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OScaR RA: Finnish national reference architecture on open science and research

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Abstract

Finland has decided to implement the national open science and research (OScaR) declaration, policies, and recommendations by using the enterprise architecture (EA) method. The OScaR policies drive the Open science and research field in Finland. Succeeded implementation of these policies is a critical success factor in the Open science and research field. The EA method is a tried, tested, and recognized tool for gaining digital transformation because of its important strategic and operational role in public and private sector organizations and service ecosystems. With the EA tool, OScaR policies and objectives can be described and visualized as strategy, business, information, and application architectures.

EA is a holistic tool for understanding and describing the target area in different abstract layers, views, and viewpoints. It aims to serve and provide beneficial information to all stakeholders, which makes it challenging to manage. For this reason, the chief architect of the project has to be very careful with risk management and into the project have to allocate enough resources to gain an appropriate level of maturity in communication and collaboration capabilities.

EA and EA problems have been studied a lot. However, in the field of open science and research, there are hardly any literature on it and no comparable EA projects in the EU. Thus the OScaR project and its deliverables could be a driver to start a discussion on the need for shared open science and research reference architecture among higher education institutions in the EU.

Keywords: Enterprise architecture, Open science and research, Digital transformation

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1 Introduction

Open science and research is an international movement that promotes the adoption of open approaches to research and science. It promotes collaboration and more inclusive science (Jamali et al., 2020), research data management (Boiko et al., 2022), and provides new data management roles for academic libraries (Kiviluoto & Sinisalo, 2019). Finnish declaration of open science and research 2022-2025 vision statements that OScaR is integrated with researchers' everyday work and that the Finnish research community is a forerunner in this area. The policies of open science and research in Finland include principles, goals, and action plans for gaining the objectives of the declaration. And practical recommendations have been published so far 21. A couple of them are in English. A couple of the recommendations are in English.

Powering the execution of the declaration, policies, and recommendations, the Finnish ministry of education and culture has funded the EA project of reference architecture on open science and research. The two-year EA project (2022-2023) has been facilitated by Secretariat for the National Open Science and Research Coordination. The project involves around a dozen HEIs, research institutions, and public agencies, including more than 30 directors, researchers, architects, and other specialists.

Finnish public administrations and organizations are eagerly gaining public sector digital transformation and realizing accessible human-centric digital services, similar to other European countries (Datta et al., 2020; Scupola & Mergel, 2022; Gabryelczyk, 2020). Digital transformation leads to changes in organizations' business models. And it differs from digitalization in that its aim is not to optimize business services or processes but transform business models (Verhoef et al., 2021).

EA has been studied a lot, and its capacity to achieve digital transformation has been identified (Lamanna & Kurnia, 2022; Niemi & Pekkola, 2020; Korhonen et al., 2017). In this context, EA can be seen as an information management tool that helps to visualize and execute OScaR policies by describing strategy, business, data, and application architectures and connections between them.

Thus, EA is an appropriate tool for definite future state open science and research domain. However, decision-makers, architects, and substance experts struggle with a wide range of EA problems. Communication and collaboration are among common problems that can be seen as even root causes of other EA problems (Banaeianjahromi & Smolander, 2019; Rouvari & Pekkola, 2023). Therefore researchers have to find different proposes to deal with them (Jusuf & Kurnia, 2017; Seppänen, 2014; Dang & Pekkola, 2017).

This project has been resourced to communication and collaboration between the stakeholders. People with different roles have joined hands-on working groups and workshops, and a dedicated communication team has been established.

There are relatively few reference architecture projects in the open science and research field. In Finland, has been published earlier version reference architecture on OScaR 2016, which is out of date and only in Finnish.

Thus, the deliverables of the OScaR project could be a starting point EU level reference architecture collaboration on open science and research domain. And the main deliverables of the project are 1) strategic, 2) business, 3) information architecture definitions, and 4) implementation that includes an executive summary, development work packages, and roadmaps. Besides these, there may be some EA artifacts definitions of application and technology architecture if needed. The paper is organized as follows. The first is a deeper description of the deliverables of the project. This is followed by a discussion and findings section, and the article ends with conclusions.

2 Deliverables of the project

This section has described the project OScaR EA domains, including the most appropriate EA artifacts.

2.1 Governance-level EA artifacts

The project OScaR uses a Finnish national EA framework, JHS 179 which is based on the international de facto EA standard Open Group TOGAF. The Open Group Archimate 3.2 notation language and QPR EA modeling tool and repository are used for creating, storing, and sharing the EA diagrams. Besides these, the architecture definition is open to the world on the wiki repository. This EA domain also includes the architecture vision, metamodel, and governance model for the OScaR EA: 1) the architecture vision is a list of EA artifacts that are aiming to provide, 2) the metamodel describes the structure and used elements and connectors of the architecture and 3) the governance model is management model for the OScaR EA. The governance model is under construction.

2.2 Strategic architecture i.e. principle-level domain

This chapter describes the essential EA artifacts of the principle domain and their roles. The principle domain is the most relevant EA domain because its role is to steer the other architecture domains. It is the contextual-level description of the EA.

EA artifact	Role and meaning	Description
Scope	Temporal and functional delimitation of the EA project	2028
EA principles	To be followed basic principles for the EA work	17 principles grouped by the EA domains
Legislation	Described how to take into account	13 identified EU and national acts
Related EAs	Architectures that have an impact and are taken into account in the OScaR EA	21 identified national and international related EAs plus all Finnish EAs of the HEIs and research institutes
Strategy	The main steering strategic document	The Declaration for Open Science and Research 2020- 25 presents a common vision for the Finnish research community. International strategies have also been taken into account.
Strategic goals	Objectives	Four main policies including 8 sub-policies some in progress
Strategic outcomes	Realizing strategic goals	22 outcomes
Courses of actions	Represents an approach or plan undertaken to achieve a goal	36 courses of action

Capabilities	Abilities needed to achieve strategic goals	56 capabilities, grouped into strategic, core, operative, supporting, and governance capabilities
Resources	Needed asset as competence, processes, data, and information systems needed to build the capabilities	159 identified resource components
Business model	A description of what the OScaR ecosystem does and what services it provides in line with its value proposition	Not yet done. Could be done by using a business model canvas

Table 1: Strategic architecture artifacts

2.3 Business architecture domain

This chapter describes the most relevant business architecture domain EA artifacts and their roles. The business architecture domain is the second most important, after the strategy domain, because it describes our target area's business.

EA artifact	Role and meaning	Description
Actors	The main stakeholders and their roles, thus to know who provides services to whom to use them	The actors are grouped into seven categories based on their roles: 1) steering and funding, 2) enablers, 3) right owners, 4) right holders 5) researchers, 6) users of open science, and 7) providers of support services
Actor integration diagrams	To describe the main interactions between the key stakeholders: 1) contract associations, 2) payment flows, 3) information flows, and product flows	Five different diagrams: 1) interactions between the main roles; 2) contractual relations between right owners, right holders, and users; 3) contracts related to the publications 4) Contracts related to the production of research data; and 5) contracts for the production of learning materials
Business services	Business services are provided by OScaR actors to meet users' needs.	75 described business services grouped into six service areas: 1) Overarching, 2) Publication, 3) Research data and methodologies 4) Learning and learning materials 5) Responsible assessing, and 6) Citizen science
Business processes	A business process represents a sequence of actions of different actors that realize a business service	Identified but not yet described
Business service chains	To enable user-centric service- and value-chains	Creating interoperable business services in cooperation beyond organizations' and administrative branches. Not yet done

Table 2: Business architecture artifacts

2.4 Information architecture domain

This chapter describes the essential information architecture domain EA artifacts and their roles. Usually, the information architecture domain is excluded in the reference architecture definition, but

this project data, especially research data, is at the center, so the information architecture definition is necessary. These EA artifacts have not yet been defined because the project is in progress.

EA artifact	Role and meaning	Description
Terminologies	Common concepts to ensure semantic interoperability	Research management vocabulary Education and training vocabulary Open science vocabulary (to be updated)
Conceptual models	To describe and visualize concepts and the relationships between them	Research data and metadata conceptual models (not yet done)
Data models	To ensure technical interoperability	To be done where necessary

Table 3: Information architecture EA artifacts

2.5 Application architecture domain

It is not yet decided does the application architecture definition will be done. However, there may be some needed EA artifacts in the architecture domain, likewise logical interfaces between application components because they enable technical interoperability in the open science field. Usually, application and technology architecture domains have not been defined in these kinds of national reference architectures.

2.6 Implementation of the OScaR reference architecture

The implementation of the architecture is a crucial part of project OScaR, if it fails, our community will not achieve the main objectives of the architecture work, and the use of the architecture will be under-utilized.

EA artifact	Role and meaning	Description
Executive summary	To underline key courses of action	The summary of the prioritized course of actions and recommendations on how they could be implemented
Visualizations	To improve communication and understanding	Standardized ArchiMate notation may be hard to understand for non-architects. Easy-to-use visualizations ensure the usability of the architecture for decision-makers.
Guidance	OScaR RA user manual	To ensure different user groups can use the OScaR reference architecture
Communication	Communication and collaboration with stakeholders	The OScaR RA communication group has been established to ensure communication and collaboration during the architecture definition and deployment phases

Table 4: Implementation artifacts

3 Discussion and findings

The challenge with broad reference architectures such as this one is that the field they describe is steered by several national and international strategies. So the architecture usually has to manage several

strategy maps, which may even have conflicting objectives. In this case, we have been fortunate in that Finland has a good and up-to-date Declaration on Open Science and the policies and guidelines guiding its implementation, which makes it easy to define the reference architecture.

Another important issue at the architecture principle level is the scope of the architecture. We made scoping in the early stages of the work, and we probably were too optimistic. The scope of the work must be carefully defined, avoiding overestimating the human, time, and skills resources involved.

Thirdly, the identification of related architectures helps to avoid overlapping work. In Finland alone, the research sector has three related architectures Oscar, scientific computing, and research data reference architectures. They need to be interoperable to create a coherent whole of the area being managed.

Finnish higher education institutions, among other European countries, have started to use a business capability model by The Higher Education Reference Model (HERM). Project OScaR decided not to use The HERM capability model because our viewpoint slightly differs from HEIs', and research institutions are included in the OScaR community or ecosystem. However, after the OScaR capabilities have been identified they will be mapped and harmonized with the HERM capabilities for semantic interoperability.

In the business architecture domain of OScaR RA, a defining feature is that the community is large, and the project has identified many actors grouped into seven main role categories. That leads to a cautious approach to their needs and aspirations.

Another defining feature of the OScaR domain is the need to describe contractual license and ownership relations between right owners, right holders, researchers, and users from different perspectives as publishing and producing research data and producing learning materials.

Defining the realization of business services has proved to be a particular challenge: because the identified open science domain business services can be either local, national, or international, and quite many of them may be all of them at the same time. Thus, decision-makers need to define the execution way of the business services and identify the service providers.

In general, the critical success factors identified in previous public administrations' EA projects (Rouvari & Pekkola, 2023) also apply here. Such as communication and collaboration is the root cause of problems in EA work and need special attention (Banaeianjahromi & Smolander, 2019). The struggle with understanding the used architecture notation language is another common issue that has not been solved. However, the enterprise architecture method seems to be the most promising mean to gain digital transformation in public administration.

4 Conclusion

The OScaR reference architecture visualizes and implements Finnish national and open science and research declaration, policies, and recommendations. And they are based on international Open science strategies and policies. Thus, the OScaR RA definition could be a starting point or based on which a project could be launched to implement a European reference architecture on open science and research. Reference architecture communication and collaboration is a way to realize interoperable Open science and research infrastructures.

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