publication Forum (Jufo Portal)	Research actors	Publishing process support, promoting open publishing, assessment of the quality of publication channels
		Local PARTIALLY	Local disparities in service levels.			
Open access publishing infrastructures	Funding open publishing infrastructures. The service develops and maintains, for example, publishing platforms (Journal.fi, Edition.fi) and publication archives.	National PARTIALLY	There are no sustainable financing models for all national infrastructures.	Research and education support service providers	Research actors	Funding model, funding allocation, impact assessment, infrastructure development and maintenance
		Local PARTIALLY	In principle, local services work well, but there is room for improvement and more resources could be devoted to them.			
Publishing	The service provides authors with publishing support and services, and directs them to publishers' services. It can also be offered as a complete publishing service.	Local PARTIALLY National WELL International WELL	Great local variations.	Research and education support service providers	Research actors	Evaluation and peer review, making publishing contract, editing, publishing and metadata production, dissemination of publications, metadata creation support, also for publishers etc.

3.3.2.2 Services for open access of research publications						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Self-archiving and reporting publications	Service provides authors with the possibility to self-archive their publication in the organisation's open access repository. Service provides support for registration of publication data in research information systems and for reporting.	National WELL Local WELL		Research and education support service providers (often libraries)	Research actors	Infrastructure development and maintenance, self-archiving support, automatic accumulation of repositories, automatic accumulation of research information systems, manual accumulation of research information systems, publication information reporting
Training for publishing support and open access publishing	The training will ensure adequate skills to publishing support and open access publishing.	Local WELL		Research and education support service providers	Research and education support service providers	Creation and maintenance of expert network, planning open science training, defining learning goals, acquisition and creation of educational resources, publication of educational resources, training, assigning learning badges or certificates, recognition of learning

3.3.2.3 Services for the management of research data and methods

The service area consists of services that support the high-quality management, production and reuse of research data and methods.


National research data management coordination
Marketing and communication
Resourcing
Creation and maintenance of expert network
Observing FAIR-principles
Coordination
Training for support service experts
Marketing and communication
Coordination
Creation and maintenance of expert network
Planning open science training
Defining learning goals
Acquisition and creation of educational resources
Publication of educational resources
Training
Assigning learning badges or certificates
Recognition of learning
Research data production, preparation, curation, opening and removal
Marketing and communication
Observing FAIR-principles
Data management planning
Preparation of research data
Production of research data
Research data quality management
Contract and license management
Metadata production and development
Assigning identifiers
Research data storing
Publishing research data
Assuring technical usability
Preserving understandability
Removal of research data
Training for research data management
Marketing and communication
Planning open science training
Defining learning goals
Acquisition and creation of educational resources
Publication of educational resources
Training
Assigning learning badges or certificates
Local, national and international cooperation
Research data management planning support
Marketing and communication
Counseling
Creation of guidelines
Creating data management plan (DMP) templates
Support for writing and updating data management plans
Information acquirement
Support for documenting research data management
Local, national and international cooperation
Onsite support in research data production and use
Marketing and communication
Counseling
Creation of guidelines
Support for production and use of research data
Research data opening and publishing support and findability support
Marketing and communication
Counseling
Creation of guidelines
Support for opening and publishing
Ensuring findability
Research method development, management and opening
Development of research work and methods
Quality management for research methods
Contract and license management
Documentation
Creating metadata for research methods and ensuring referencing
Publishing research methods
Research method use support
Marketing and communication
Counseling
Creation of guidelines
Personal support
Training for support personnel
Järjestelmien kehittäminen aineistoille ja menetelmille
Marketing and communication
Resourcing
Observing FAIR-principles
Definition and management of consortiums
Requirements definition
Purchase of systems
System development
System documentation
System maintenance
Computing services
Creation and maintenance of computing environment
Training
Creation of guidelines
Accessibility management
Support for making GDPR-applicable contracts
Counseling
Support for computing services
Anonymisation and pseudonymisation
Marketing and communication
Creation of guidelines
Counseling
Training
Support for making GDPR-applicable contracts
Support for implementing anonymisation and pseudonymisation tools
Pseudonymisation
Anonymisation
Inspecting pseudonymisation
Inspecting anonymisation plan and anonymisation

3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
National research data management coordination	The service coordinates nationally the guidance and tools for the design and implementation of data management among research organisations and with funders. This type of work is currently carried out by the DMP Consortium, the Open Science and Research Coordination's Research Data Expert Panel and the National Committee on Research Data.	National PARTIALLY	dynaamisuus ja konee-luettavuus ovat kesken	Research and education support service providers	Research and education support service providers	Marketing and communication, resourcing, creation and maintenance of expert network, observing fair-principles, coordination
Training for support service experts	The training will ensure that data experts and other providers of research and education support services have necessary skills. Service includes in particular data steward training. It includes formal training in higher education, including vocational training institutions. The training service is aimed at anyone working or planning to work in data management support roles. The training provides the opportunity to specialise in different dimensions of data management (such as data curation or general data management support and training).	Local POORLY		Research and education support service providers	Research and education support service providers	Research and education support service providers

3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Research data production, preparation, curation, opening and removal	The service produces and provides data for research and other further use. Research data are prepared and their usability is maintained and ensured. For example, research infrastructures provide data services.	Local PARTIALLY National PARTIALLY International PARTIALLY		Research and education support service providers Research actors	Research actors Research and education support service providers Open science users and beneficiaries	Marketing and communication, observing fair-principles, data management planning, preparation of research data, production of research data, research data quality management, contract and license management, metadata production and development, assigning identifiers, research data storing, publishing research data, assuring technical usability, preserving understandability, removal of research data
Training for research data management	Training services are offered to all groups that produce and/or use data in their work or studies. The training covers all steps and topics related to the management and use of data.	Local PARTIALLY National PARTIALLY		Research and education support service providers	Research actors	Marketing and communication, planning open science training, defining learning goals, acquisition and creation of educational resources, publication of educational resources, training, assigning learning badges or certificates, local, national and international cooperation

3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Research data management planning support	The service helps to plan the management of research data. It supports compliance with organisational and national policies and funder requirements. The service supports the systematic management of the life cycle of research data, starting with the design of the research.	Local PARTIALLY National PARTIALLY		Research and education support service providers	Research actors	Marketing and communication, counseling, creation of guidelines, creating data management plan (dmp) templates, support for writing and updating data management plans, information acquirement, support for documenting research data management, local, national and international cooperation
Onsite support in research data production and use	The service provides local support for researchers, teachers and students in the handling of research data, such as accessing, documenting, organising, analysing, opening, publishing and storing. It supports the discoverability, understandability and re-use of research data. It is a local service that implements the choices made in the management of research data and supports the researcher in the research process.	Local PARTIALLY	Somewhere even well, but not everywhere.	Research and education support service providers Research actors	Research actors	Marketing and communication, counseling, creation of guidelines, support for production and use of research data

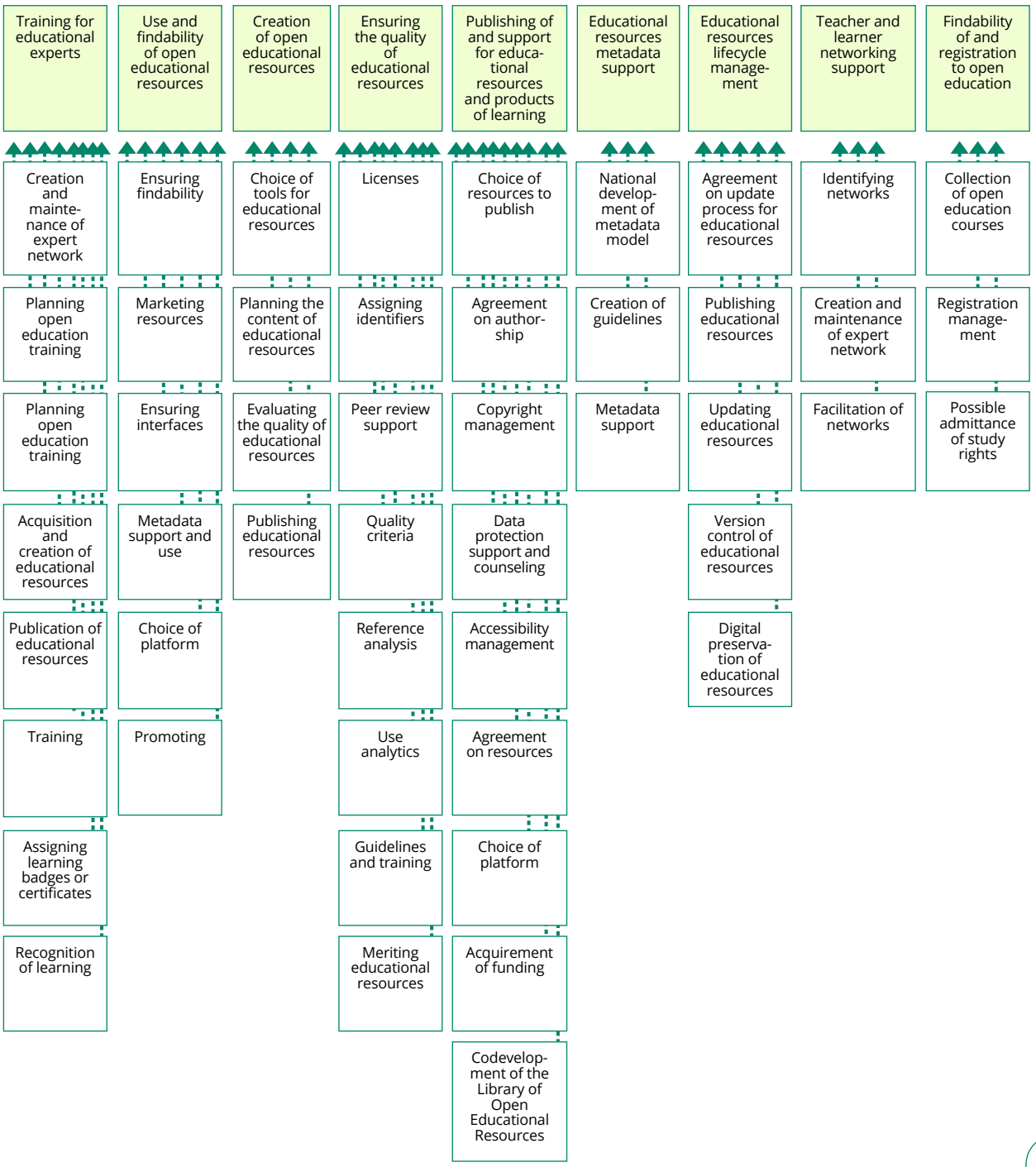
3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Research data opening and publishing support and findability support	The service helps to open and publish research data and related metadata, documentation and other contextual information relevant to understanding the data. This includes, for example, agreeing on authorship, ownership and access rights, and ensuring citability. The service also covers support for opening up "mere" metadata and other documentation. It will support the choice of the publication channel for the research material, such as a journal or repository, and ensure that the research material complies with FAIR principles. It also supports the discoverability of existing research material.	Local PARTIALLY		Research and education support service providers	Research actors	Marketing and communication, counseling, creation of guidelines, support for opening and publishing, ensuring findability
		National PARTIALLY	Variably, e.g. a lot of variation in the availability of services Lack of integrations			
Research method development, management and opening	In the service, researchers typically develop and use platforms and tools to produce, document and open research methods, and to collect and process research data. Examples of research methods include algorithms, software, source codes, scripts, protocols, artificial intelligence and language models, machine learning, systematic reviews, questionnaires, interview guides, documentation of installations (e.g. hardware), data collection methods and documentation, laboratory notebooks and instructions.	Local POORLY National POORLY International POORLY		Research and education support service providers, Research actors	Research actors	Development of research work and methods, quality management for research methods, contract and license management, documentation, creating metadata for research methods and ensuring referencing, publishing research methods

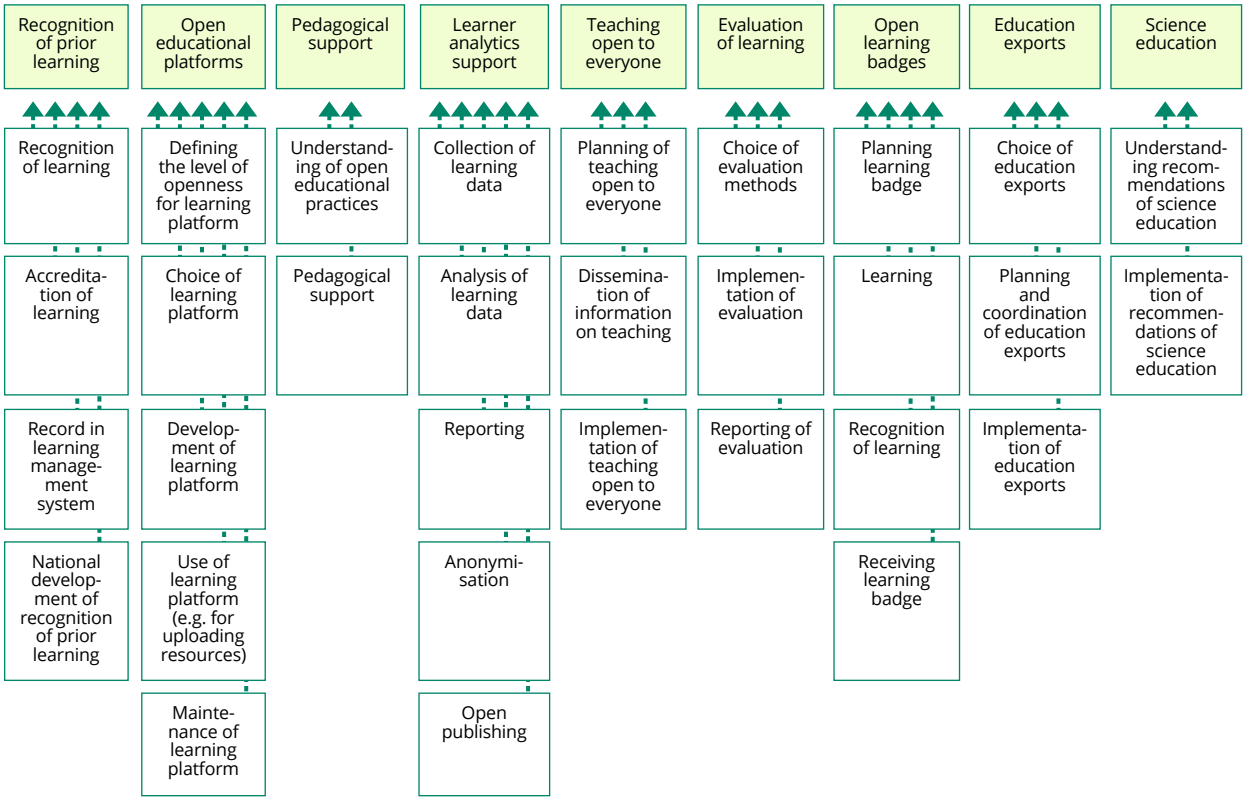
3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Research method use support	The service supports the use of research methods by providing access to methodological services, advice on the use of services, tools and methods to produce reproducible, high-quality research. For example, GitHub tutorials, research infrastructures, research method manuals, Atlas.fi -tutorials.	Local PARTIALLY National POORLY International POORLY		Research and education support service providers	Research actors	Marketing and communication, counseling, creation of guidelines, personal support, training for support personnel
System development and maintenance for data and methods	The service builds, develops and maintains technical systems for processing, storing, accessing and sharing research outputs, associated metadata and documentation and other information relevant to their understanding.	Local PARTIALLY National PARTIALLY International PARTIALLY	It has been recognised that there should, for example, be more services where sensitive data can be reused (e.g. interview data and surveys that are not "worth" anonymising).	Research and education support service providers (often local ICT, library and research services)	Research actors Research and education support service providers	Marketing and communication, resourcing, observing FAIR-principles, definition and management of consortiums, requirements definition, purchase of systems, system development, system documentation, system maintenance
Computing services	The service provides services and support for the computing and computing network services and the computing environment.	Local WELL National WELL International WELL		CSC, research performing organisations	Research actors	Creation and maintenance of computing environment, training, creation of guidelines, accessibility management, support for making GDPR-applicable contracts, counseling, support for computing services

3.3.2.3 Services for the management of research data and methods						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Anonymisation and pseudonymisation	The service provides anonymisation and pesudonymisation. These are applied to the data created by the researcher. The service also provides guidance, support and training in anonymisation and pseudonymisation, also for support service providers. It also provides tools and methods and support for their use.	Local PARTIALLY	It has been recognised that more services should be provided.	Research and education support service providers	Research actors Research and education support service providers	Marketing and communication, creation of guidelines, counseling, training, support for making GDPR-applicable contracts, support for implementing anonymisation and pseudonymisation tools, pseudonymisation, anonymisation, inspecting pseudonymisation, inspecting anonymisation plan and anonymisation

3.3.2.4 Services for education and educational resources

This service area includes, in particular, services required to make education and educational resources open. Opening up education refers to the extension of access to and participation in education to cover a wider audience and more target groups by reducing barriers to education, improving accessibility to and supply of education, and focusing on the learner. Open educational resources refer to materials or information that are designed partially for teaching and learning purposes in any format and available for use on any device that have been released into the public domain or shared with an open licence, which grants parties other than the original authors the right to freely access, reuse, adapt, modify and redistribute the material.




Recognition of prior learning
Recognition of learning
Accredita-tion of learning
Record in learning manage-ment system
National develop-ment of recognition of prior learning
Open educational platforms
Defining the level of openness for learning platform
Choice of learning platform
Develop-ment of learning platform
Use of learning platform (e.g. for uploading resources)
Mainte-nance of learning platform
Pedagogical support
Understand-ing of open educational practices
Pedagogical support
Learner analytics support
Collection of learning data
Analysis of learning data
Reporting
Anonymi-sation
Open publishing
Teaching open to everyone
Planning of teaching open to everyone
Dissemina-tion of information on teaching
Implemen-tation of teaching open to everyone
Evaluation of learning
Choice of evaluation methods
Implemen-tation of evaluation
Reporting of evaluation
Open learning badges
Planning learning badge
Learning
Recognition of learning
Receiving learning badge
Education exports
Choice of education exports
Planning and coordination of education exports
Implementa-tion of education exports
Science education
Understand-ing recom-mendations of science education
Implementa-tion of recommen-dations of science education

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Training for educational experts	The training will ensure that organisations have sufficient skills in the production of open educational resources, the implementation of open education and their support services. The training service is aimed at anyone who works or wants to work in the field of open educatio.	Local POORLY National POORLY	Not much training available for experts on open education.	Research and education support service providers	Research and education support service providers Research actors	Creation and maintenance of expert network, planning open education training, defining learning goals, acquisition and creation of educational resources, publication of educational resources, training, assigning learning badges or certificates, recognition of learning
Use and findability of open educational resources	Open educational resources (OER) are usually digital materials aimed at teaching, education or learning, licensed under an open licence. This gives the right to use and redistribute the educational resource free of charge and often also to adapt it. The educational resource is usually distributed on one of the open publishing or learning platforms.	Local PARTIALLY	Some higher education institutions recommend using the AOE.fi service, for example, but many do not have any recommendation for a place to store educational resources. The use of educational resources is not systematically monitored.	Research and education support service providers	Open science users and beneficiaries	Ensuring findability, marketing resources, ensuring interfaces, metadata support and use, choice of platform, promoting
		National WELL	The AOE.fi service provides tools for finding open educational resources. For the author, the service offers the possibility to monitor the use of their own educational resources.			
		International POORLY	No widely used and well-known international OER platform.			

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Creation of open educational resources	The service includes applications and software to create quality educational resources, e.g. H5P.	Local PARTIALLY	Some universities are already very good at providing tools for making educational resources, others are not. The fragmentation of the level of service is reflected in the large variation in the amount of open educational resources produced.	Research and education support service providers	Research actors	Choice of tools for educational resources, planning the content of educational resources, evaluating the quality of educational resources, publishing educational resources
Ensuring the quality of educational resources	Ensuring the quality of open educational resources, for example through national quality criteria for open educational resources, peer review and/or quality assurance support.	Local PARTIALLY	In some universities quality assurance is well developed (e.g. XAMK's quality process for open educational resources), in others the service is in its infancy.	Research actors, Research and education support service providers	Research actors	Licenses, assigning identifiers, peer review support, quality criteria, reference analysis, use analytics, guidelines and training, meriting educational resources and career paths
Publishing of and support for educational resources and products of learning	Making educational resources and products of learning openly available to users through digital platforms. Providing support for the publication of open educational resuources and products of learning.	Local PARTIALLY	Some universities have advanced services, others are in their infancy.	Research and education support service providers Library of Open Educational Resources	Open science users and beneficiaries, Research actors	Choice of resources to publish, agreement on authorshipn, copyright management, data protection support and counseling, accessibility management, agreement on resources, choice of platform, acquirement of funding, codevelopment of the Library of Open Educational Resources
		National WELL	AOE.fi provides a national platform for publishing open educational resources.			

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Educational resources metadata support	Supporting the integration of metadata about the target audience, purpose and educational context of the educational resource through a digital service.	Local PARTIALLY	In some universities educational resources metadata support services are well developed, in others in their infancy.	Research and education support service providers Library of Open Educational Resources (Library of Open Educational Resources includes a service for describing educational resources, but some educational resources are also part of a publication series etc., so the metadata can also be done elsewhere.)	Research actors, Research and education support service providers	National development of metadata model, creation of guidelines, metadata support
		National WELL	The AOE.fi service has produced guidelines for describing educational resources.			
Educational resources lifecycle management	Managing the life cycle of published educational resources (e.g. updating, archiving of outdated information, digital preservation). Supporting the management of the life cycle of educational resources.	Local POORLY	Educational resources lifecycle management is in its infancy and there are not much plans, for example, to update the organisation's educational resources.	Research actors, Research and education support service providers Avointen oppimateriaalien kirjasto	Avoimen tieteen käyttäjät, Tieteen ja tutkimuksen tekijät	Agreement on update process for educational resources, publishing educational resources, updating educational resources, version control of educational resources, digital preservation of educational resources
		National PARTIALLY	The AOE.fi service offers the possibility to update and archive educational resources. There are no national services for the digital preservation of educational resources.			

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Teacher and learner networking support	A support service to create networks for teachers and learners to share knowledge and peer learning. The service includes networking activities, facilitation and platforms.	Local PARTIALLY	Some networks exist, but not comprehensively in all higher education institutions.	Research actors, Research and education support service providers, Open science and research enablers	Teacher, Learner	Identifying networks, creation and maintenance of expert network, facilitation of networks
		National PARTIALLY	At some level, e.g. the Expert Panel on Open Education and various teaching networks serve this need, but there is not yet sufficient awareness of them in higher education.			
Findability of and registration to open education	The service contains information about open education and enables learners to enrol in open education offered by higher education institutions and other education providers.	National POORLY	Enrolment option coming to the Continuous Learning Portal, but not yet implemented.	Research and education support service providers, Digivisio	Learner	Collection of open education courses, registration management, possible admittance of study rights

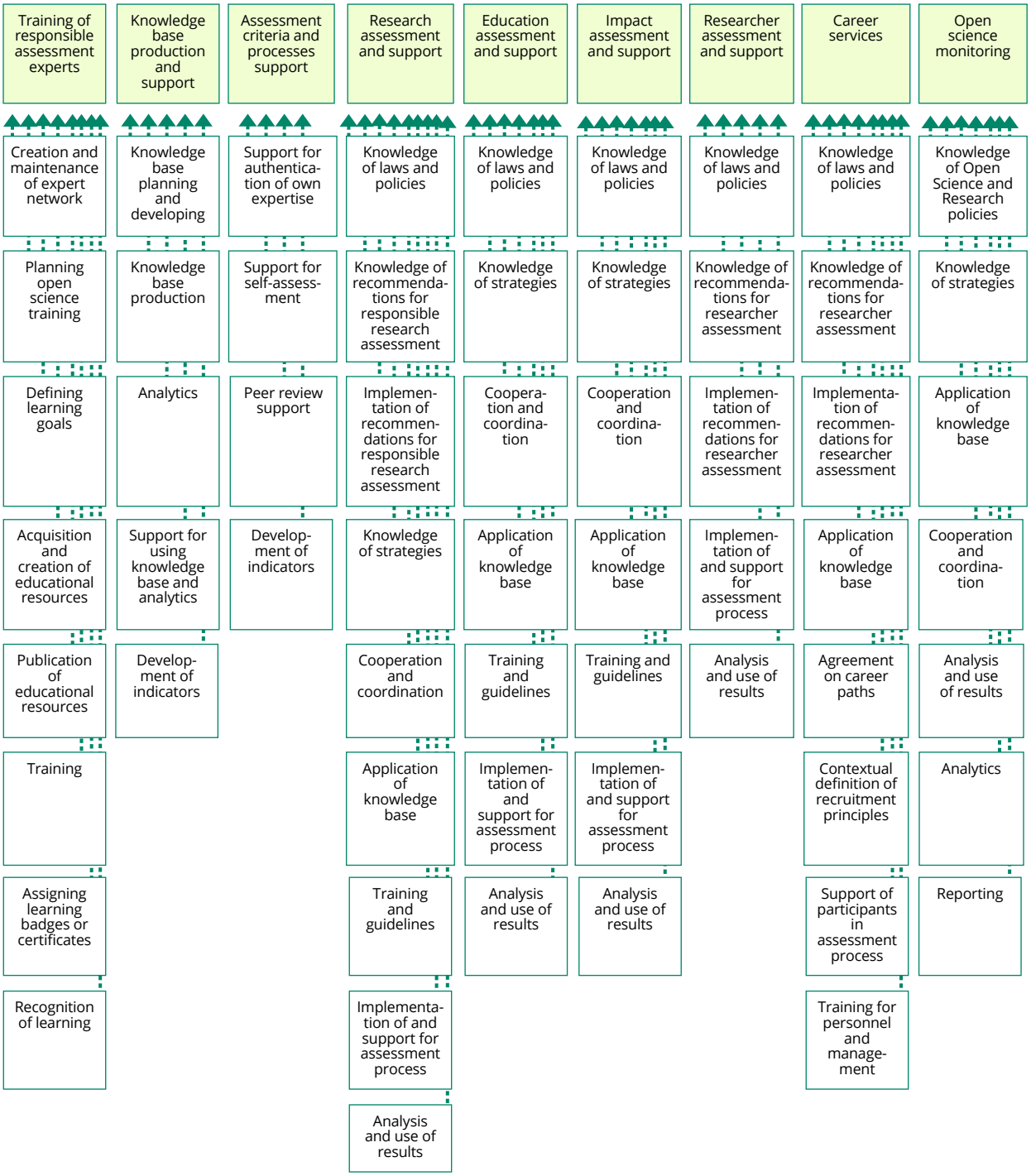
3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Recognition of prior learning	Recognition and accreditation of prior open education.	Local POORLY	While recognition of prior learning as such is well managed in higher education, recognition of prior learning in open education still needs a lot of improvement.	Teacher, Research and education support service providers	Learner	Recognition of learning, accreditation of learning, record in learning management system, national development of recognition of prior learning
Open educational platforms	A service for the digital organisation of learning and teaching, a digital learning environment that learners can join regardless of their background. The service includes distance learning and excludes learning platforms restricted to internal use within the organisation.	Local PARTIALLY	Many learning platforms (e.g. Moodle) offer in principle the possibility to openly share content, but in practice this can be difficult to implement.	Research and education support service providers	Open science users and beneficiaries, Research actors	Defining the level of openness for learning platform, choice of learning platform, development of learning platform, use of learning platform (e.g. for uploading resources), maintenance of learning platform
Pedagogical support	The service provides support for the pedagogical development of open education and educational resources.	Local PARTIALLY	Some higher education institutions have been working on open education pedagogy for a long time, very many may not even be aware of the need for it.	Research and education support service providers	Teacher	Understanding of open educational practices, pedagogical support
Learner analytics support	The service includes the collection, measurement, analysis, reporting and open use of data from the learner and the learning process. The aim is to understand and improve education and learning environments.	Local PARTIALLY	The possibilities for using learning analytics vary greatly between different higher education institutions.	Research and education support service providers, Research actors	Open science users and beneficiaries, Research actors	Collection of learning data, analysis of learning data, reporting, anonymisation, open publishing
		National POORLY	No national platform for collecting learning analytics (possibly planned for Digivisio project).			

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Teaching open to everyone	All education that is widely available and that anyone can attend free of charge. Awarding a learning credit for teaching that is open to all may be subject to a fee. Teaching open to everyone can take the form of face-to-face, distance or hybrid teaching.	Local PARTIALLY	Some higher education institutions already offer courses open to all, others do not.	Research actors	Open science users and beneficiaries	Planning of teaching open to everyone, dissemination of information on teaching, implementation of teaching open to everyone
		National PARTIALLY	No national portal to search for learning open to all (Continuous Learning Portal coming soon).			
		International PARTIALLY	Teaching open to all is available internationally, but there are no clear portals from which to search it.			
Evaluation of learning	Learners will be informed at the start of their studies about the criteria and methods of assessment and will be assessed on completion of their studies. The learner will receive the results of the assessment and will be able to compare them with the open learning analytics.	Local PARTIALLY	The assessment itself is going well, but there is not yet a consistent way of comparing your own results with learning analytics.	Teacher	Learner	Choice of evaluation methods, implementation of evaluation, reporting of evaluation
Open learning badges	An easy and possibly standardised way of identifying learning gained from teaching open to everyone open education.	Local POORLY	The use of open learning badges s is fragmented and very few organisations have any services available for this purpose.	Research actors, Research and education support service providers	Teacher and Learner	Planning learning badge, learning, recognition of learning, receiving learning badge
		National POORLY	No national learning badge platform (possibly coming in Digivisio).			
		International WELL	International standard for open learning badges exists.			

3.3.2.4 Services for education and educational resources						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Education exports	The service develops and coordinates open education exports. The service includes not only the development of education export but also education export activities.	Local PARTIALLY	Some higher education institutions use open education for education exports, others do not.	Research actors, Research and education support service providers, Open science and research enablers	International research and higher education organisations	Choice of education exports, planning and coordination of education exports, implementation of education exports
		National POORLY	No national plan for open education exports.			
		International POORLY	No significant international open education exports.			
Science education	Teaching and communicating to individuals and society the basic skills of processing researched information, acquiring reliable knowledge, critical thinking and learning, and creating an understanding of the results, functions and significance of the various disciplines.	Local PARTIALLY	Some universities organise a lot of science education, others not so much.	Research actors, Research and education support service providers, Open science and research enablers	Learner	Understanding recommendations of science education, implementation of recommendations of science education
		National PARTIALLY	A national recommendation on science education has been published. Some national actors promoting science education. No national science education plan, portal, etc.			

3.3.2.5 Services for responsible evaluation

This service area includes, in particular, services required for responsible evaluation. Responsible evaluation is characterised by the transparency and integrity of the evaluation work, the equal treatment of those being evaluated, the competence of the evaluators and the diversity of the evaluation criteria.



3.3.2.5 Services for responsible evaluation						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Training of responsible assessment experts	The training will ensure adequate knowledge of responsible evaluation in organisational support services. The training service is aimed at anyone who works or plans to work in the field of responsible assessment support.	Local POORLY	Hardly any training for experts in responsible assessment.	Open science and research enablers, Research and education support service providers	Research and education support service providers,	Creation and maintenance of expert network, planning open science training, defining learning goals, acquisition and creation of educational resources, publication of educational resources, training, assigning learning badges or certificates, recognition of learning
Knowledge base production and support	The service focuses on producing a versatile knowledge base and analytics and on supporting their utilisation. In addition, the knowledge base is refined for further use, and sufficient expertise for utilisation of the information is secured. The service produces information on, for example, applying for and using quality ratings and certificates and supports the utilization of this information.	Local POORLY	Data quality in research information systems is poor from the point of view of responsible assessment. There is no support for qualitative assessment and no systems or models for narrative CVs.	Open science and research enablers	Research actors	Knowledge base planning and developing, knowledge base production, analytics, support for using knowledge base and analytics, development of indicators
		National POORLY	Data quality in the national research information system is poor from the point of view of responsible assessment. There is no support for qualitative assessment and no systems or models for narrative CVs.			
		International POORLY	Ei kansainvälisiä järjestelmiä, jotka palvelisivat vastuullista arviointia.			

3.3.2.5 Services for responsible evaluation						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Assessment criteria and processes support	The service supports peer review of research, teaching, impact and actors. The transparency and responsibility of the review processes and criteria are ensured. The peer reviewer's competence in reviewing is ensured by guidance, communication and training.	National POORLY	National work on developing assessment methods has only just begun.	Research actors, Actors funding and steering research and education	Research actors	Support for authentication of own expertise, support for self-assessment, peer review support, development of indicators
		Local POORLY	Local guidelines exist, and only some research organisations are committed to COARA, which develops methodologies.			
		International PARTIALLY	COARA is committed to developing assessment-methods.			
Research assessment and support	The service enables the description, assessment and presentation of the diversity of research outputs. The service guides you to consider the impact and quality of the research, taking into account discipline-specificity and research cultures. The service offers support and guidance with developing assessment expertise. It offers support for the creation of appropriate and reliable information used in assessment and for the implementation of transparent assessment processes.	National POORLY	At national level, there has been no discussion of research assessment support services.	Open science and research enablers Actors funding and steering research and education	Research actors Research performing organisations	Knowledge of laws and policies, knowledge of recommendations for responsible research assessment, implementation of recommendations for responsible research assessment, knowledge of strategies, cooperation and coordination, application of knowledge base, training and guidelines, implementation of and support for assessment process, analysis and use of results
		Local POORLY	International research assessmentprocess models poorly known.			
		International PARTIALLY	At EU level, there is a clear process and training available for research assessment, but not elsewhere in the world.			

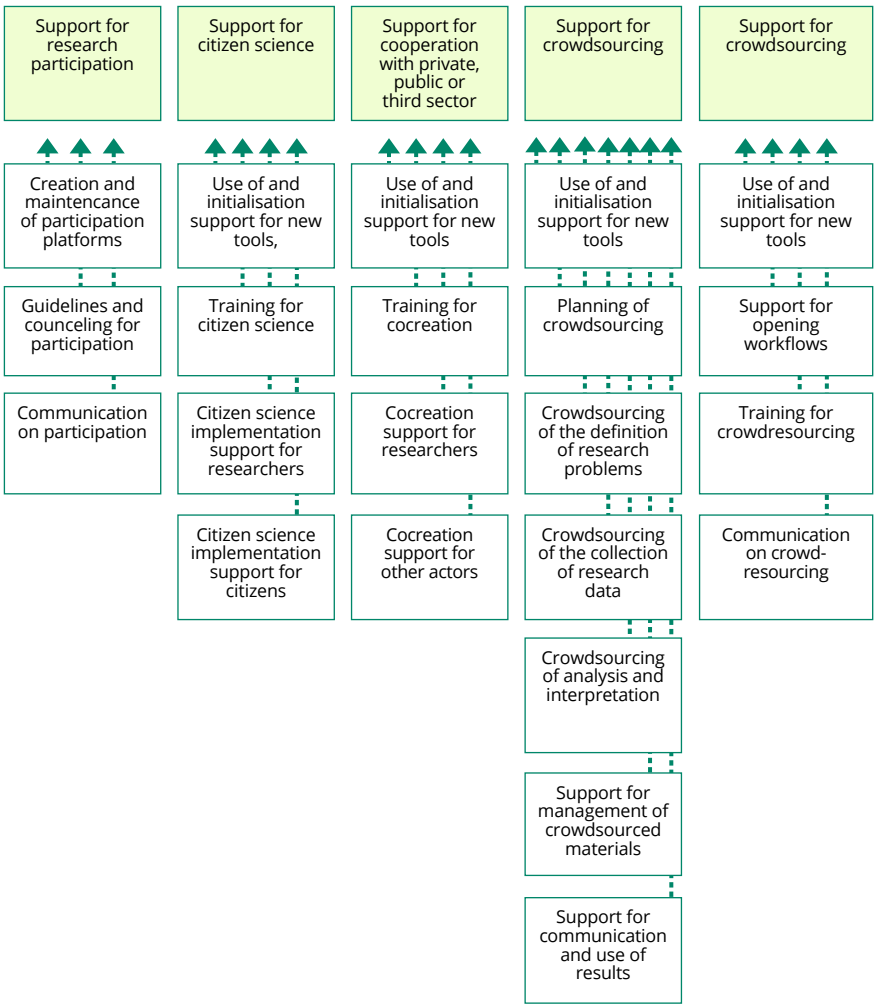
3.3.2.5 Services for responsible evaluation						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Education assessment and support	The service offers support and guidance for developing assessment expertise. It offers support for the creation of appropriate and reliable information used in evaluation and for the implementation of transparent assessment processes. The service produces information on applying for and using quality ratings and certificates and supports the utilization of this information.	National PARTIALLY	Finnish Education Evaluation Centre carries out an assessment of education, but the openness of education has not been taken into account.	Open science and research enablers Actors funding and steering research and education	Research actors Higher education institutions	Knowledge of laws and policies, knowledge of strategies, cooperation and coordination, application of knowledge base, training and guidelines, implementation of and support for assessment process, analysis and use of results
		Local POORLY	Openness has hardly been taken into account in the assessment of education.			
		International PARTIALLY	Some international certifications exist, but the openness of education has not been taken into account.			
Impact assessment and support	Assessment of the societal impact of education and research and its support. Participation in the development and utilisation of new indicators and tools for impact. The service supports and produces information to create interaction with various actors in society.	National POORLY	Not much national work done. There are national recommendations on citizen science, but no recommendations on wider societal impact. There is also a lack of national indicator descriptions.	Open science and research enablers Actors funding and steering research and education	Research actors Research performing actors	Knowledge of laws and policies, knowledge of strategies, cooperation and coordination, application of knowledge base, training and guidelines, implementation of and support for assessment process, analysis and use of results
		Local PARTIALLY	Some support and tools for impact assessment have been developed, but the field is very underdeveloped and practices in different organisations are not comparable.			
		International POORLY	UNESCO's Open Science Recommendation takes account of social impact, but tools and indicators for impact assessment have not been developed.			

3.3.2.5 Services for responsible evaluation						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Researcher assessment and support	In the service, experts with the necessary expertise assess the researcher's work and outputs fairly, diligently and with transparent criteria, and take into account the diversity of the work and outputs in their assessment. In the researcher's assessment, the career stage of the researcher is taken into account.	National POORLY	Development work has been done (e.g. TENK CV model, national recommendation for researcher assessment, FINN-CAM), but tools are still under-developed. Development work is still at an early stage.	Actors funding and steering research and education, Open science and research enablers Research actors	Research actors, Actors funding and steering research and education, Open science and research enablers	Knowledge of laws and policies, knowledge of recommendations for researcher assessment, implementation of recommendations for researcher assessment, implementation of and support for assessment process, analysis and use of results
		Local POORLY	Recruitment processes do not recognise the merits of open science very well.			
		International POORLY	International initiatives exist (e.g. COARA), but development is still in its infancy.			
Career services	Service promotes the renewal of the culture of recognition and rewards. The service creates consistent recruitment principles to support versatile career paths. It supports the participants in the assessment process. The service includes training, guidance and advice on recruitment, merit recognition and incentives for management and HR. The service supports the recognition and rewarding of expertise in open science and supports professional development.	Local POORLY	Career path models exist, but open science or responsible assessment are not well taken into account.	Actors funding and steering research and education, Open science and research enablers	Research actors Research and education support service providers	Knowledge of laws and policies, knowledge of recommendations for researcher assessment, implementation of recommendations for researcher assessment, application of knowledge base, agreement on career paths, contextual definition of recruitment principles, support of participants in assessment process, training for personnel and management
		National PARTIALLY	National career path has been created, but it does not touch much on open science or responsible assessment. FINN-CAM under development.			
		International (e.g. CoARA) PARTIALLY	Individual good career path models exist and a few universities are well advanced, but they are not widespread.			

3.3.2.5 Services for responsible evaluation						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Open science monitoring	The service evaluates and reports on the realisation of the principles and objectives of open science. The monitoring collects information on the state of openness of the Finnish research community. It supports the promotion of openness in organisations.	National PARTIALLY	The Open Science and Research monitoring process for research performing organisations is well developed, but monitoring of the wider research community (e.g. funder-monitoring) is still ongoing.	Federation of Finnish Learned Societies Open science and research enablers	Actors funding and steering research and education, Open science and research enablers, Research and education support service providers Research actors	Knowledge of Open Science and Research policies, knowledge of strategies, application of knowledge base, cooperation and coordination, analysis and use of results, analytics, reporting
		Local POORLY	Organisations only monitor open science in the context of national monitoring.			
		International PARTIALLY	Many monitoring processes exist (e.g. EOSC, EEA), but the field is fragmented and their development is not well integrated at national and local level.			

3.3.2.6 Service area of participatory science

Participatory science is scientific research that involves actors from outside the research community, such as citizen scientists, businesses and third-sector organisations. The service area includes services specifically related to participatory science. In addition, participatory science can take advantage of services such as overarching services or services concerning research data and methods.



3.3.2.6 Service area of participatory science						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Support for research participation	The service supports researchers in using a wide range of tools to involve volunteers in scientific activities, for example as research subjects. It also develops and maintains platforms for volunteers to sign up to help with research.	Local POORLY	Organisations have varying levels of tools and platforms for participation.	Research and education support service providers	Research actors	Creation and maintenance of participation platforms, guidelines and counceling for participation, communication on participation
		National POORLY	There are no common tools or platforms for participation at national level.			
		International PARTIALLY	Some research areas are well served by tools and platforms, others less so.			
Support for citizen science	The service involves and supports citizens in doing citizen science, for example by providing information on funding opportunities, developing citizens' access to citizen science and promoting the impact of citizen science. The service provides training for both citizens and researchers on how to do and use citizen science. It will support researchers in implementing citizen science, for example in recruiting and training participants and in ethical issues related to citizen science.	Local POORLY	There is still very little support for citizen science in research performing organisations.	Research and education support service providers Open science and research enablers Research actors Learned societies	Citizens Research actors	Use of and initialisation support for new tools, training for citizen science, citizen science implementation support for researchers, citizen science implementation support for citizens
		National POORLY	No national support for citizen science. National recommendation exists. National association for citizen science is in the making.			
		International PARTIALLY	Guidelines on citizen science exist. Toolkits and literature on citizen science are readily available.			

3.3.2.6 Service area of participatory science						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Support for cooperation with private, public or third sector	The service involves and supports actors to participate in research and produce research-based knowledge and solutions. It also supports researchers in guiding, facilitating and supporting the cocreation of research. It will provide training for actors and researchers to work together.	Local PARTIALLY	Research performing organisations promote cooperation with private, public and third sector organisations, either within their own departments or as part of their research services. The quality of these services varies from one organisation to another, and different disciplines have different ways of using them.	Research and education support service providers Open science and research enablers Research actors Learned societies	Private sector Public sector Third sector Research actors	Use of and initialisation support for new tools, training for cocreation, cocreation support for researchers, cocreation support for other actors
		National PARTIALLY	National guidelines on business cooperation exists. Some national actors offer support.			
		International PARTIALLY	The UNESCO Open Science Recommendation and EU-level recommendations encourage cooperation with other actors. For example, support for IPR issues of collaboration is available. The issue is so new that the implications are not yet clear.			

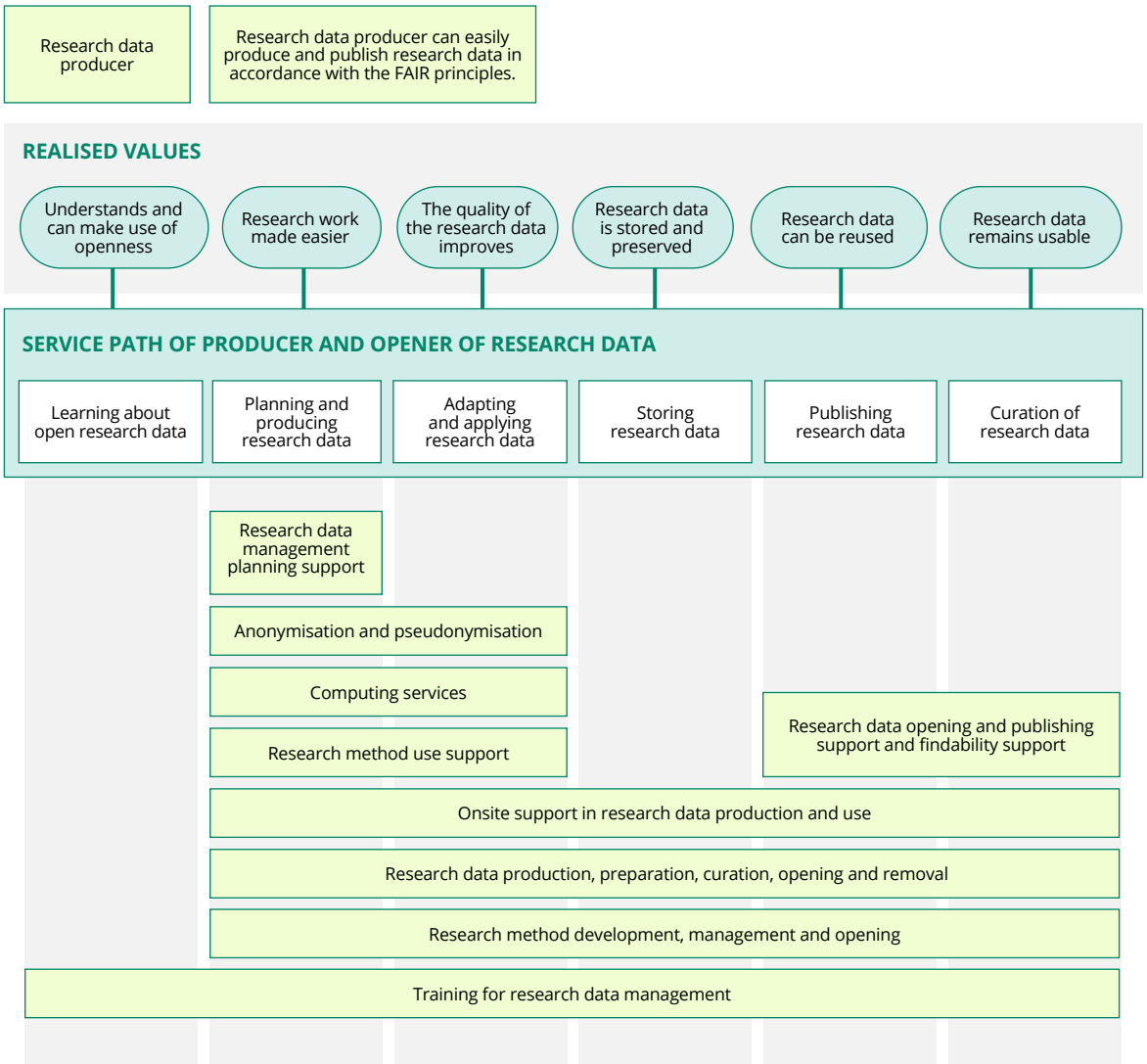
3.3.2.6 Service area of participatory science						
Name of the business service	**Description of the service**	**National/ Local/ International**	**Explanation for the analysis of the status of the service**	**Service provider**	**User**	**Processes**
Support for crowd-sourcing	The service collects research ideas and problems, observations and other research data from citizens and from private, public and third sector organisations, and involves them in the interpretation and analysis of the data. It provides systems for collecting, analysing, storing and preserving the data. It will design, organise and implement crowd-sourcing services. It provides information and notifications on various phenomena and events. The services can be reciprocal: the recipient of the notification can add data to the service.	Local POORLY	Organisations have varying levels of tools and platforms for crowdsourcing.	Research and education support service providers Open science and research enablers Research actors	Research actors	Use of and initialisation support for new tools, planning of crowdsourcing, crowdsourcing of the definition of research problems, crowdsourcing of the collection of research data, crowdsourcing of analysis and interpretationn, support for management of crowdsourced materials, support for communication and use of results
		National POORLY	At national level, there are no common opportunities or tools for crowdsourcing.			
		International PARTIALLY	Some research areas are well served by tools and platforms, others less so.			
Crowdresourcing	The service supports the opening up of research workflows to enable others to provide resources to improve the quality and impact of research. It provides tools to access and provide resources such as funding, skills and manpower for research. Examples of services include Open Aire, Crowdhelix, Ratkaisuja tieteestä.	Local POORLY	It is still unclear how organisations would support the crowdresourcing.	Research and education support service providers Open science and research enablers Learned societies	Research actors Open science users and beneficiaries	use of and initialisation support for new tools, support for opening workflows, training for crowdresourcing, communication on crowdresourcing
		National POORLY	No national services or tools for crowdresourcing.			
		International PARTIALLY	In some research areas, progress in opening up workflows.			

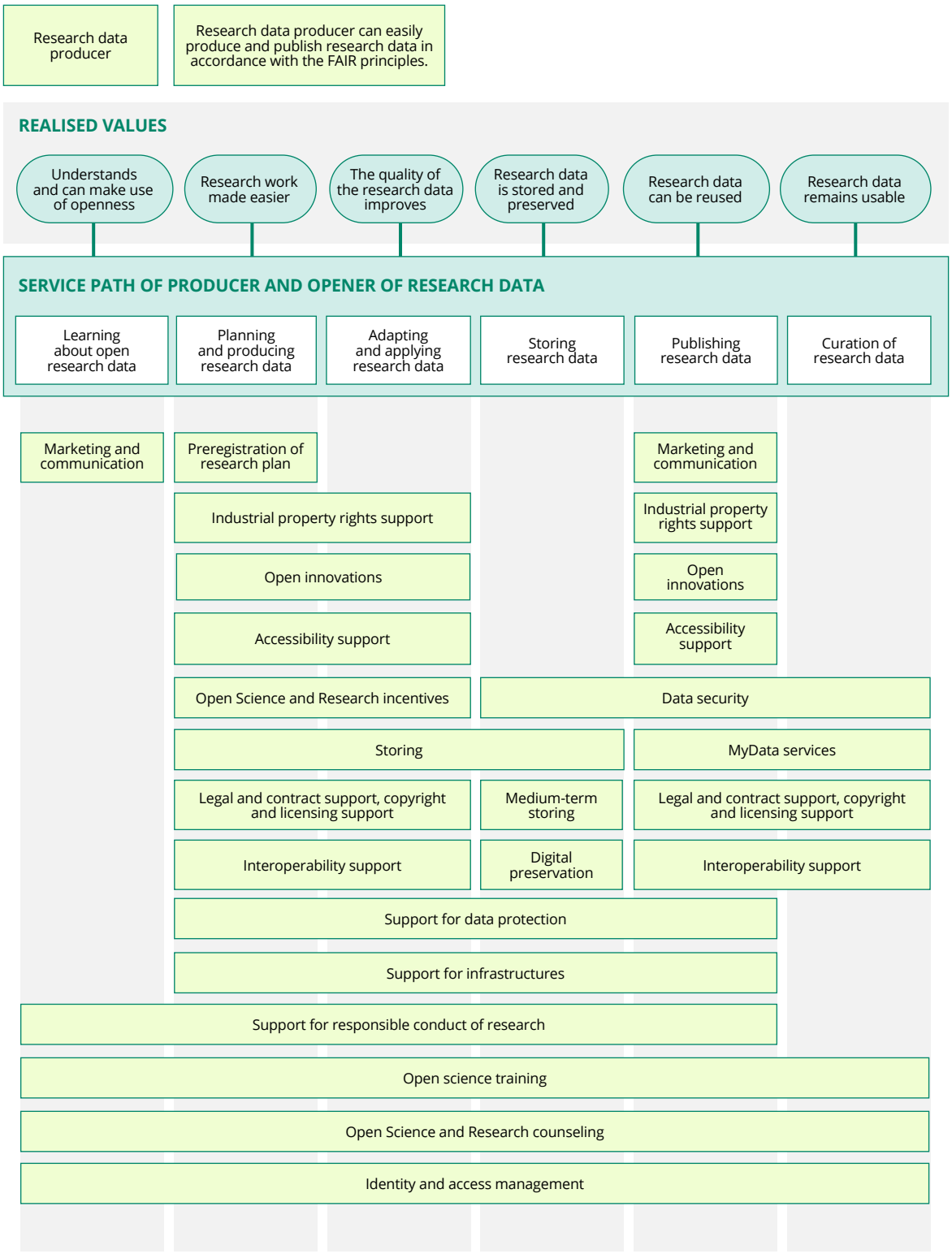
3.3.3 Service paths

As an example of applying the service map to the reference architecture, descriptions of service paths have been created, especially in the areas of research data and education services. The descriptions illustrate which services specific groups of actor utilise at different stages of the service path, what values the actors gain from the services and what type of a value proposition can be attributed to the entire service path. Two separate illustrations have been made for each service path: one highlights the service area's own services, while the other focuses on overarching services or services in the other service areas.

3.3.3.1 Service path of actors who produce and open up research data

A value proposition is made to research data producers and openers that, through the service path, they can easily produce and publish research data in accordance with the FAIR principles.

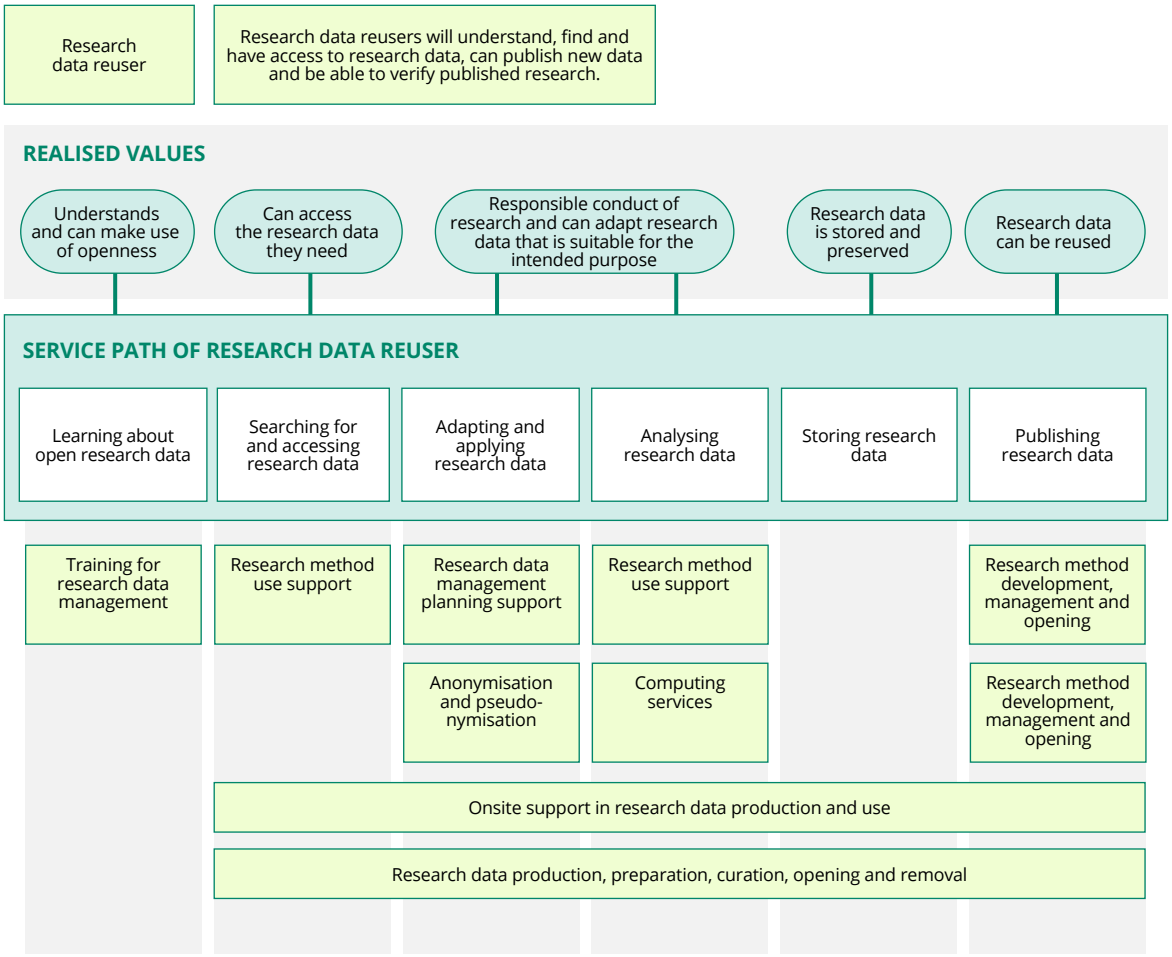


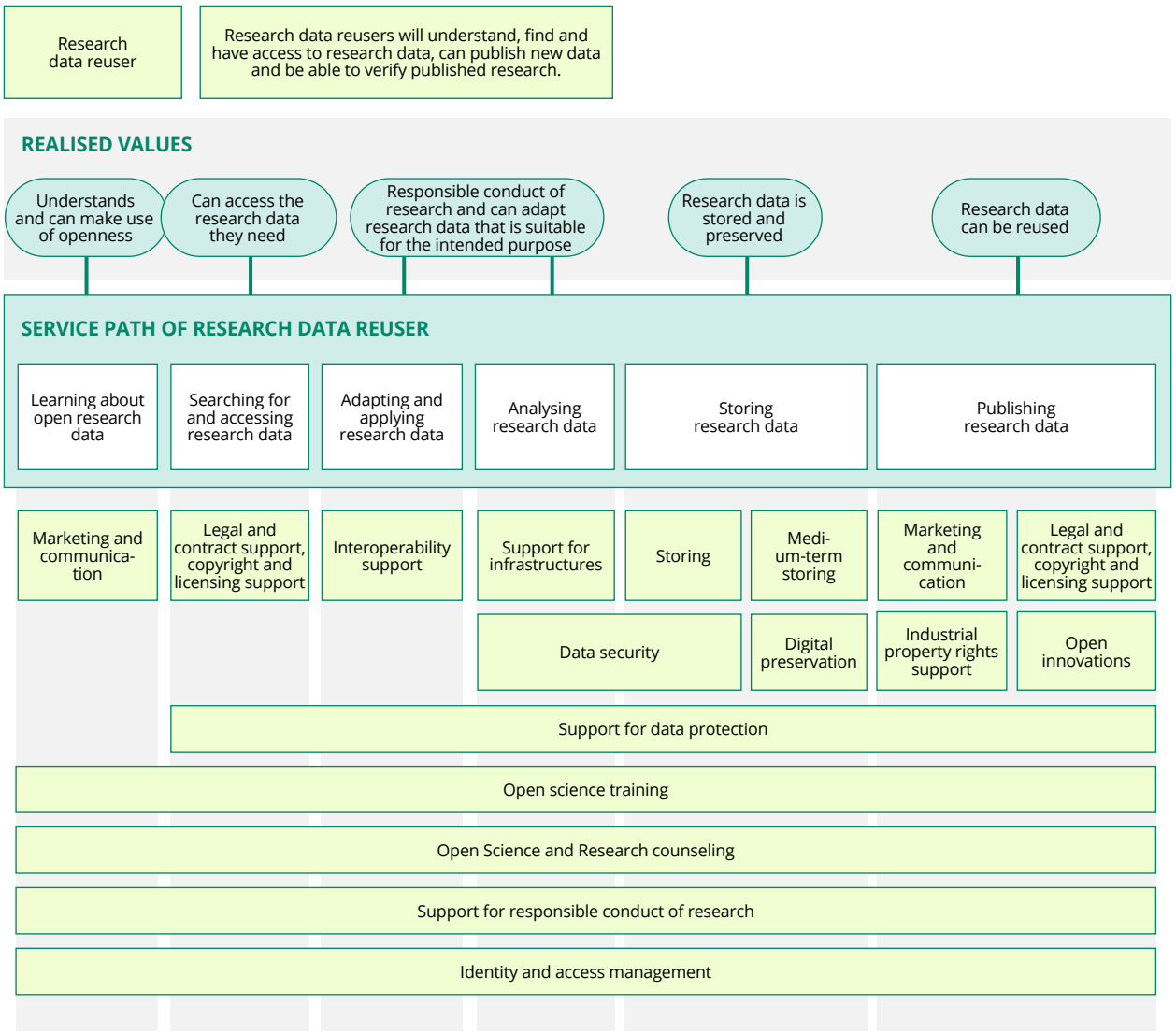

Research data producer
Research data producer can easily produce and publish research data in accordance with the FAIR principles.
REALISED VALUES
Understands and can make use of openness
Research work made easier
The quality of the research data improves
Research data is stored and preserved
Research data can be reused
Research data remains usable
SERVICE PATH OF PRODUCER AND OPENER OF RESEARCH DATA
Learning about open research data
Planning and producing research data
Adapting and applying research data
Storing research data
Publishing research data
Curation of research data
Marketing and communication
Preregistration of research plan
Marketing and communication
Industrial property rights support
Industrial property rights support
Open innovations
Open innovations
Accessibility support
Accessibility support
Open Science and Research incentives
Data security
Storing
MyData services
Legal and contract support, copyright and licensing support
Medium-term storing
Legal and contract support, copyright and licensing support
Interoperability support
Digital preservation
Interoperability support
Support for data protection
Support for infrastructures
Support for responsible conduct of research
Open science training
Open Science and Research counseling
Identity and access management

3.3.3.1 Service path of actors who produce and open up research data			
Point in service pathway	**Realised values**	**Services related particularly to research data and methodst**	**Overarching and other services**
Learning about open research data	The producer and opener of research data understands and can make use of openness.	Training for research data management	Marketing and communication, Support for responsible conduct of research, Open science training, Open Science and Research counseling, Identity and access management
Planning and producing research data	Research work made easier for the producer and opener of the research data,	Research data management planning support, Anonymisation and pseudonymisation, Computing services, Research method use support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal, Research method development, management and opening, Training for research data management	Preregistration of research plan, Industrial property rights support, Open innovations, Accessibility support, Open Science and Research incentives, Storing, Legal and contract support, copyright and licensing support, Interoperability support, Support for data protection, Support for infrastructures, Support for responsible conduct of research, Open science training, Open Science and Research counseling, Identity and access management
Adapting and applying research data	The quality of the producer's and opener's research data improves.	Anonymisation and pseudonymisation, Computing services, Research method use support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal, Research method development, management and opening, Training for research data management	Industrial property rights support, Open innovations, Accessibility support, Open Science and Research incentives, Storing, Legal and contract support, copyright and licensing support, Interoperability support, Support for data protection, Support for infrastructures, Support for responsible conduct of research, Open science training, Open Science and Research counseling, Identity and access management
Storing research data	The producer's and opener's research data is stored and preserved.	Onsite support in research data production and use, Research data production, preparation, curation, opening and removal, Research method development, management and opening, Training for research data management	Data security, Storing, Medium-term storing, Digital preservation, Support for data protection, Support for infrastructures, Support for responsible conduct of research, Open science training, Open Science and Research counseling, Identity and access management

3.3.3.1 Service path of actors who produce and open up research data			
Point in service pathway	**Realised values**	**Services related particularly to research data and methodst**	**Overarching and other services**
Publishing research data	The producer's and opener's research data can be reused.	Research data opening and publishing support and findability support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal, Research method development, management and opening, Training for research data management	Marketing and communication, Industrial property rights support, Open innovations, Accessibility support, Data security, MyData services, Legal and contract support, copyright and licensing support, Interoperability support, Support for data protection, Support for infrastructures, Support for responsible conduct of research, Open science training, Open Science and Research counseling, Identity and access management
Curation of research data	The producer's and opener's research data remains usable.	Research data opening and publishing support and findability support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal, Research method development, management and opening, Training for research data management	Data security, MyData services, Legal and contract support, copyright and licensing support, Interoperability support, Open science training, Open Science and Research counseling, Identity and access management

3.3.3.2 Service path of actors who reuse research data



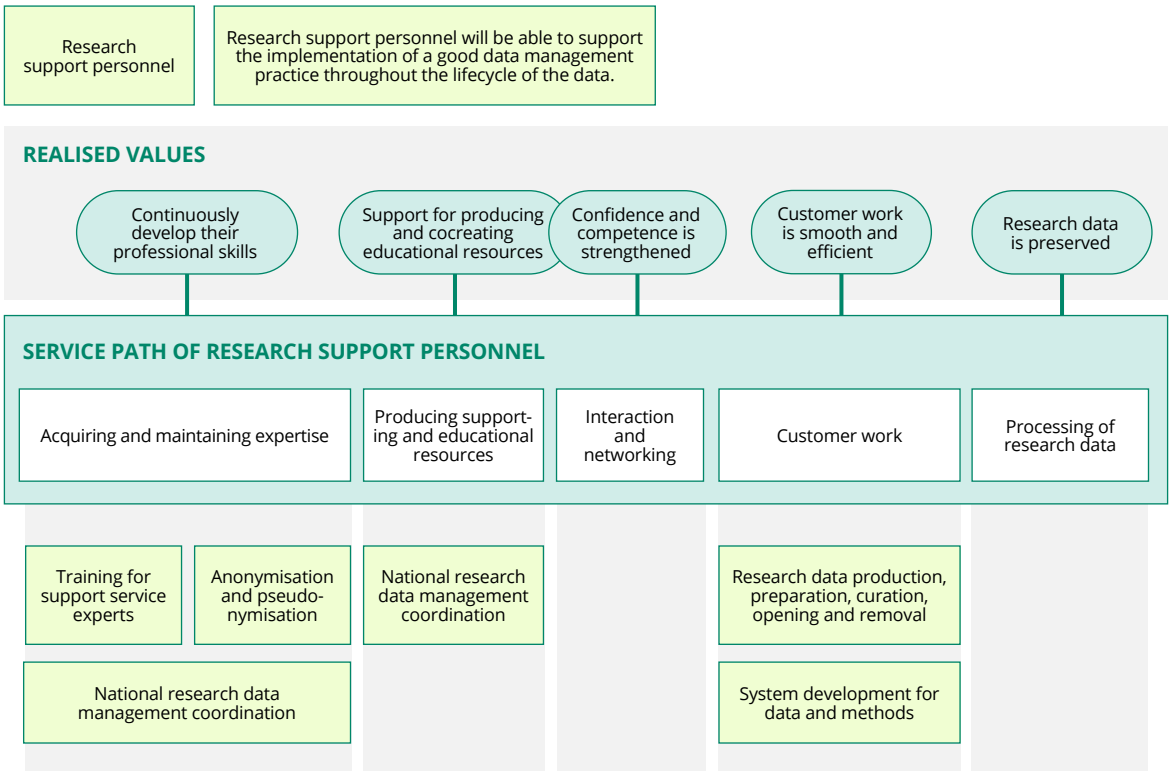


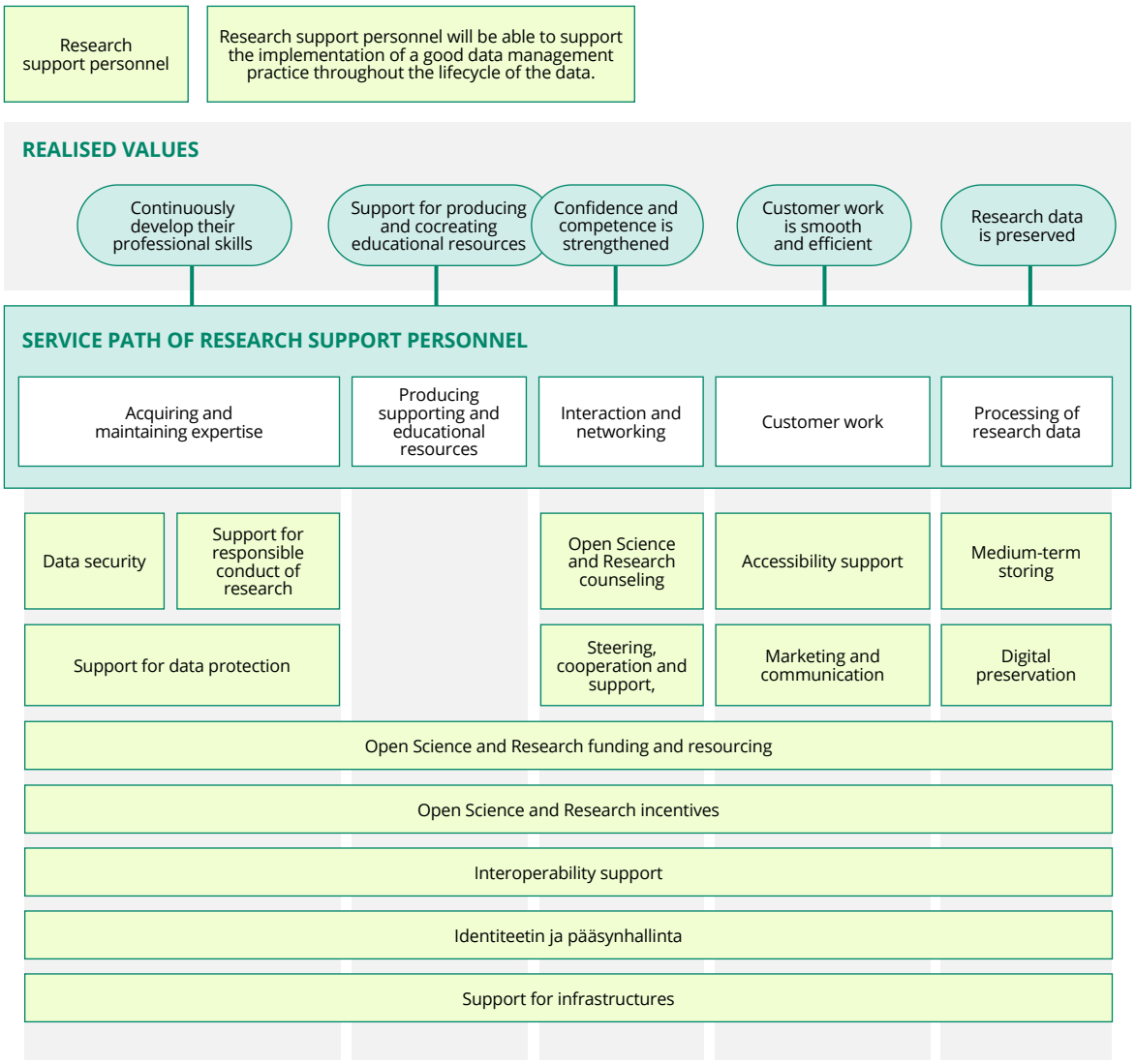
A value proposition is made to research data reusers that they will understand, find and have access to research data, can publish new data and be able to verify published research.

3.3.3.2 Service path of actors who reuse research data			
Point in service pathway	**Realised values**	**Services related particularly to research data and methodst**	**Overarching and other services**
Learning about open research data	Reuser of research data understands and can make use of openness.	Training for research data management	Marketing and communication, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management
Searching for and accessing research data	Reuser can access the research data they need.	Research method use support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal	Legal and contract support, copyright and licensing support, Support for data protection, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management
Adapting and applying research data	The reuser can adapt research data that is suitable for the intended purpose in accordance with the responsible conduct of research.	Research data management planning support, Anonymisation and pseudonymisation, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal	Interoperability support, Support for data protection, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management
Analysing research data	The reuser can adapt research data that is suitable for the intended purpose in accordance with the responsible conduct of research.	Research method use support, Computing services, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal	Support for infrastructures, Data security, Support for data protection, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management
Storing research data	Research data of the reuser is stored and preserved.	Onsite support in research data production and use, Research data production, preparation, curation, opening and removal	Storing, Medium-term storing, Digital preservation, Data security, Support for data protection, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management
Publishing research data	The reuser's research data can be reused.	Research method development, management and opening, Research data opening and publishing support and findability support, Onsite support in research data production and use, Research data production, preparation, curation, opening and removal	Marketing and communication, Legal and contract support, copyright and licensing support, Industrial property rights support, Open innovations, Support for data protection, Open science training, Open Science and Research counseling, Support for responsible conduct of research, Identity and access management

3.3.3.3 Service path of research support personnel

A value proposition is made to research support personnel that they will be able to support the implementation of a good data management practice throughout the lifecycle of the data.

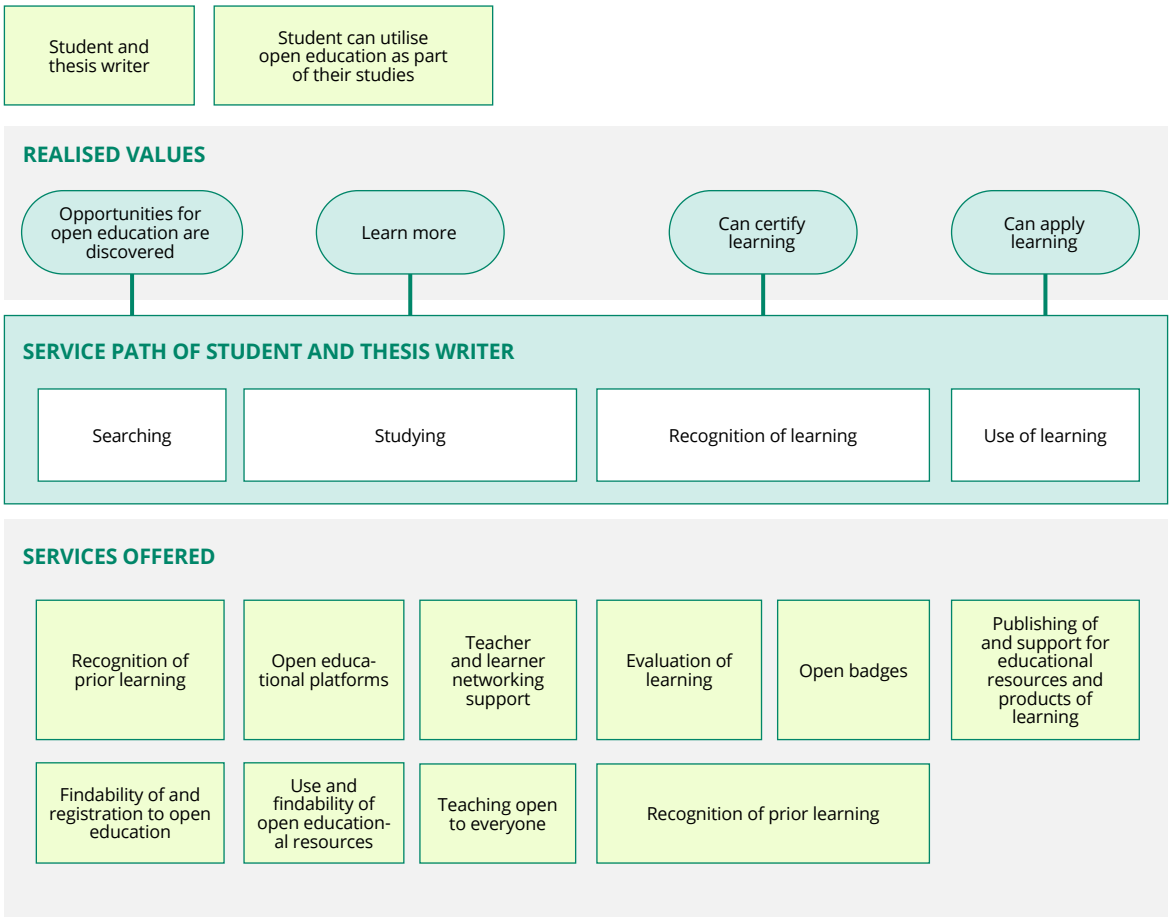


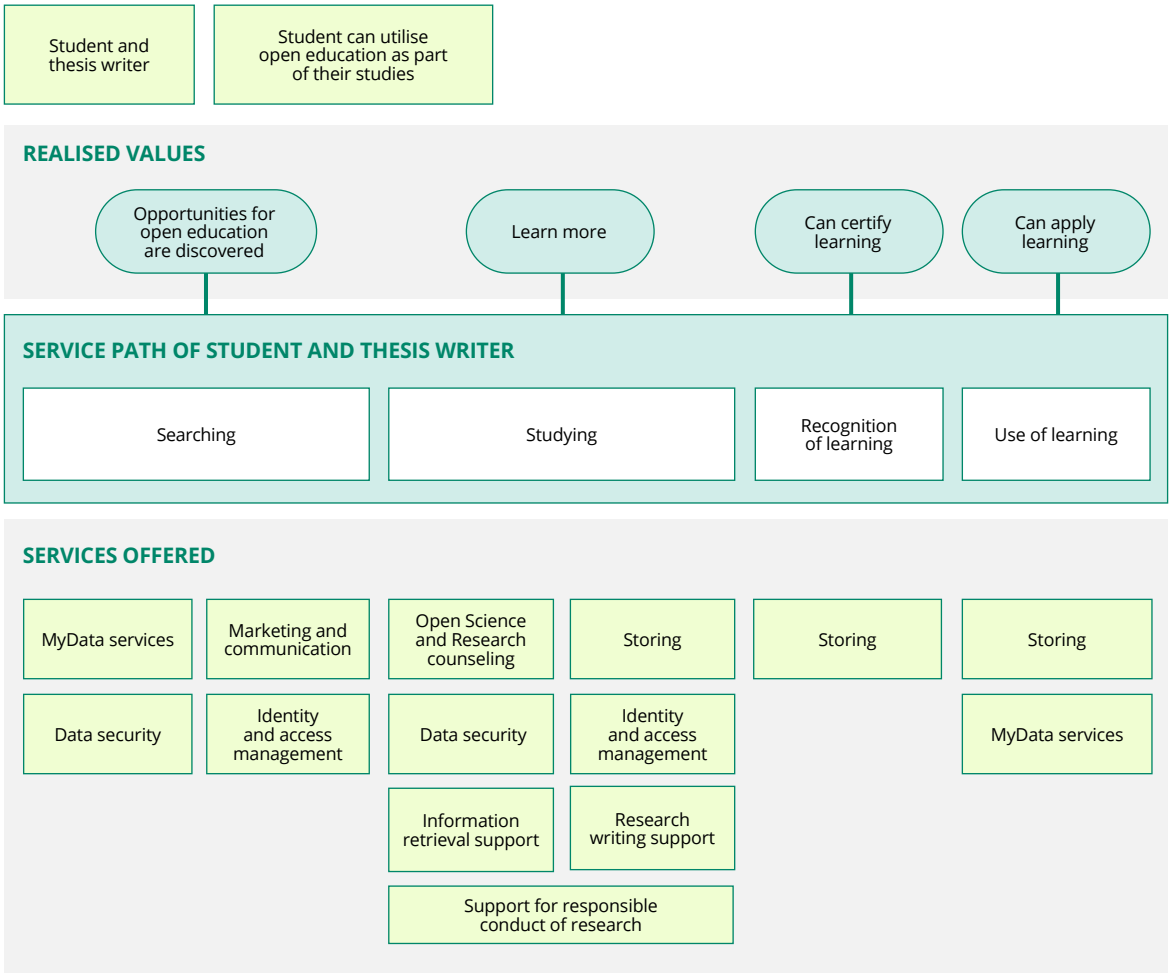

Research support personnel
Research support personnel will be able to support the implementation of a good data management practice throughout the lifecycle of the data.
REALISED VALUES
Continuously develop their professional skills
Support for producing and cocreating educational resources
Confidence and competence is strengthened
Customer work is smooth and efficient
Research data is preserved
SERVICE PATH OF RESEARCH SUPPORT PERSONNEL
Acquiring and maintaining expertise
Producing supporting and educational resources
Interaction and networking
Customer work
Processing of research data
Data security
Support for responsible conduct of research
Open Science and Research counseling
Accessibility support
Medium-term storing
Support for data protection
Steering, cooperation and support,
Marketing and communication
Digital preservation
Open Science and Research funding and resourcing
Open Science and Research incentives
Interoperability support
Identiteetin ja pääsynhallinta
Support for infrastructures

3.3.3.3 Service path of research support personnel			
Point in service pathway	**Realised values**	**Services related particularly to research data and methodst**	**Overarching and other services**
Acquiring and maintaining expertise	Research support personnel continuously develop their professional skills.	Training for support service experts, Anonymisation and pseudonymisation, National research data management coordination	Data security, Support for responsible conduct of research, Support for data protection, Open Science and Research funding and resourcing, Open Science and Research incentives, Interoperability support, Identity and access management, Support for infrastructures
Producing supporting and educational resources	Research support personnel receive support for producing and cocreating educational resources.	National research data management coordination	Open Science and Research funding and resourcing, Open Science and Research incentives, Interoperability support, Identity and access management, Support for infrastructures
Interaction and networking	Confidence and competence of the research support personnel is strengthened.		Open Science and Research counseling, Steering, cooperation and support, Open Science and Research funding and resourcing, Open Science and Research incentives, Interoperability support, Identity and access management, Support for infrastructures
Customer work	The research support personnel's customer work is smooth and efficient	Research data production, preparation, curation, opening and removal, System development for data and methods	Accessibility support, Marketing and communication, Open Science and Research funding and resourcing, Open Science and Research incentives, Interoperability support, Identity and access management, Support for infrastructures
Processing of research data	The research support personnel can ensure that the research material is preserved.		Medium-term storing, Digital preservation, Open Science and Research funding and resourcing, Open Science and Research incentives, Interoperability support, Identity and access management, Support for infrastructures

3.3.3.4 Service path for students and thesis writers

Students and thesis writers are promised that they can utilise open education as part of their studies.



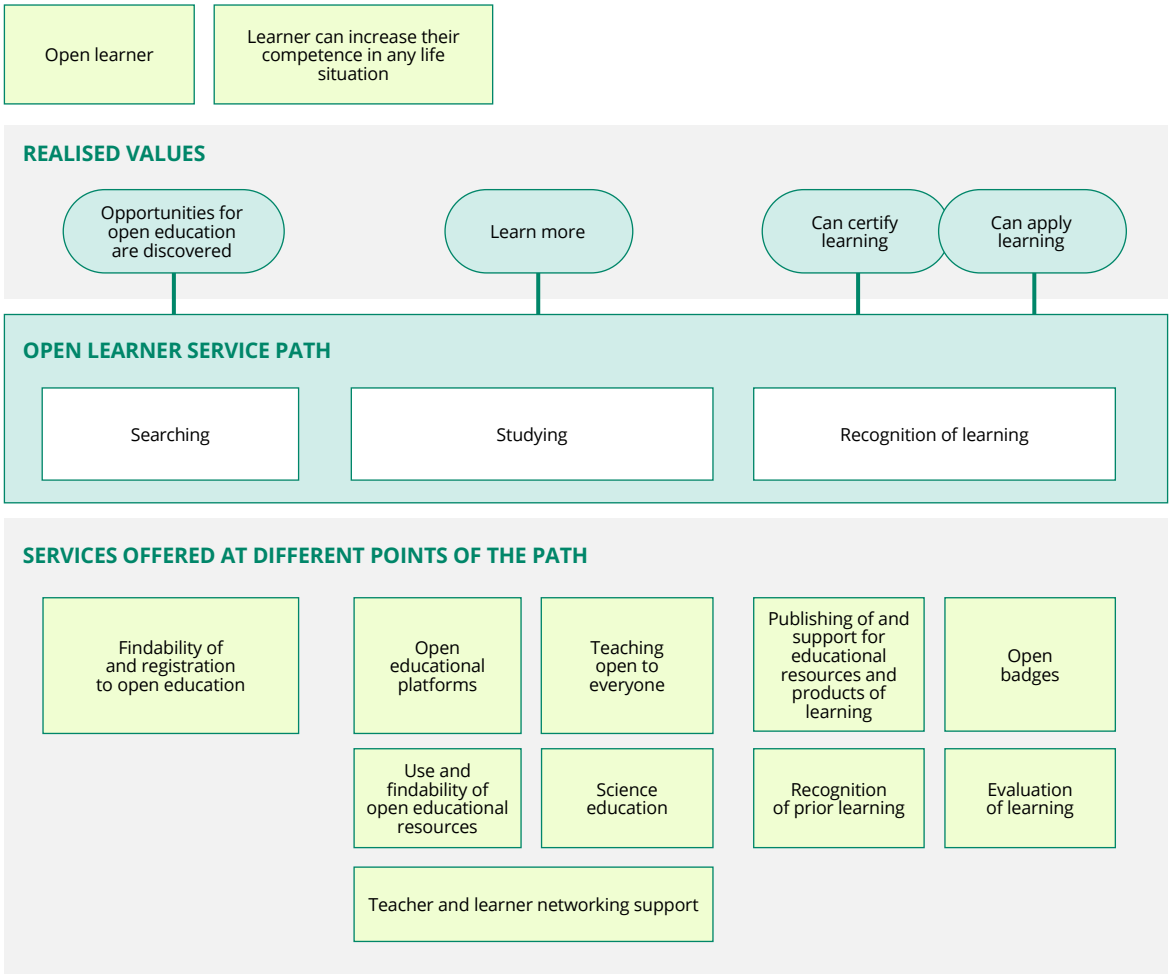


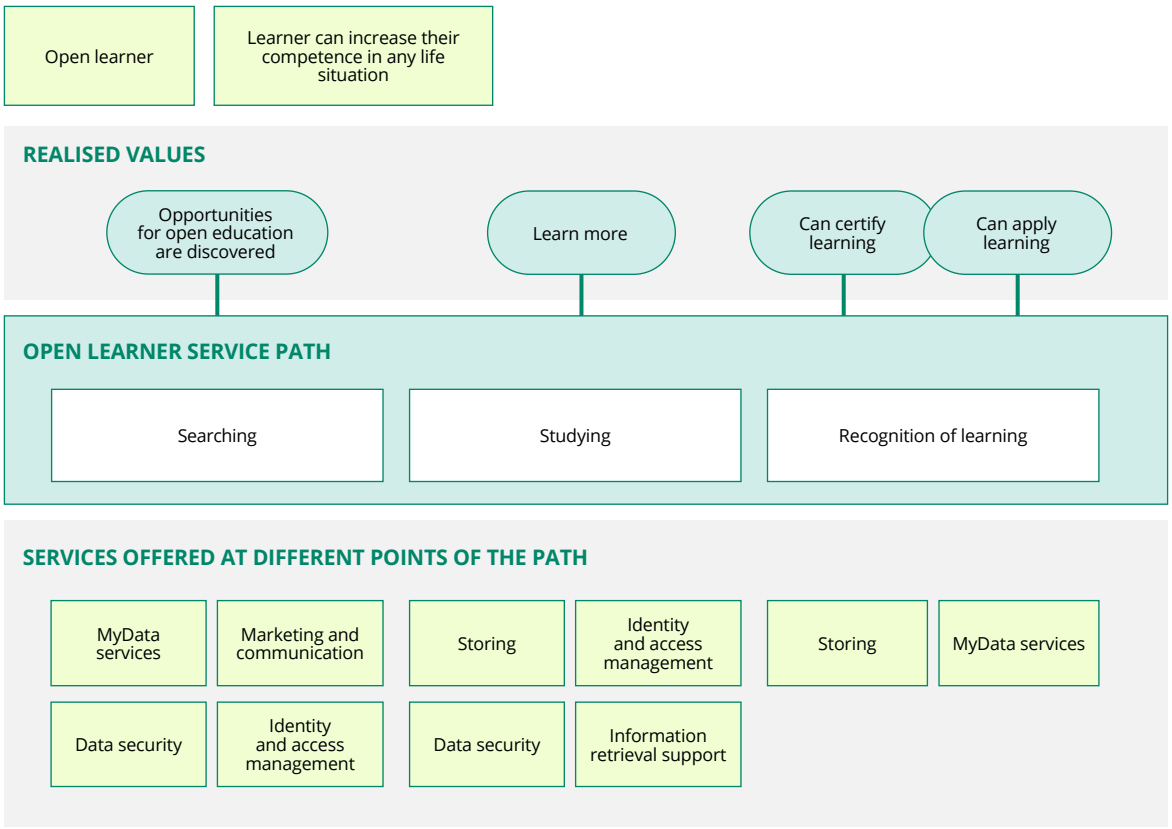
3.3.3.4 Service path for students and thesis writers

Point in service pathway	Realised values	Services related particularly to education and educational resources	Overarching and other services
Searching opportunities for education	Opportunities for open education are discovered by students and thesis writers.	Recognition of prior learning, Findability of and registration to open education	MyData services, Marketing and communication, Data security, Identity and access management
Studying	The student and the thesis writer learn more.	Open educational platforms, Teacher and learner networking support, Use and findability of open educational resources, Teaching open to everyone	Open Science and Research counseling, Storing, Data security, Identity and access management, Information retrieval support, Research writing support, Support for responsible conduct of research
Recognition of learning	The student and the thesis writer can certify their learning.	Evaluation of learning, Open badges, Recognition of prior learning	Storing
Use of learning	The student and the thesis writer can apply their learning.	Publishing of and support for educational resources and products of learning	Storing, MyData services

3.3.3.5 Service path for open learner

An open learner is promised that they can increase their competence in any life situation.



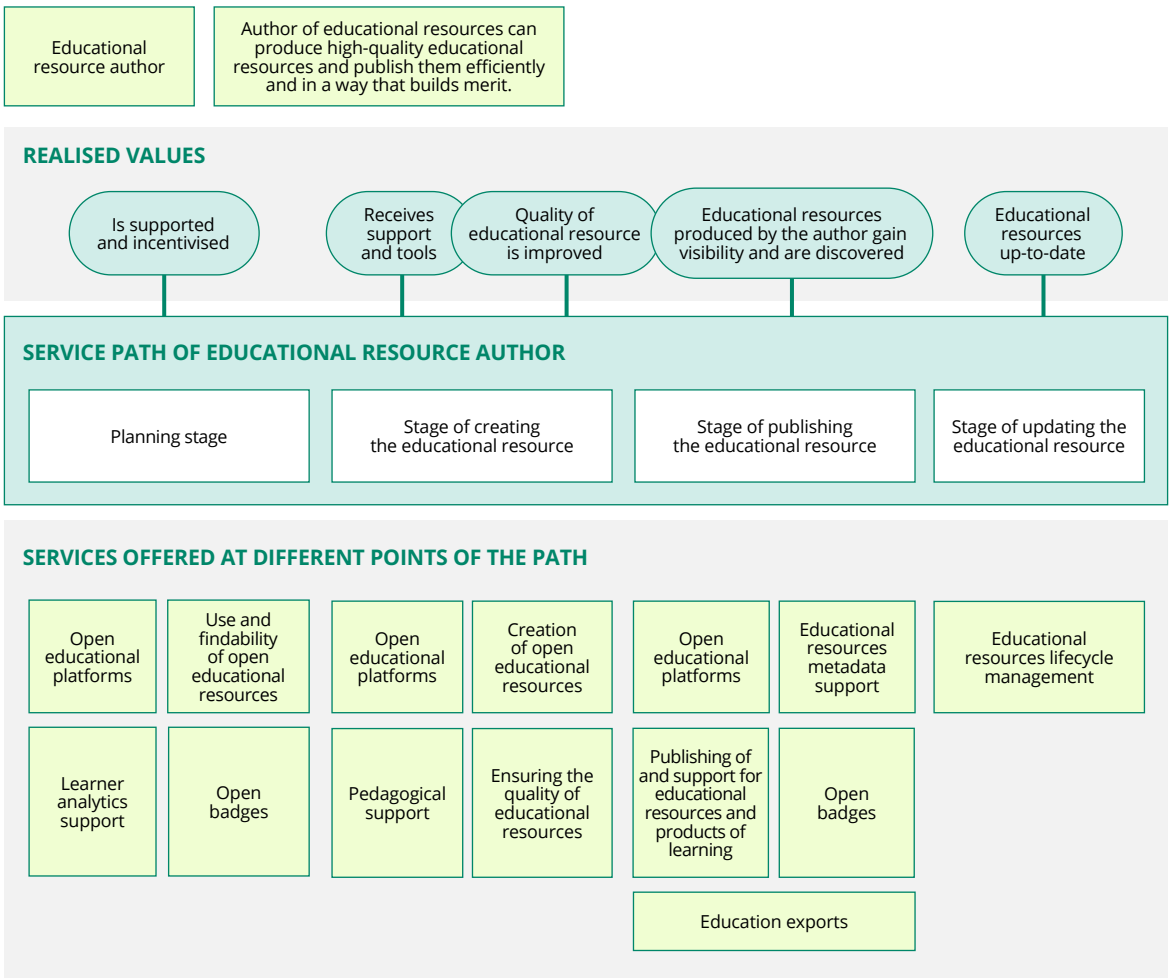


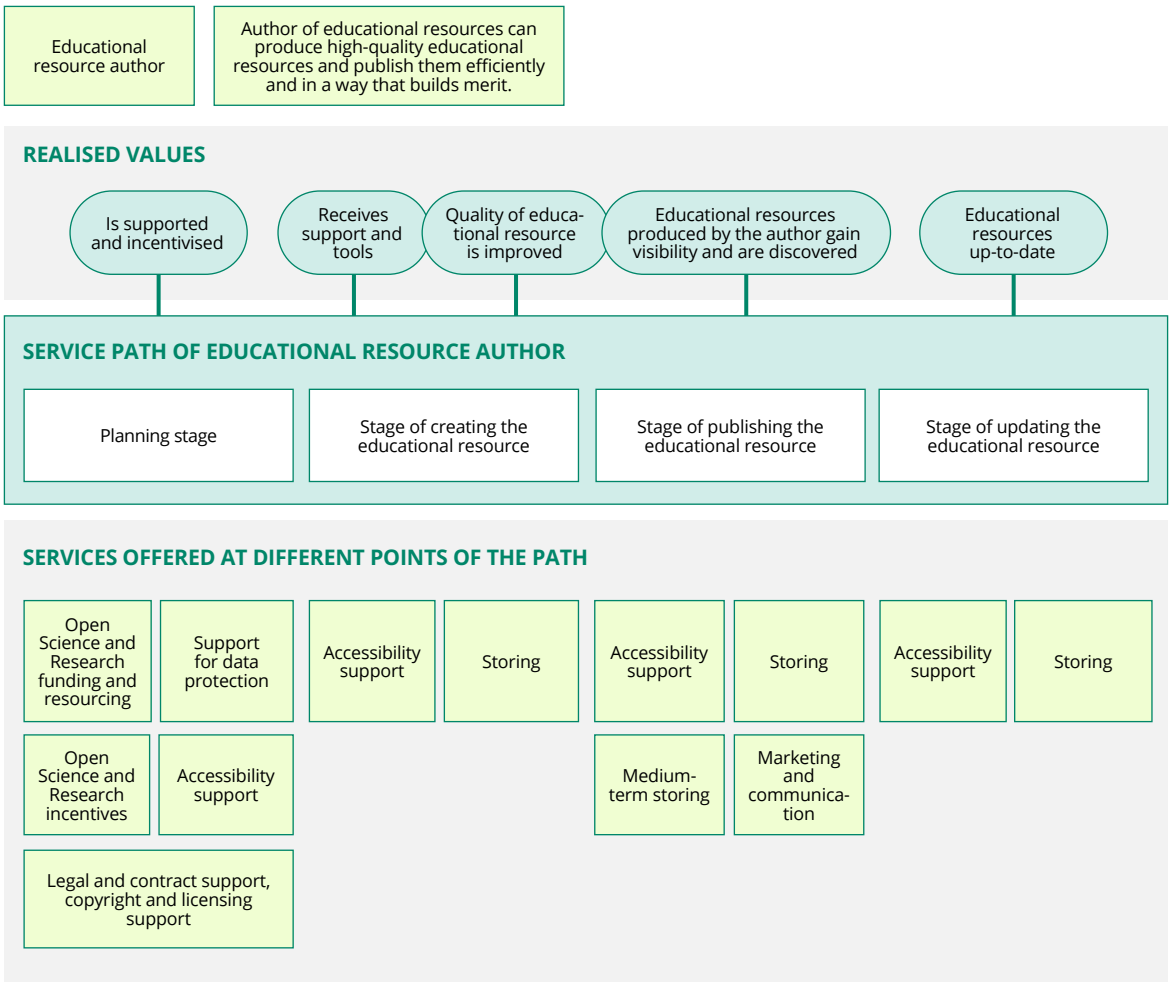
3.3.3.5 Service path for open learner

Point in service pathway	Realised values	Services related particularly to education and educational resources	Overarching and other services
Searching opportunities for education	Opportunities for open education are discovered by the learner.	Findability of and registration to open education	MyData services, Marketing and communication, Data security, Identity and access management
Studying	The learner learns more.	Open educational platforms, Teaching open to everyone, Use and findability of open educational resources, Science education, Teacher and learner networking support	Storing, Identity and access management, Data security, Information retrieval support
Recognition of learning	The learner can certify and apply their learning.	Publishing of and support for educational resources and products of learning, Open badges, Recognition of prior learning, Evaluation of learning	Storing, MyData services

3.3.3.6 Service path for educational resource authors

Authors of educational resources are promised that they can produce high-quality educational resources and publish them efficiently and in a way that builds merit.



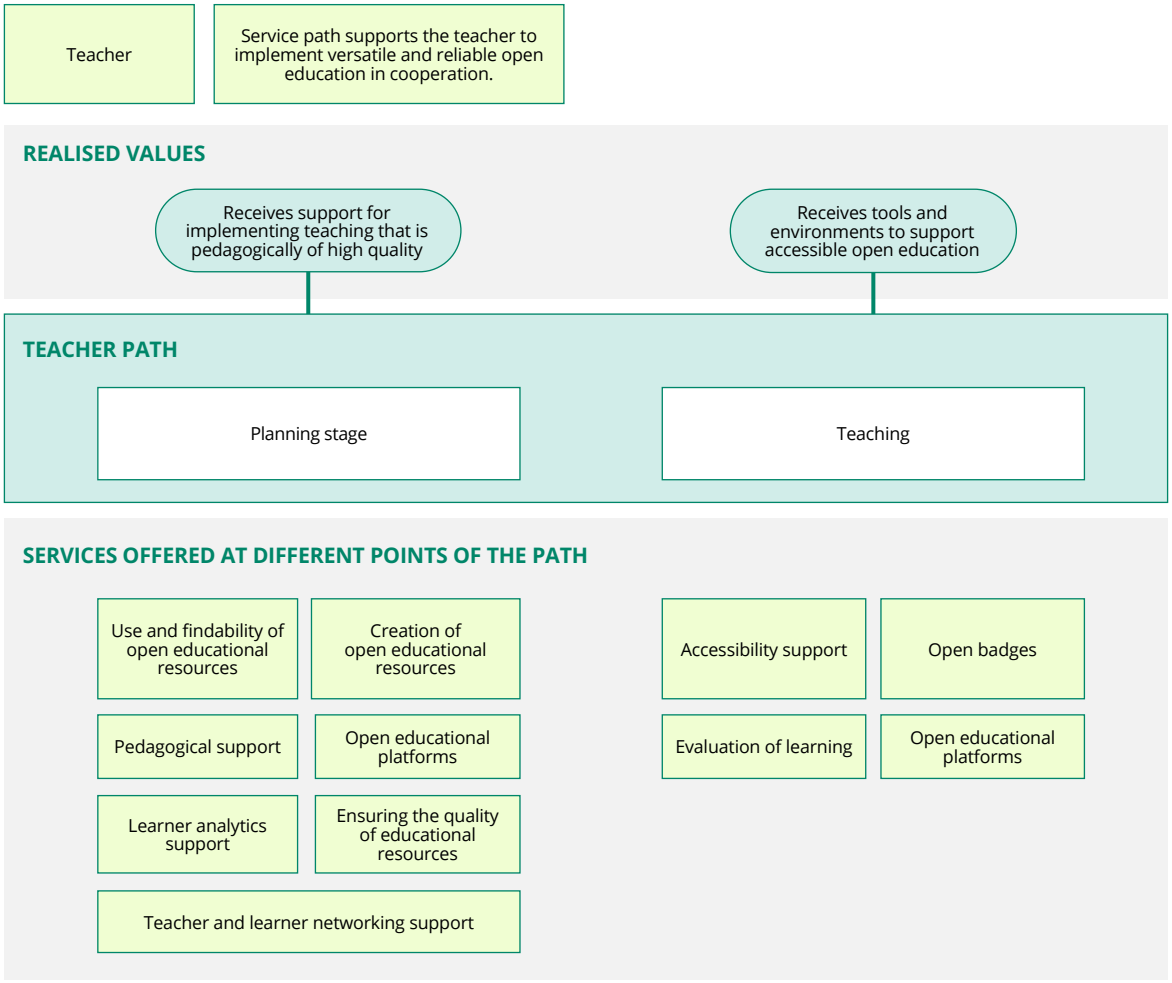


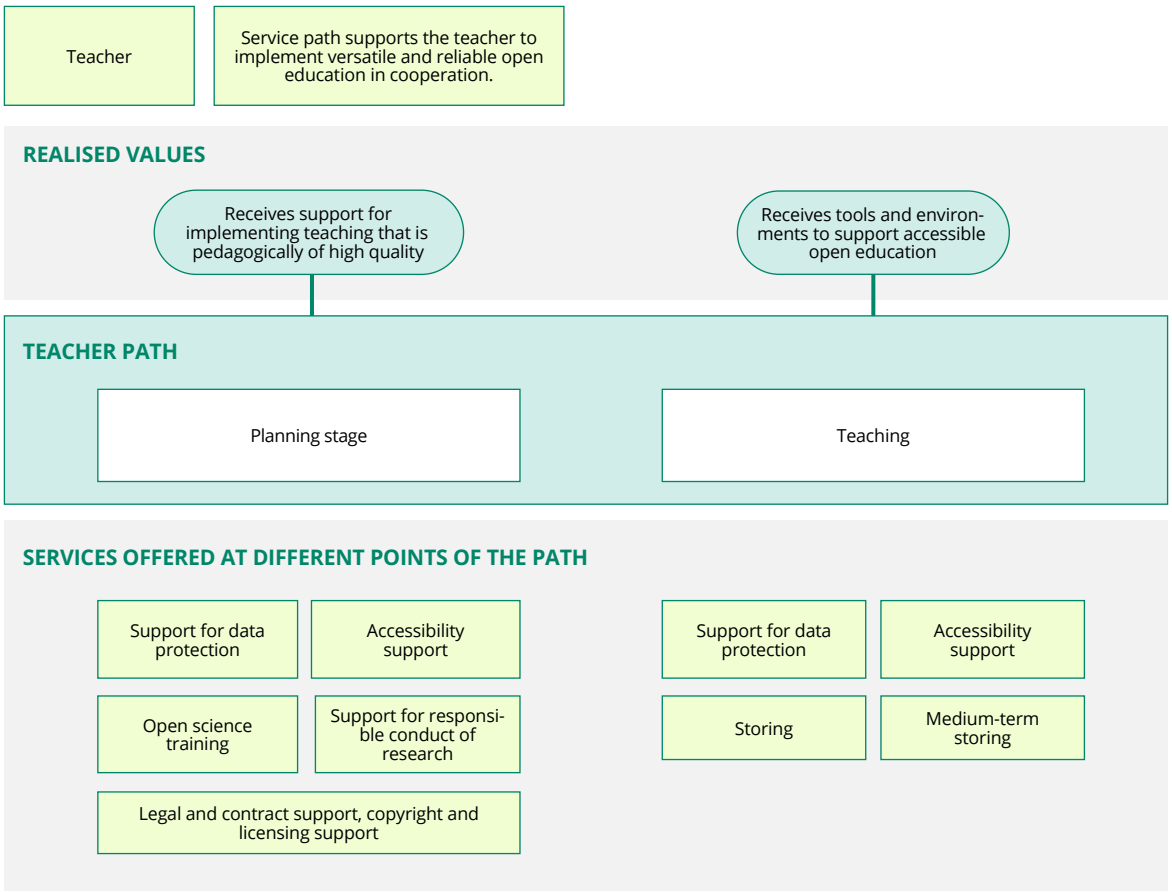
3.3.3.6 Service path for educational resource authors

Point in service pathway	Realised values	Services related particularly to education and educational resources	Overarching and other services
Planning the educational resource	The author of the educational resource is supported and incentivised.	Open educational platforms, Use and findability of open educational resources, Learner analytics support, Open badges	Open Science and Research funding and resourcing, Support for data protection, Open Science and Research incentives, Accessibility support, Legal and contract support, copyright and licensing support
Creating the educational resource	The author of the educational resource receives support and tools and the quality of their educational resource is improved.	Open educational platforms, Creation of open educational resources, Pedagogical support, Ensuring the quality of educational resources	Accessibility support, Storing
Publishing the educational resource	Educational resources produced by the author themselves gain visibility and are discovered.	Open educational platforms, Educational resources metadata support, Publishing of and support for educational resources and products of learning, Open badges, Education exports	Accessibility support, Storing, Medium-term storing, Marketing and communication
Updating the educational resource	Educational resources of the author remain up-to-date.	Educational resources lifecycle management	Accessibility support, Storing

3.3.3.7 Service path for teachers

The teacher is promised that they will be supported to implement versatile and reliable open education in cooperation.





3.3.3.7 Service path for teachers

Point in service pathway	Realised values	Services related particularly to education and educational resources	Overarching and other services
Planning	The teacher receives support for implementing teaching that is pedagogically of high quality.	Use and findability of open educational resources, Creation of open educational resources, Pedagogical support, Open educational platforms, Learner analytics support, Ensuring the quality of educational resources, Teacher and learner networking support	Support for data protection, Accessibility support, Open science training, Support for responsible conduct of research, Legal and contract support, copyright and licensing support
Teaching	The teacher receives tools and environments to support accessible open education.	Pedagogical support, Open badges, Evaluation of learning, Open educational platforms	Support for data protection, Accessibility support, Storing, Medium-term storing

4 GLOSSARIES USED

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

Open Science

Federation of Finnish Learned Societies

tjnk