D5.2: EOSC Service Portfolio

Author(s)	Sergio Andreozzi (EGI), Axel Berg (SURFsara), Jan Bot (SURFsara), Ian Collier (STFC), Bas Cordewener (JISC), Sy Holsinger (EGI), Nuno Ferreira (SURFsara), Kostas Koumantaros (GRNET), Karl Meyer (GEANT), Dario Vianello (EMBL)
Status	Final
Version	v1.0
Date	04/01/2018

Dissemination Level

X	PU: Public
	PP: Restricted to other programme participants (including the Commission)
	RE: Restricted to a group specified by the consortium (including the Commission)
	CO: Confidential, only for members of the consortium (including the Commission)

Abstract:

This document outlines an initial draft framework for Service Portfolio Management for the EOSC. This will form the basis of further discussion with various EOSC stakeholders.

In this document, we describe the current landscape of Research IT services, give examples of service portfolio management in a number of communities and provide a first sketch on how service portfolio management can be implemented for the EOSC.

The European Open Science Cloud for Research pilot project (EOSCpilot) is funded by the European Commission, DG Research & Innovation under contract no. 739563

Document identifier: EOSCpilot -5-D5.2	
Deliverable lead	**SURFsara**
Related work package	**WP5**
Author(s)	Sergio Andreozzi (EGI), Axel Berg (SURFsara), Jan Bot (SURFsara), Ian Collier (STFC), Bas Cordewener (JISC), Sy Holsinger (EGI), Nuno Ferreira (SURFsara), Kostas Koumantaros (GRNET), Karl Meyer (GEANT), Dario Vianello (EMBL)
Contributor(s)	Donatella Castelli (CNR), Leonardo Candela (CNR), Damien Lecarpentier (CSC), Matthew Viljoen (EGI), Jos van Wezel (SURFsara), Tiziana Ferrari (EGI).
Due date	**31/12/2017**
Actual submission date	**15/01/2018**
Reviewed by	Michelle Williams (GEANT), Mauro Campanella (GARR), Sune Rastad Bahn (ESS ERIC), Marco Molinaro (INAF), Massimo Cocco (INGV), Keith Jeffery (NERC), Vincent Breton (CNRS)
Approved by	**Brian Matthews (STFC)**
Start date of Project	**01/01/2017**
Duration	**24 months**

Versioning and contribution history

Version	Date	Authors	Notes
0.5	04/12/2017	Sergio Andreozzi (EGI), Axel Berg (SURFsara), Jan Bot (SURFsara), Bas Cordewener (JISC), Sy Holsinger (EGI), Nuno Ferreira, Kostas Koumantaros, Karl Meyer, Dario Vianello (EMBL)	Version for internal review.
0.7	17/12/2017	Jan Bot (SURFsara), Bas Cordewener (JISC)	Adjusted text based on comments from internal review. This version was made available for external review.
1.0	08/01/2018	Jan Bot (SURFsara) , Ian Collier (STFC)	Adjusted text based on external review. Added WLCG text.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This document represents the work done by WP5.2 in the first year of the EOSCpilot project. It presents an analysis of the service landscape in Europe, the service portfolio management methodologies employed by a number of e-infrastructure providers and puts forward a proposal of how service portfolio management can be accomplished in the EOSC. This work is an intermediary result and aims to facilitate discussion on what EOSC aims to be and the methodology to get there.

The service landscape in Europe is diverse, with e-infrastructures being provided by a broad range of stakeholders, from local ICT groups in research institutes to pan-European research projects. What they deliver varies, some provide tailor made community specific services while others provide components that can be combined to create new functionality. Some providers, like e.g. the Research Infrastructures, deliver both kinds of services. Bringing these stakeholders together and putting them under a single umbrella is the main objective of this task. This can only be done in a transparent and open manner, whilst trying to abstract away some of the complexities.

Multiple, well established, methodologies exist to do service portfolio management with and these are successfully being used by a variety of service providers. The lightweight implementation of FitSM seems to be taken up by various groups. However, many of the service providers have not adopted a formal methodology but have instead defined their own processes and procedures, which seem to provide similar results. The proposed EOSC portfolio management process therefore puts no requirements on how this is implemented by the provider but assumes the provider takes care of this internally.

The service portfolio management process proposed here is kept as lightweight as possible, putting most of the control in the hands of resource providers. The process separates entering the portfolio & catalogue from establishing service quality. This ensures early exposure of services that are still in development while also allowing more mature services to showcase their quality. Quality of a service is investigated upon request of the service provider and can be established by two types of metrics, those that apply to most EOSC services and those that are only of use for specific scientific domains. The metrics rely, where available, on established quality indicators such as ISO certificates, as not to make EOSC a certification bureau. Directly observable traits, like e.g. uptime, could be monitored, and subsequently made public, through EOSC services.

1. SECTION 1 – INTRODUCTION

1.1. This deliverable in context

The overall ambition for the European Open Science Cloud is described in the EC Communication on European Cloud Initiatives. It highlights the importance of data in all areas of modern research and envisages an Open Science Cloud "that makes it possible to move, share and re-use data seamlessly across global markets and borders, and among institutions and research disciplines".

The EOSCpilot project will take as its primary focus two of five key reasons given in the aforementioned document as to why European research is not yet fully tapping into the potential of data. It aims to reduce fragmentation and improve interoperability between data infrastructures by demonstrating how data and resources can be shared even when they are large and complex and in varied formats.

The development of the EOSC service portfolio is fundamental and instrumental to this objective. EOSC services will support the entire data lifecycle and research process workflow and support Open Science policies and practices, and will be built from regional, national and European e-Infrastructures including NGIs and NRENs, RIs, EIROs services and research facilities. It will take trust, easy accessibility and use by researchers into account. In this way, the EOSC service portfolio will reduce fragmentation, leveraging existing service portfolios and service federation, in order to meet use case requirements and improve user experiences and best practices.

The objective of EOSCpilot WP5 services is the definition of a portfolio of validated EOSC services and the related rules of engagement for service providers in order to define the activities and processes regulating their provisioning and allow a further future enhancement and evolution of the portfolio, without burdening service providers with unnecessary rules and regulations.

The EOSCpilot WP5 will deliver an overarching service architecture that includes a wide spectrum of validated EOSC services (EOSCpilot Task 5.1). This will follow a "system of systems" approach and identify the key components and services needed to:

I. make EOSC a system on its own,
II. smoothly aggregate into a coherent whole the offerings, facilities and data of existing providers (including national and European e-Infrastructures, public cloud service providers, and domain specific service providers like Research Infrastructures & EIROs), and
III. offer advanced functionality realised by dynamically leveraging the aggregated constituents.

This architecture is described in D5.1 Initial EOSC Service Architecture, which is published in parallel to this document on the EOSC Service Portfolio (D5.2). A glossary of terms has also been developed and will be published alongside the D5.1 deliverable.

The EOSCpilot will deliver a Service Management System (SMS) that describes the implementation of principles, policies and structured processes of the EOSC service infrastructure (EOSCpilot Task 5.3). This will clarify the operational constituents, roles and responsibilities of the EOSC Service Providers and ensure a high quality of the service delivery to the customers and their users. In particular, the SMS will specify the Principles of Engagement for any organisation wishing to act as a service or data provider within the EOSC.

The EOSC service portfolio (Task 5.2) will be modelled according to the architecture specifications and will be designed to include a wide spectrum of validated services meant to support the whole research life cycle and support Open Science policies and practices.

In relation to the EOSC Service Architecture it develops a coherent EOSC service portfolio, in

terms of business value, specifying what the services, data catalogues, etc. are, how they are bundled or packaged, and what benefits they provide. Starting point are the service portfolios from the various existing European e-infrastructures and RI's. Output of this is one or more useful service catalogues from the EOSC service portfolio targeting the needs of different EOSC customers/users, including guidance and support.

1.2. Deviation from Body of Work

In the Body of Work (BoW) the main deliverable of this task was to produce an overview of the services landscape in Europe. However, at the start of this project it became evident that some of the work as described in the BoW overlapped with output of the eInfraCentral project. This has led to a number of changes in the methodology of the task and the scope of this deliverable. First, eInfraCentral was contacted to see where effort could be shared, this has been done e.g. with the service description template and the description of the services of the European e-infrastructures (EGI, EUDAT, GÉANT, OpenAIRE and PRACE). This change meant that priority could be given to describing services from Research Infrastructures and national / regional providers.

Secondly, the WP has prioritised portfolio management methodology for this task, leading to some of the sections now present in this report. The focus here has been to establish guidelines and common practises which will lead to the implementation of EOSC Service Portfolio Management processes.

1.3. Reading guide

This text consists of three main parts. The first 'Current Service Landscape', describes the service landscape as we observe it today, showcased by examples of partners in the EOSCpilot project and taken from responses of shepherds of Science Demonstrators to a survey on experiences with EOSCpilot as it is now. The second part 'Service Portfolio Management', shows how frameworks like FitSM deal with portfolio management. The methodology is demonstrated by using a number of examples, highlighting the differences in approach. The third part, 'EOSC Service Portfolio Management' goes into how portfolio management can be done within EOSC.

2. CURRENT SERVICE LANDSCAPE

There are many ways to describe a landscape. Here we will look at three aspects that are relevant: Stakeholders, Services and the FAIR principles.

2.1. Stakeholders in the services landscape

In Task 5.1, the European Open Science Cloud Architecture, Anatomy and Physiology, stakeholders are listed in three clusters: EOSC Clients, EOSC (research) suppliers, and EOSC Managers, some clusters having sub-roles defined. For each of the clusters and sub-roles we will describe where services, either catalogue or portfolio management, will play a role.

In Task 2.2, the deliverable D2.2 Governance Framework has been produced, also identifying roles of stakeholders and levels of governance/decision making. For each of the levels and actors involved we will describe where and how service catalogues or service portfolio management fits in.

2.2. T5.1 Stakeholders and their connection with services

How relevant are the stakeholders identified in Task 5.1, the European Open Science Cloud Architecture, Anatomy and Physiology, when assessed from the Services perspective? For each of the three clusters of T5.1 stakeholder roles and sub-roles we identified their stakes with regards to Services. (See Appendix A: Stakeholders T5.1 Architecture for details). The result is represented in table 1. Observations from the mapping is discussed in the following sub-sections.

Table 1: Stakeholders and relation to Service Catalogue and Service Portfolio Management

T5.1 Stakeholder	Use the service	Develops / Contributes	Manages / Provides	SC and/or SPM*
EOSC client	√			SC
Scientist	√			SC
Data Scientist	√			SC
Citizen Scientist	√			SC
Researcher / Admin	√			SC
Research Output Manager / Adm.	√			SC
External Service Provider	√			SC
EOSC [Resource] Supplier	√	√	√	SC + SPM
EOSC Service Component(s) Supplier	√	√	√	SC + SPM
EOSC Data (Service) Supplier	√	√	√	SC + SPM
EOSC Service Component(s) Dev.		√		
EOSC Service Developers		√		
EOSC Manager				

EOSC Owner				
EOSC Top Manager				
EOSC Serice Provider		√	√	SC + SPM

* (SC = Service Catalogue; SPM = Service Portfolio Management

2.2.1. Stakeholder EOSC clients in relation to Services

In general, the EOSC clients are using different subsets of the services, depending on their role and objective. They will have expectations on the continued availability of the services and interoperability with others. In order to use services, a Service Catalogue is essential to be able to select the most eligible (and also effective, efficient and affordable) service that meets these expectations. The requirement in relation to Service Portfolio Management is simple: services that are in the Services Catalogue should comply to EOSC standards, and the continuation of the service (or - depending on its nature - the seamless replacement by another service) should be guaranteed for the agreed duration of the research, the storage or archive. This poses challenges to Service Portfolio Management because the guarantees depend on various providers, with different approaches (e.g. to lifecycle management) to ensure 'compliance' to the EOSC standards.

2.2.2. Stakeholder EOSC [Resource] Suppliers in relation to Services

In general, the EOSC [Resource] Suppliers will provide services (or service components) to EOSC, that will be offered as EOSC services - and therefore they'll need to comply to the rules and conditions of the Service Catalogue and meet requirements set out by EOSC Service Portfolio Management. There are no special relations between the sub-roles of EOSC [Resource] Suppliers that do the technical service development.

2.2.3. Stakeholder EOSC Managers in relation to services

In general, the EOSC Managers are not users of the system's services but responsible for keeping it working, without being involved in Service Portfolio Management. The role of EOSC Service Provider is very much related to, and the actor must be involved in Service Catalogue and Service Portfolio Management.

2.2.4. Conclusion on T5.1 identified stakeholders in relation to Services

The stakeholders as defined for T5.1 can be mapped on actors one would identify as stakeholder with regards to Service Catalogue and Service Portfolio Management. Some sub-roles identified in T5.1 are, as can be expected, less relevant to Services than they are to the overall EOSC Architecture.

The group most affected by Service Catalogue and Service Portfolio is by far the EOSC client, as for the quality and reliability over time of the service(s) to be used for the research and education, the client is depending on the information in the Catalogue and the professional quality of the Portfolio Management. A complication is that part of the services are not delivered to actual end-users (e.g. researchers) but to other EOSC service providers.

When setting up processes and procedures for maintenance of the Service Catalogue and Service Portfolio Management it is important to involve the EOSC clients. The table can help to include essential stakeholders.

2.3. T2.2 Governance Framework Stakeholders and their connection to services

How does the Draft Governance Framework for the European Open Science Cloud (result of WP 2.2) compare to the Services Catalogue and Services Portfolio Management?

First, we look at the statements in the Open Science Policy Platform (OSPP) that refer to services *[followed by our interpretation of the consequences related to services]*:

OSPP Statement 3. European countries and EC should ensure long-term funding of the services that are needed to enable the integration of and access to the resources that can be federated in the EOSC. *[this addresses the sustainability of 'core' services, or 'provisioned' services]*

OSPP Statement 4. Different and innovative funding schemes should be investigated to support users to consume services from EOSC-certified providers that are approved based on a commonly-agreed European certification scheme. *[this implies that 'EOSC certified' must be defined and established per service]*

Conclusion on T2.2 Governance Framework references to OSPP statements and Services

All services in EOSC, must have a clear status and a long-term funding to guarantee their existence, unless marked as 'beta services, non EOSC standard compliant'. This information should be taken into account at service catalogue entry-point and either the long-term funding is guaranteed, or - if the service makes it to the Service catalogue - it should be clear the long-term funding is not guaranteed.
Each service in the service catalogue should be EOSC certified. So, we must define what EOSC certification is, any checks that might be made when entering the public-facing catalogue, and have a mechanism to renew the certification.

Second, we take a look at stakeholders identified in the Governance Framework. For all ten stakeholders we provided a summary of the original description and assessed the relevance with regards to services offered/used *(See Appendix B: Stakeholders T2.2 Governance Structure. for details)*

The ten T2.2. Governance Framework stakeholders:

- **Researchers** (including science and technology professionals)
- **Service Providers** functioning nationally or at a larger scale, with commercial, non-profit or public status
- **Research Producing Organisations, Academic Institutions and Research Libraries,** core users, promoters, supporters, enablers of the European Open Science Clouds *offered at Service Catalogue level]*
- **Learned Societies, Research Communities, Scientific and Professional Associations** are key allies to build, use and promote the EOSC
- **Enterprise** Small and Medium sized (SMEs), large enterprises, dynamic European start-ups and entrepreneurs-to-be, researchers, developers, deployers, providers, distributors, etc.
- **Research Infrastructures** can be traditional large physical installations, as well as distributed facilities which "include networked resources and skill / capacity building initiatives.
- **E-infrastructures, VREs and other pertinent H2020 projects** are key building blocks of the European Open Science Cloud – offering/using bundled and shared services.
- **General Public** will be participating In the EOSC created cross-border and multi-disciplinary open innovation environment
- **National, Regional or Local Government Agencies** will move, share and reuse data seamlessly across European borders, among institutions and analytical facilities and

between different research and data disciplines
- **Research Funding Bodies** make research grants available to researchers

Assessing the T2.2 Governance Framework stakeholders to Services results in table 2.

Table 2: WP2 Governance Structure Stakeholders and relation to Service Catalogue or Service Portfolio Management

Governance Framework Stakeholder(s)	Service Catalogue	Service Portfolio Management	Additional
Researchers	Yes	No	
Service Providers	Yes	Yes	
Research Producing Organisations, Academic Institutions and Research Libraries	Yes	No/Yes	Yes, if also builders
Learned Societies, Research Communities, Scientific and Professional Associations	Yes	No	
Enterprise	Yes	Yes	
Research Infrastructures	Yes	Yes	
e-Infrastructures, VREs and other pertinent H2020 projects	Yes	Yes	
General Public	Yes	No	Relate to everyday challenges
National, Regional and Local Government Agencies	Yes	No	Requirements on government regulations information in Service Catalogue
Research Funding Bodies	Yes	No	Requirements on cost info in Service Catalogue

Conclusion on T2.2. Governance Framework identified stakeholders and Services

All ten stakeholders identified in the Governance Framework have a relation to the services-aspect, but some more directly than others, and for half of them the link/relevance is limited to the Service Catalogue (researchers, learned societies, general public, government agencies and funders). As a consequence, the EOSC Service Catalogue should primarily meet the needs of these groups.

Heavily involved with both Service Catalogue and Service Portfolio Management are Research Infrastructures and e-Infrastructures, and - if building services, the service providers. As a consequence, the Service Portfolio Management should support the needs of and assist the operation of these stakeholders.

2.4. FAIR principles in connection to services

A major development in the world of Open Science is the adoption of the FAIR principles. Initially launched by FORCE11, these principles addressed the requirements and conditions that will make data findable, accessible, interoperable and reusable. Inspired by the appealing simplicity of the principles and as an alternative for the always ambiguous term 'open data' ('does it mean I have to give my data away for free?'), the research infrastructure community has embraced 'FAIR' as the new banner towards the realisation of Open Science. Many universities, organisations and institutions have statements or policies (ready or being prepared) on making their data FAIR.

The discussion has started if the FAIR principles can only apply to data, or can also apply to software, to services, to infrastructure. With EOSC often being described as an ecosystem for Open Science there is a logic in looking how the FAIR principles that seem to work well for opening up data, can also help to make other elements more open. Reason to apply FAIR principles to services as well, is that it may help to harmonise the EU infrastructures.

Although FAIR principles may not yet be part of the current services landscape they may very soon be. Therefore, further down in this document we will briefly look at FAIR principles with regards to Services and how FAIR might be part of Service Catalogue and Service Portfolio Management approaches. What should be taken into account is that services, unlike data, need people/organisations to be a service - and these people/organisations can change. So for the application of FAIR principles to services, they will need to be adjusted to the current instances of the service.

2.5. Description of the services landscape

Variety
The current services landscape is (not surprisingly) very heterogeneous in every imaginable aspect. Ranging from the variety of providers (and users), and differences in purpose, technology, costs and funding mechanisms to the disciplinary and geographical remit of the services. They can be regional/national or international, they can be e-infrastructure or research services, can be services that process, augment, transport, store and/or archive data.

Challenges
The challenges this variety presents can be illustrated through the funding of RDM infrastructure services. The RDM example is deliberately chosen because of a recent briefing paper (May 2016) 'Funding research data management and related infrastructures', by Knowledge Exchange and Science Europe . The paper concluded that '*There are differences in the ways in which the various actors perceive their own and others' roles with regard to RDM and RDI. The funding mechanisms do not yet seem to be adapted to the shifting demands that are being made concerning the management, preservation and sharing of research data across borders, disciplines and beyond a particular organisation's interest*'. As EOSC is much more than 'just' RDM and RDI, the situation with regard to funding mechanisms not yet adapted to an Open Science reality, and actors' different perceptions of roles, will present a huge challenge to overcome.

Working on the challenges
On a positive note, there are various initiatives that try to address the variety and complexity of Open Science, which can help EOSC to think about its function and shape. The GO FAIR initiative should be mentioned, positioning itself as 'a bottom-up international approach for the practical implementation of the European Open Science Cloud (EOSC) as part of a global Internet of FAIR data and services'. There is the Research Data Alliance with its eighty plus working groups that on a global scale explore and try to solve the gaps to connect and 'inter-operationalise' data and data related infrastructure and processes.
The recently published report 'The Knowledge Exchange Approach to Open Scholarship' presents

an overview of the Open Science landscape, suggesting an Open Scholarship framework that brings together arenas, stakeholders and three (micro, meso and micro) levels of concern. At the EOSC Stakeholder Meeting, 30 November and 1 December 2017, Professor Carole Goble from the School of Computer Science, University of Manchester referred to Knowledge Exchange Open Scholarship framework saying that a lot of work is happening at macro level - setting-up formal structures; that gaps exist at meso level - the burden to organisations is unknown; and that recognition issues are not solved yet, there is a lack of common tools; and at micro level researchers do not have a clue, - FAIR is yet unheard of.

Providing the services
Currently the main providers of services are:

- European e-Infrastructures: EUDAT, EGI, OpenAIRE, GEANT and PRACE;
- National e-infrastructures
- Data / Research Initiatives: variety of organizations and initiatives, e.g., RDA interest and working groups, organized research communities with specific stakes
- Cloud providers: public and private, providing services to a wide range of research activities
- Research Infrastructures: complementing the existing EU infrastructure services, providing thematic (vertical) infrastructures in contrast with the horizontal e-infrastructure, and organized in an operational structure and use or provide cloud services.

Varied complex landscape: need for Catalogue
The aim of EOSC is to offer European researchers and professionals in science and technology a virtual environment with free at the point of use, open and seamless services for storage, management, analysis, curation and re-use of research data, across borders and scientific disciplines. Just looking at the variety in services and the diversity in providers makes it obvious that a Service Catalogue will be a necessary instrument and not an easy service to achieve.

Examples of services
In order to get an impression of the complexity we are dealing with, eight example services are assessed to get an indication of distinctions that emerge from their descriptions that should be taken into account when setting up a Service Catalogue.

DEIMS (Dynamic Ecological Information Management System) is a catalogue of environmental research facilities, featuring foremost but not exclusively information about all LTER sites on the globe and this information is used by science, politics and the public in general.
The service is **provided** by US LTER, the University of New Mexico, the University of Puerto Rico, the University of Wisconsin, and Palantir.net, and the **funding** comes from ECOPOTENTIAL, eLTER H2020, EnvEurope Project, ExpeER.

ICOS Carbon Portal (part of ICOS ERIC) offers access to research data, as well as easily accessible and understandable science and education products. Measurement data in the Carbon Portal is quality controlled through the ICOS thematic centers, divided into Ecosystem, Atmospheric and Ocean Thematic Centers and a Central Analytical laboratory. Researchers all over the world contribute to, and use, the elaborated products catalogue.
The service is **provided** by ICOS RI and **funded** by regional institutions.

SeaDataNet (Pan-European Infrastructure for Ocean & Marine Data Management) is a standardized unique virtual data management system for large and diverse data sets collected by the oceanographic fleets and the new automatic observation systems. It facilitates networking and enhances the currently existing infrastructures: national oceanographic data centres and satellite data centres of 35 countries, active in data collection.
The service is **used** by the academic/research community, **provided** by local institutions in the framework of SeaDataCloud and **funded** by National Institutions.

HPC Cloud computing facility is an Infrastructure as a Service (IaaS) platform that offers users a (virtual) environment to provision their own processing, storage and networking resources, while deploying, configuring and running arbitrary software (including your operating system of choice), via interaction with the HPC Cloud using the web interface that OpenNebula offers.
The service is **used** by scientists of a variety of disciplines **provided** by SURFsara, and is **funded** by SURF.

Dimension Data, part of the GEANT cloud catalogue, provides hybrid cloud-enabled by data centres, networking, collaboration and security to people, processes and technology across on-premise, cloud, network, and security services via a single point of contact and a single service portal for monitoring and managing the hybrid infrastructure end-to-end.
Used by the international research community, the service is **provided** by NRENs, and **funded** partly via GEANT and partly via contract agreements.

CloudSigma, part of the GEANT cloud catalogue, is a pure-cloud Infrastructure-as-a -Service (IaaS) provider that offers highly available, flexible, enterprise-class cloud servers and cloud hosting solutions, able to provision processing, storage, networks and other fundamental computing resources at users' discretion, meaning CPU, RAM, Storage and bandwidth can be purchased independently. Customer can "right-size" their workloads and take advantage of cost control methods for best possible VM and Storage consumption, managed via a web-interface.
Used by the international research community, the service is **provided** by NRENs, and **funded** partly via GEANT and partly via contract agreements.

Research Workspace Services (RWS), is a user-oriented, user-friendly (virtual) ICT environment, which provides 24/7 access to all (research) ICT services and applications of Groningen University. The Workspace can be customised at user request and is also available as a local clone of the Workspace. RWS can also be used by customers from outside of the university.
Used by researchers/scientists, the service is **provided** by the Center for Information Technology of the university, and **initially funded** by the university and other parties - and extended usage **requires additional funding**.

ILL Data Portal. Through this portal all experimental data produced by the ILL (Institut Laue Langevin) instrument suite are archived and made accessible online. Users can search all textual metadata related to experiments and quickly retrieve all data of interest. Experimental teams control their own data-release process, i.e. authorize access to an individual or release data publicly before the end of the standard non-disclosure period.
Users come from the academic and scientific communities including data scientists, and industry. The ILL Data Portal is **provided** by the Institut Laue Langevin and service operation is **funded** by the ILL internal budget.

eScience Research Software Directory aims to promote the impact, the exchange and re-use of best practices and to prevent fragmentation and duplication of research software. The Research Software Directory helps researchers to find high-quality open-source software and enables research software developers, funders and research organization to view the scientific impact of software.
Users are researchers, research software developers, funders, research organizations. The service is **provided** by NLeSC (Netherlands eScience Center), and receives **national funding** through the ministry of Education, culture & science, through research funder NWO and through SURF.

Essential Skills workshops are 1- and 2-day hands-on workshops - based on Software and Data Carpentry - teaching researchers version control using Git, to collaborate on software and research projects using GitHub and to understand the fundamental programming principles of Python.

Users are researchers. The service is by NLeSC (Netherlands eScience Center), and receives **national funding** through the ministry of Education, culture & science, through research funder NWO and through SURF.

2.6. Observations from collected services

Although the eight collected service examples are most probably not representative for the whole of European service offerings, they demonstrate that statements about diversity - and therefore complexity in bringing them together in a service catalogue - are a reality, as can be seen table 3.

Table 3: Collected services

Service name	Type	Funding method	Provider	User	Pricing/ SLA/TOR
DEIMS	catalogue	various funders	various providers (in America)	research community, politics & public	?
HPC Cloud	IaaS	SURFsara (national IT centre)	SURFsara (national IT center)	research community	?
Carbon Portal	RD services	regional institutions	ICOS_RI (ERIC)	research community & public	?
SeaDataNet	RD services	national institutions	Local member institutions	research community & public	?
CloudSigma	IaaS	partly Geant/partly pay	NRENs	research community & public	Yes
Dimension Data	Hybrid cloud	partly Geant/partly pay	NRENs	research community & public	Yes
Research Workspace Services (RWS)	(beyond) RD services	structural funding pending	University Center or Information Technology	research community & public	?
ILL Data Portal	RD services	ILL (international research centre)	ILL (international research centre)	research community & public	? (currently free to use)
eScience Research Software Directory	RD services	Various national funders	NLeSC (national eScience center)	Research community	? (currently free to use)

Essential skills workshops	Educational service	Various national funders	NLeSC (national eScience center	Researchers	Yes (paid for)

A quick observation shows that in the 10 examples there are 6 types of services, 7 ways in which services are funded (or funding is pending), and provided. The users are more or less the same for all services: research community (including funders and developers) and society. Keeping in mind that the whole endeavour of EOSC is aimed at serving the users, the table above suggests that the service catalogues should at least provide clear, distinctive information, about the type, the provider and cost/funding information.

What can be learnt from the paragraphs on the T5.1 and T2.2 stakeholders mapping to services and the current landscape – including the examples?

First observation must be that the heterogeneity of all aspects of the services is in itself a huge challenge. For a service catalogue and for service portfolio management this means that `ways must be found to group services together that in a logical way belong together, either to represent them in a catalogue (for EOSC users to see), or classify them into service portfolio management clusters, putting together services that can be 'portfolio-managed' in a similar way. In the following chapters, we will be exploring how this can be done, and see there is no easy solution.

Second observation follows from the comparisons with the T5.1 Architecture stakeholders and the WP2 governance structure stakeholders: the first comparison led to the conclusion that the end-users should be involved (or their interests represented) in the service portfolio management. The example services demonstrate that the end-users are quite a broad group: the research community and beyond; the second comparison identified that, among the stakeholders defined from governance perspective, two should be most involved: RI's and infrastructures. In the selected example services the RI's and infrastructures play either no role, or the role of funder, or the role of provider) - this again is an indication how hard it will be to get crucial stakeholders involved and at the same time organise SPM in an efficient and effective way.

One of the approaches to deal with the above described challenge of 'stakeholder overload' will be to keep as much as possible decisions related to SPM at the level of the services and service providers themselves.

2.7. Observations from survey to shepherds regarding science demonstrators' views on EOSC

To ensure that all issues that are relevant to Task 5.2 are covered we have looked at the responses to the science demonstrator survey performed by WP5 on service architecture and portfolio management that was issued to the demonstrator shepherds. Here we present (eleven) observations that have relevance to the work on Service Portfolio management and Service Catalogues.

Benefits of EOSC to Science Demonstrators
The Science Demonstrators see the expected benefits and added value resulting from being implemented in EOSC as follows: 'cloudification' (mentioned 5 times), 'FAIRification' (4), multi-disciplinarity (2), widening scientific audience/reach (1) and harmonisation / standardisation (1) Cloudification (transforming local services to offerings in the cloud) is at the heart of EOSC – starting with the availability of demand driven capacity and computing power but without limits to any other functionality. This notion does not present additional aspects to the work on service portfolio management that has been identified already.

FAIRification (applying FAIR principles to all elements of the EOSC ecosystem) is an important aspect to T5.2: FAIR compliance will play a role in entrance (meet requirements) of a service in EOSC as well as in the documentation (level of FAIRness) of services in the service catalogue.
Multi-disciplinarity, from a services portfolio management perspective, means that stakeholders from more disciplines should be involved, ensuring that particular disciplines can indeed use and collaborate while using the same services. A service catalogue should give an indication/description of the actual multi-disciplinary potential of the service.

Observation 1. T5.2 should pay attention to the appliance of FAIR, and a service catalogue that includes information on multi-disciplinary possibilities.

Development roles
Actor roles that play an active part in developing and operating the demonstrator scenario are the following: Scientists / data scientists / citizen scientists (mentioned 9 times), Resource suppliers / resource providers (8), Managers (5), Research Managers (3) and Middleware standards developers (1)
The development phase these responses refer to, is not strongly related to service portfolio management. However, the answers demonstrate that the more mature services (e.g. LOFAR) put more emphasis on / have more experience with management aspects.

Observation 2. For SPM in EOSC this group of mature services is an important factor to be inspired by and to agree with when setting up SLA's, life cycle management and exit strategies.

Services from multiple providers
The SDs have a big appetite to use services (network, storage, computing, data, domain-specific software tools) and data from multiple providers. There is no doubt that multiple provider services will be used, many are in fact doing so already. However, the appetite of the SDs often is qualified by specific inclusions/exclusions – presenting a 'granularity' challenge.

Observation 3. The EOSC service portfolio management (including service catalogues) should pay high attention to the 'multi-domain supply chain' of providing many services and solidly embed multiple service provision (and usage details) in the SPM approach.

Difficulties using services
The main difficulties that SDs encounter in their usage of services concentrate on technical issues and malfunctioning services – this is not part of T5.2. Some issues are closer to T5.2: (lack of) standardisation, certification, registered formats. This issue is eloquently formulated in the response from Science Demonstrator Data Sciences in Life Sciences: A structured catalogue of metadata repository services and their focus, capabilities and security options would be extremely useful.

Observation 4. Standardisation, certification, registered formats that should be worked on/embedded in SPM, and clearly described in Service catalogues.

SLAs and Governance
The landscape of SLAs used by SDs is varied and having a SLA in place or not depends on the provider of the service(s). Monitoring the adherence to licenses, access restrictions and policies are hardly existing. Currently none of the SDs works with SLAs for users but this may be due to being demonstrators and not professional, operational (EOSC) services yet.

Observation 5. The variety of approaches will present a challenge to EOSC's SPM. Minimum requirements or categories may have to be formulated, including an agreed method/approach to (self?) monitoring of adherence. This will strongly relate to the appliance of (and adherence to) FAIR principles to all EOSC data, processes, services and products.

Standards
There are very few SDs (only three) that come up with a standard that they would like providers to adhere to.

Observation 6. For SPM standards adhered to are important to be known, either to describe a service to users or as an entry condition. There must be mechanisms in place to discuss such (entry) matters.

Scientific products
The scientific products and identified difficulties to make these products findable, accessible and re-usable, do not seem to relate to T5.2 services. One issue mentioned that is relevant in a generic way are license conditions.

Observation 7. T5.2 should learn from, and offer solutions regarding the difficulties SDs experience around licences.

Scholarly communication metrics

With regard to evaluation of value and impact of SD products it is advised to collect all factual usage of EOSC content, tools and methods. This does require an EOSC-infrastructural approach, and this in turn implies that it must be possible for EOSC to 'measure' all services and tools used.

Observation 8. Options to be able to measure relevant aspects of EOSC usage could be an essential requirement for entry to the EOSC service portfolio?

Required collaboration

Several types of required collaboration are brought forward by the SDs; between scientists and engineers to make things work across RI's; between providers and between repositories to establish guaranteed security levels; and between providers, users and EOSC stakeholders in order to get to a metadata standard and/or support all metadata. The collaboration with public databases and also description of workflows are mentioned. It is mentioned that 'cloudification' of services does require collaboration between all EOSC stakeholders. These are not necessarily elements that the Services work package should address. However, what does relate to the work package are the suggested services/tools that EOSC should have available in its portfolio to support collaboration, e.g. registries for docker/singularity, services for public database depositing, workflow descriptions (project) collaboration tool (authorisation mechanisms); options for multi-user terminal sessions, multi-head graphical output

Observation 9. The SPM of EOSC should ensure that services that support collaboration are represented in the portfolio.

Better perform and implement Open Science
An inventory to identify how actors in the SDs can better perform and implement the Open Science vision shows that:

Observation 10. The various SDs hope EOSC (and T5.2 is part of EOSC) will (a) cope with and stimulate standards, i.e. workflows; (b) work on AAI and interoperability of services, (c)overall enhance infrastructure functions (d) provide clear information and use webinars

Management and governance
Only the more mature SDs have SPM in place, although reportedly in basic format. No SD has full management in place at the level of generic requirement, lifecycle management etc. This implies that there is a great discrepancy between the 'established' EOSC infrastructure services, such as

EGI or GÉANT, and the SDs.
Only LOFAR has some governance structure in place and a new structure is to be decided; one SD applies for ITIL certification.

Observation 11. To EOSC, including T5.2, the lack of, or at least immaturity of portfolio management and of governance structures must be an alert that a big effort will be required to set up a mutually working, understood and satisfactory portfolio management model and governance structure.

3. SERVICE PORTFOLIO MANAGEMENT

In this section, Service Portfolio Management (SPM) is introduced as it is practiced by individual organisations. Through a number of examples the scope of SPM, the procedures that make up SPM and some of the challenges in dealing with SPM are shown. It will also show some of the challenges that EOSC faces when dealing with SPM. This section, however, is not an endorsement of any one SPM strategy or particular methodology but serves to provide an overview of established practices that can help shape SPM in EOSC.

3.1. Introduction to Service Portfolio Management

The service portfolio is a list of all services offered by the service provider at some point in time. It encompasses services that might still be under development, but also those in production or even discontinued. As such, the service portfolio is not exposed to the customers themselves, only interested in the production ready products advertised in the service catalogue. Nevertheless, the service portfolio is the basis for the catalogue, and as such, a consistent portfolio is of paramount importance for any organization that wishes to provide added value for their customers.

The management of the service portfolio is a crucial process for all organizations aiming to comply with ITSM standards. The goal of this process is to both define and maintain a service portfolio. The demands and requirements of the customers are taken into consideration while defining the specifications of new or improved services. In the end, this process ensures that the service provider has the right mix of services to meet current and future business plans.

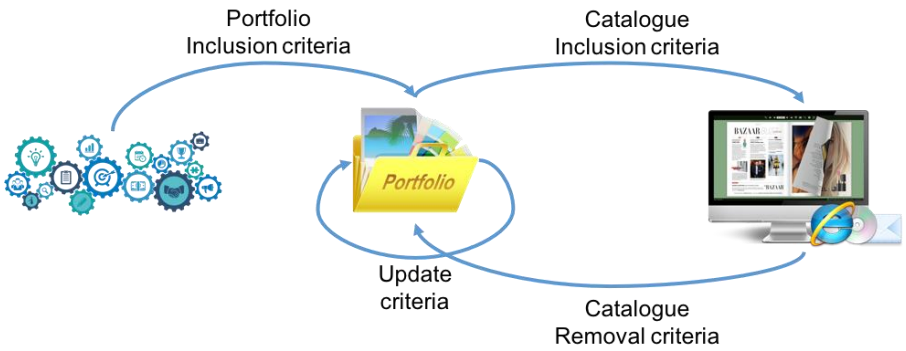

Figure 1: Overview of Service Portfolio Management

3.2. Examples of Service Portfolio Management

To show the current state of affairs and the diversity of service portfolio practices, a number of examples were collected. They represent efforts from a variety of communities that have rather well established IT service management practices. Although not representative of all different types of service providers in Europe, it does offer a glimpse of the range of practices currently employed.

3.2.1. Example 1: EGI

EGI is a federated e-Infrastructure set up to provide advanced computing services for research and innovation. The EGI e-infrastructure is publicly-funded and comprises hundreds of data centres and cloud providers spread across Europe and worldwide.

Service management

EGI is the first European-wide publicly-funded e-infrastructure to be certified to ISO 9001:2015 (quality management) and ISO/IEC 20000-1:2011 (service management) standards. The EGI Integrated Management System (IMS) hosts all information regarding how EGI plans, implements, monitors and continually improves all business processes and services under responsibility of EGI Foundation. The overall IMS is periodically audited through internal and external audits. The

following diagram outlines each process defined within the IMS, which includes a dedicated process on Service Portfolio Management.

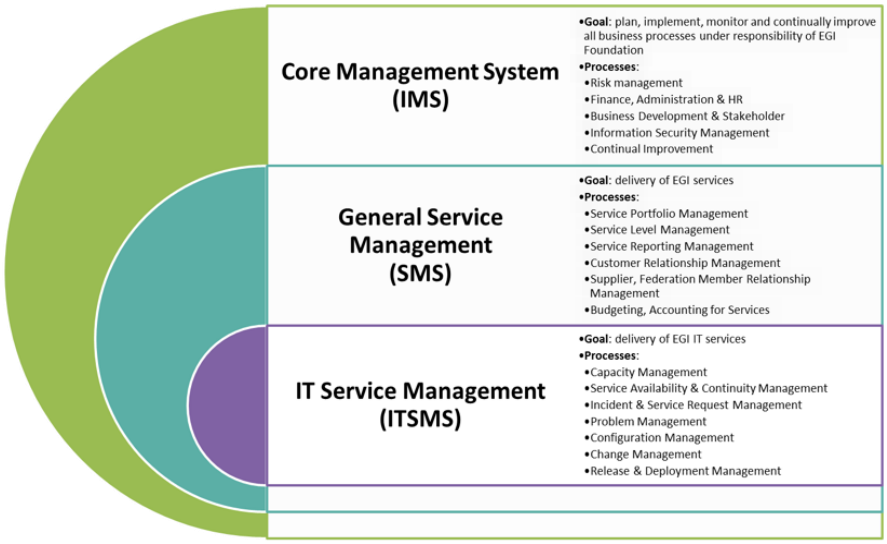

Figure 2: EGI IMS Process Structure

Overall activities follow a process-oriented approach, which started from initial implementation of FitSM, a lightweight service management standard and output of a European funded FP7 project called FitSM (ended Sept 2015). From there, efforts expanded through the move towards ISO 9000 and ISO 20000 certifications, as previously mentioned.

However, before detailing EGI's approach to Service Portfolio Management, it is important to make a distinction between the terms and concepts adopted by EGI that are taken from FitSM:

1. **Service Portfolio:** The internal list of all services offered, including those in preparation, live and discontinued. The service portfolio includes information such as its value proposition, target customer, service description, relevant technical specifications, cost and price, risks, service level packages offered, etc.
2. **Service Catalogue:** The customer-facing list of all live services offered along with relevant information about these services. The service catalogue is a filtered version of the service portfolio providing specifically a customer view only.

The approach to Service Portfolio Management starts from the need of a mechanism to feed requirements that are collected and translated into services, whether new or improved (Figure 3). This is handled by a dedicated process called Service Portfolio Management.

Service Portfolio Management is designed to manage the service portfolio in order to ensure its regular review and to align new or changed services with business decisions as part of the overall organisation strategy. This includes that:

- A service portfolio is maintained and that all services are specified within it.
- The design and transition of new or changed services are planned and consider timescales, responsibilities, new or changed technology, communication and service acceptance criteria.
- The organizational structure supporting the delivery of services is identified, including a potential federation structure as well as contact points for all parties involved.

For all new services or major changes to existing service within the EGI Service Portfolios a Service Design and Transition Package (SDTP) must be created in order to ensure the definition of the necessary pieces of information regarding the service design, delivery and transition planning and its proper evaluation. A template for creating an SDTP is provided in order to structure the necessary information, as well as serves as a record for future reference and/or re-use. The template includes:

- Value Proposition: Customer/User Profile, Service Overview, Success Criteria
- Business Case: Demand assessment, Assumptions, Expected Impact, Cost, Revenue, Risk, Suppliers, Constraints, Access Policy, Links to EGI Strategy
- Service Design: Requirements, Architecture, Service Order Workflow, Service Acceptance Criteria, Service Options, Service Requests
- Service Transition Plan: Transition Activities (Specification, negotiation and agreement); Development and procurement; Testing; Operation with early life support; Regular operation and Service Phase Checklist

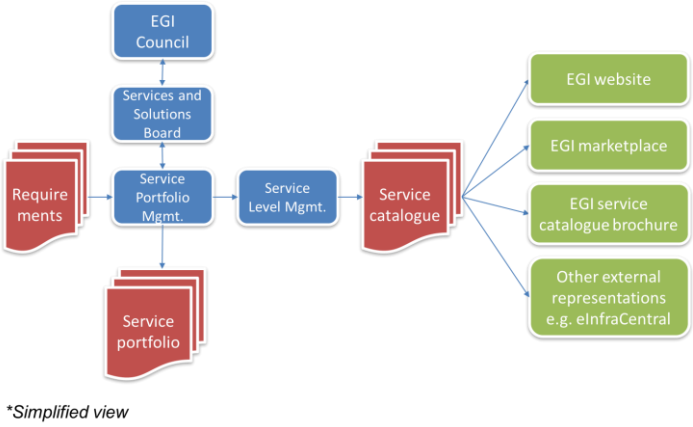

Figure 3: EGI Service Processes

Governance structure

The management team behind this process is called the EGI Service and Solutions Board (SSB), which comprises a number of process owners, service owners and policy group representatives, who evaluate all new service ideas or requests for major changes and ensure information is clear and well-articulated. This allows for effective decision taking regarding service phase changes and when to interface with the EGI Council. The EGI Council has final approval of all new services, which provides a level of transparency as well as offers an opportunity to validate that resources are being invested and ensure links to the overall EGI strategy.

The end of the process results in a formalised service portfolio, but within EGI (and the FitSM standard), this then triggers another separate process called Service Level Management (SLM). The SLM process is responsible for ensuring that any applicable agreements are in place (such as Service level Agreements - SLAs and Operational Level Agreements - OLAs) and for coordinating the Service Catalogue, which again, is the public rendering of all services that can be requested.

This results in a cleaner, clearer communication of services, whether through the EGI website, the EGI Marketplace, through targeted promotion material as well as other external catalogues such as the eInfraCentral project and eventually the EOSC.

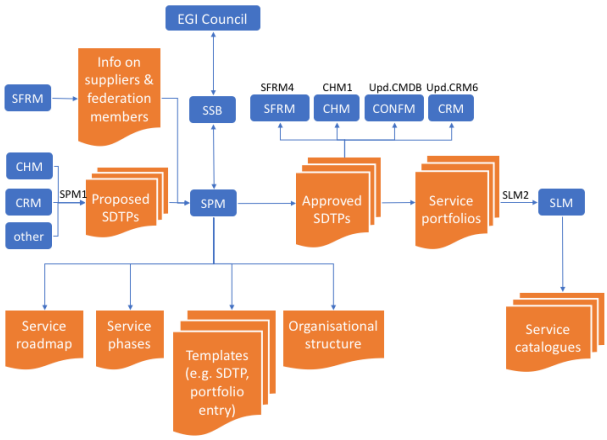

Figure 4: EGI SPM Interfaces

3.2.2. Example 2: Elixir

ELIXIR is an intergovernmental organisation that brings together life science resources from across Europe. These resources include databases, software tools, training materials, cloud storage and supercomputers.

Service types

ELIXIR services are grouped around 5 different platforms: Data (data resources, linkage of data and literature), Tools (tools registry), Compute (storage, sharing and analysis of large-scale datasets), Interoperability (development and fostering of standards for life science data) and Training (training registry, training administration). Whilst no formal SLA has been developed, the provided Services are regulated by the Service Delivery Plans (SDP) created by the ELIXIR HUB in agreement with the ELIXIR node providing them. The implementation of each SDP is monitored by the Collaboration Oversight group, constituted by the ELIXIR Director, the Head of Nodes (HoNs) and other individuals appointed by them.

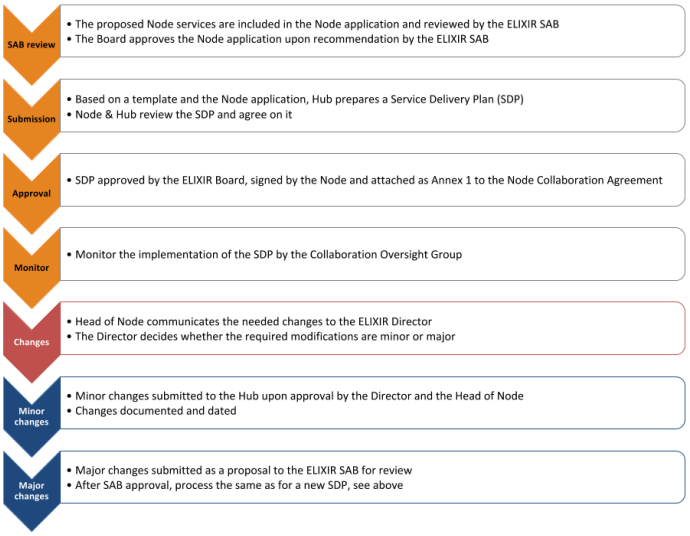

Figure 5: Elixir service management

Portfolio management

New services are put forward by the national ELIXIR node to which they belong. This can happen in two different ways:

- When a new Node is established, the proposed services are included in the node application and review by the ELIXIR Scientific Advisory Board (SAB). The ELIXIR Board then ratifies the Node application based on the recommendation of the SAB.
- If the Node has already been established, the HoN can notify the ELIXIR Director of required changes such as removal or addition of a Service. These changes are then review by the ELIXIR SAB for approval

In both cases, new services are included in the Service Delivery Plan for the node, and their implementation is monitored by the Collaboration Oversight Group. The entire process of adding or removing services is outlined in Figure 5.

As a preliminary step when considering to add or update a Service, Nodes are required to take into account:

1. Relevance of the service to ELIXIR platform(s)
2. The requirements defined by the Node Collaboration Agreement (available here). *For example, on quality assurance, Terms of Use, user training and compliance with the Ethics Policy.*
3. The life cycle state of the service and service sustainability
4. The benefits of the ELIXIR label to the service

This ensures a second level of review at the Node level, which puts forward Services that have already been pre-selected at the National level according to the criterias mentioned above. For the ELIXIR nodes, having services included the ELIXIR platforms ensures significant benefits in terms of visibility, as well as demonstrate that each service is internationally recognised as an important service for the user community and compliant with specific requirements that help ensure quality, reliability and sustainability. Additional details around the definition of a Service in ELIXIR and the mutual advantage of their presence in the ELIXIR platforms are available here. While the majority of the services present in ELIXIR are proposed by the Nodes themselves, ELIXIR can, through the Commissioned Services mechanism, commission services from ELIXIR Nodes and sustain their development process to cater for an European-wide user community.

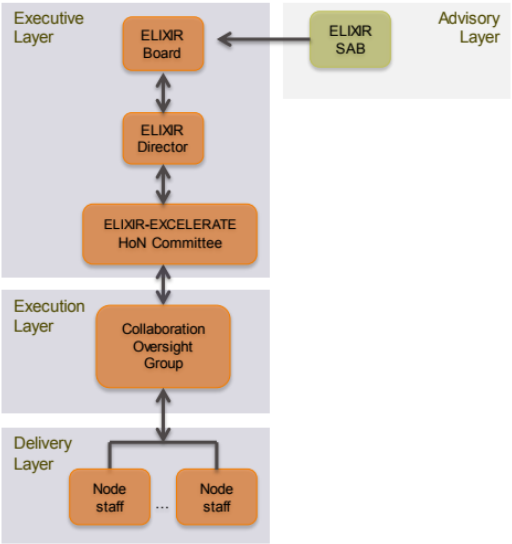

Figure 6: Elixir governance structure

Governance structure

The relationship between the ELIXIR Hub and each ELIXIR node is defined in the Collaboration Agreement (available here). The main role of the ELIXIR Hub is to coordinate the activities, with ELIXIR nodes in charge of providing the services.

As mentioned above, each ELIXIR Nodes individually selects amongst the Services it provides to the scientific community the ones that will be put forward to become ELIXIR Services based on the four criterias mentioned above. Proposed ELIXIR services are then reviewed by the ELIXIR SAB and, once approved by the ELIXIR Board, their implementation via the Service Delivery Plan is monitored by the Collaboration Oversight Group, which is in charge of the execution of the strategic plans defined at the Executive Layer (ELIXIR Board, ELIXIR Director and HoN committee, advised by the ELIXIR SAB).

3.2.3. Example 3: GÉANT

GÉANT is a fundamental element of Europe's e-infrastructure, delivering the pan-European GÉANT network for scientific excellence, research, education and innovation. Through its integrated catalogue of connectivity, collaboration and identity services, GÉANT provides users with highly reliable, unconstrained access to computing, analysis, storage, applications and other resource in partnership with European National Research and Education Networks (NRENs).

Service Portfolio

The GÉANT service portfolio incorporates a wide range of services under three key arms

1. Network services, including standard & point-to-point connectivity, VPN, test beds, wireless services (eduroam) and multi-domain performance monitoring (perfSONAR)
2. Trust, Identity & security, including trustworthy exchange of identity information (eduGAIN[1], eduroam), public key infrastructure (eduPKI) and a Trusted Certificate Service.
3. Storage & Clouds[2]: cloudbrokerage, offering selected cloud services to the GÉANT community

In addition the stakeholders/users of these services fall into two broad areas, described below.

GÉANT offers its core services in collaboration with its members that comprise independent but mostly publically funded National Research and Education Networks across 40 countries in Europe, and to its member NRENs who themselves run their own service portfolios according to their national remits. GÉANT and the NRENs also extend those services across their multi-domain supply chain where the Campuses, NRENs and GÉANT all play a part in the end to end user service delivery.

As a result the full portfolio of services developed and managed via GÉANT is not necessarily available to all users directly. In almost all cases the in-country NREN (or NRENs in the case of multi-national projects or users) will need to participate in the selection and delivery of services to end users.

Management and Development of services

GÉANT is a community led organisation and so the instigation, development and delivery of services involves at all stages a number of NRENs and other parties. The co-ordination of all product and service delivery of products is undertaken by the Product Management Team. This team is responsible for both products and services developed as part of the GÉANT Project (GN4-

[1] https://www.geant.org/Services/Trust_identity_and_security/eduGAIN
[2] https://www.geant.org/Services/Storage_and_clouds/Pages/Home.aspx

2) and within the wider GÉANT organisation, and utilises a product lifecycle management process based on ITIL v3 2011 principles, where all services are required to submit to various gates throughout the service lifecycle.

GÉANT also undertakes regular service review processes to identify development needs within existing services or to determine end-of-life processes. These reviews are undertaken in consultation with the NRENs and other stakeholders as required, and the outcome of the initial product lifecycle management process and subsequent service reviews informs the services offered to its community. GÉANT is currently contributing to the eInfraCentral project.

Furthermore, in order to manage the challenge of interoperation between services offered by multiple providers, GÉANT is building standards-based [3] product and service catalogue management APIs into its service delivery systems.

Governance structure

GÉANT's highest governing body is the General Assembly (GA), in which representatives of member organisations meet at least twice per year.
The GA elects members to the Board of Directors which manages and administers the organization sets the overall strategy and makes any long-term strategic decisions relating to the organization. Day-to-day operations are carried out by the association's staff, based in Amsterdam and Cambridge, under the direction of the CEO and executive team

Overall management of the PLM process within GÉANT is under the direct control of the Chief Operations Officer alongside the Chief Programmes Officer who has overall responsibility for the GÉANT Project activities. Product Managers resourced from within the organisation, or from the project performing a federated Product Manager role, oversee progression of services through the PLM gates, in either an advisory or contributor role.

3.2.4. Example 4: Worldwide LHC Computing Grid (WLCG)

The Worldwide LHC Computing Grid (WLCG) is global collaboration of more than 170- computing centres in 42 countries, linking up national and international grid infrastructures. The mission of the WLCG project is to provide global computing resources to store, distribute and analyse the data generated by the Large Hadron Collider.[4]

Service types

WLCG is based on a large and diverse range of services, managed across multiple domains. There are essential federating services (for example GOCBD, APEL, VOMS, GGUS etc., managed by EGI), a range of services organized by WLCG itself – FTS, CVMFS, central monitoring, etc., and then services provided at sites exposing agreed interfaces for online and archival storage & compute. (in addition, the global services such as CVMFS and FTS, GOCG GGUS, APEL, are themselves in practice run at various participant sites.) Finally, the LHC VOs themselves manage substantial and complex services for storage management and workflow management as well as their own monitoring infrastructures.

[3] TMForum Open APIs https://projects.tmforum.org/wiki/display/API/Open+API+Table
[4] Text taken from: https://wlcg.web.cern.ch

Portfolio management

WLCG, as a whole, does not employ methodologies such as ITIL or FitSM. Rather it has established practice of investigation and testing of new services at increasing scale, typically scrutinized over time by the WLCG Grid Deployment Board (GDB, the monthly collaboration meeting attended by site and VO representatives) once services are considered useful and proven, then roll out is typically handed over to the WLCG Operations team, often with specific task forces set up to oversee specific service rollouts. This combines with extensive monitoring of the availability and performance of the network, and the interfaces presented to the collaboration by resource providers which allows the effect of service introductions and changes to be seen.

The individual sites that actually run the range of services involved typically do employ established methodologies, sometimes ITIL or FitSM, often methodologies developed independently that correspond in function to these methodologies.

Governance structure

Formally, the WLCG Management Board is the decision-making body. In practice, agreement is typically arrived at in a combination of the Grid Deployment Board and WLCG Operations, and where appropriate forwarded to the WLCG Management Board for formal approval. The GDB tests the feasibility and technical robustness, WLCG Operations handles the operational and monitoring infrastructure, the Management Board approves.

A proposed new service might be presented at a GDB, typically following at least some initial prototyping, with some analysis of the problem it solves. Then over a period of extended testing the progress would be reported periodically. If the service proves itself, the benefits are clear and any downsides judged acceptable then with the agreement of the GDB and sign off from the management board roll out and establishment of necessary operational monitoring etc. would be handed over to WLCG Operations. In the case of CVMFS, now used to distribute all LHC experiment software – in place of locally installed software servers at each site – from initial interest to full production took around a year.

3.2.5. Example 5: VI-SEEM

VI-SEEM is a Virtual Research Environment which provides its services to end-users in Southeast Europe and the Eastern Mediterranean, as specified in the VI - SEEM service catalogue. As one of the pioneers of the now general trend for e-Infrastructure projects to have service orientation that will increase their usability, the VI-SEEM project developed its own service catalogue. The catalogue offers the end-users a single point of contact for the offering of services supported by the project. Its management system has been developed in-house to support the entire service lifecycle. Using FitSM methodology and best practices, the developed management system offers interoperability with other compatible e-Infrastructure projects such as EUDAT and now also EOSC-Hub.

The catalogue of VI-SEEM services classifies services as follows:

1. Data sharing services, data repositories, long-term data archiving, persistent data identifications, working/scratch area services, data search and catalogue, data visualization, data analytics service.
2. Regional community datasets and web-based services providing easy access to underlying workflow applications, resources and visualization, workflow, pipeline and software tools repository.
3. Access services to HPC, Grid and Cloud resources, as well operational support: service management system, monitoring, operational procedures (service validation, registration, certification and monitoring), AAI system.
4. Training services for application developers and VRE users, as well as supporting materials

from VI-SEEM events.

Figure 7: Countries involved in VI-SEEM

The Services are also classified according to their target group as Internal (i.e. not for end-users) and External). Each service needs to identify its target user groups as each one of them required different level of information on how to use a service. The following categories have been created:

- Individual researchers
- Community Managers
- Service Providers
- Data Project Principle Investigator (PI)

The catalogue allows for a number of versions of a specific service to be published according to their state (New, Approved, Under Development, Pre-production, Active, To be Retired, Retired) so that a number of different versions can be tested & accessed in parallel. Usually only Pre-Production and Active are accessible by the end user.

3.2.6. Observations on SPM and Governance approaches of the example services

Once again, the first observation must be that there is a great variety in the services described. In that sense, they illustrate once more the huge challenge EOSC faces to bring all this together in a transparent, open services offering to research as a whole.

Second observation is about the different approaches towards Governance and Service Portfolio Management:

- EGI as a matured e-infrastructure service provider has established formal governance structures and (FitSM based) SPM protocols that are ISO certified and clearly identify who is responsible in what part of the process, who can make decisions, what conditions and requirements must be met, and which facilitating and supportive services must be in place, before the status of a service offered via the Service Catalogue can change. There will be SLA's and OLA's in place.

- Elixir's governance is an aggregation of collaboration agreements between national nodes and Elixir which specify how via Service Delivery Plans new services can be proposed, who is responsible and how the decision process in the Collaboration Oversight Group will work, and what criteria must be met, prior to changing the status of a service (the term Service Catalogue is not mentioned). The SDPs 'replace' SLA's and OLA's.

- WLCG has provided stable services for about a decade, developing its own methodology for service provisioning and service portfolio management. This project has shown that combining geographically distributed systems and varying IT management methodologies can be successfully combined into one large scale system.

- GÉANT is a member-led organisation, and strategic decisions take place at General

Assembly level. The service portfolio is the result of Product Lifecycle Management, undertaken by the Chief Operations Officer alongside the Chief Programmes Officer, part of the daily staff. There are clear protocols on conditions and requirements that need to be assessed/fulfilled before the status of a service in the Service Catalogue. No SLA's or OLA's. Not all services are end-user services, not all NRENs offer the same services, (therefore?) there is no mentioning of a Service Catalogue.

- VI-SEEM, also an e-infrastructure services provider but less matured (still an EC project) does not yet have a governance structure in place beyond the current project setup. There is an in-house (FitSM based) lifecycle-aware service portfolio management system in place. Information on services in the Service catalogue is tailored to the four defined end-user groups.

Conclusions on the approaches to Service Portfolio Management and Service Catalogues of the example services:

- The majority of the example services have well-defined SPM processes and protocols in place to define and manage the services portfolio.
- Although the level may differ, most have a set of conditions, requirements that need to be fulfilled - in addition to the functionality of the service itself - before the service will be offered.
- All are aware of the service lifecycle phases but not all have clearly defined standard or lifecycle phase triggered review/update mechanisms in place.
- Almost all categorise the services, but the classifications are very different: distinctions are made between user groups, types of infrastructure, services or tools, functions of the service,
- A minority mentions the use of an actual Service Catalogue - in the case of EGI the Service Catalogue may differ per NREN.

3.3. Challenges of portfolio management in a federated setting

The service portfolio management methodologies described above show the diversity of these methodologies as used by well-established projects and service providers. It is to be expected that other, less well established, service providers only increase this diversity. As the EOSC catalogue has to be able to accommodate services from all these providers, the service portfolio management process needs to be flexible.

Established ITSM frameworks such as ITIL and ISO20000 are not easily applied to federated IT infrastructures. These methodologies therefore work well for individual providers but need to be extended to work in a federated setting. We therefore base the EOSC service portfolio management methodology on FitSM and augment it with EOSC specific processes where needed.

One of the challenges that has to be dealt with is the heterogeneity of service providers and consumers. Service providers range from small scientific communities to globally distributed cloud platforms, which means that different levels of maturity in ITSM are to be expected. While ITSM is encouraged for all resource providers, it is not a requirement for entering the EOSC catalogue. It might, however, be a requirement to become part of one of the higher tiers of EOSC compliance.

As can be seen from the description of EOSC stakeholders, the user side of EOSC is heterogeneous as well, consisting of individual scientists consuming end-user services to entire RIs building on top of EOSC building blocks to provide services to their communities. The former group are unlikely to require SLAs from service providers, while the latter needs assurances to be convinced to build their platform on the infrastructure of others. The heterogeneity on the user side also means we need to add both services and service components to the catalogue. Some services will be both the final product being used by end users and, for others, the service

components underlying end-user services.

The last challenge is dealing with service quality. In SPM, quality is usually assessed before a service enters the catalogue. As EOSC aims to be inclusive and cannot grade service quality across various research communities, this step is postponed until after a service has entered the catalogue, and will only be performed on request of the service provider, as will be shown in the following section.

4. EOSC SERVICE PORTFOLIO MANAGEMENT

4.1. EOSC Service Portfolio Vision

The EOSC aims to develop a trusted, open environment for the scientific community for storing, sharing and reusing scientific data and results. [Ref EC EOSC communication] Further, the lightest possible effective governance is aimed at, following an inclusive, flexible, transparent and less centralised approach [ref HLEG report].

In terms of the EOSC Service Portfolio, this translates to an open but controlled Service portfolio that federates geographically distributed services, tools and FAIR data to support research and education.

Open means that the EOSC Service Portfolio will be inclusive where possible, and that service and data providers are invited to register services in the EOSC Service Portfolio. Users of EOSC services, rather than overarching EOSC governing bodies, will determine in practise the value and relevance of services in the EOSC Service portfolio. This can be done either as individuals, or as research communities driving the adoption of specific services.

Controlled means that certain Rules of Engagement (RoE) will be designed within the EOSC governance that apply to providers of services. These RoE make sure that for every service in the EOSC Portfolio at least:

- conditions for access to the service are clear and transparent
- the provider of the service is clear and well-described, including formal contact information
- functional specifications of the service are described according to standards, including available user- and expert support
- the service level is defined and described according to standards
- descriptions are available in English

As a consequence, the EOSC Service Portfolio will be a collection of services made available through various service providers that comply to the rules of engagement.

The benefits for users of services that are included in the EOSC Service portfolio will be that:

- the Service portfolio will provide a good and complete overview of all EOSC Services
- the services are as such 'findable' and can easily be discovered, identified and classified
- services in the EOSC Service portfolio are well-comparable due to standardized descriptions and service levels, access conditions etc.
- tailor made Service Catalogues can be made based on the EOSC Service portfolio.

4.1.1. Service stacking

One aim of EOSC is to create synergy between different Service Providers, enabling them to focus on subsets of services and relying on others to provide functionality they cannot provide themselves. A simplified model of this is shown in Figure 8, where a distinction is made between Community Services that could e.g. be delivered by Research Infrastructures, and e-infrastructure services, which can be delivered by e-infrastructure providers. In reality, the distinction is not as clear cut, more stakeholders exist and the stacking will be more complicated. For this model, we will ignore that complexity for now. Also note that the model is not prescriptive, each of these service stacking scenarios will exist in EOSC. The choice for a particular model is left to the Service Providers.

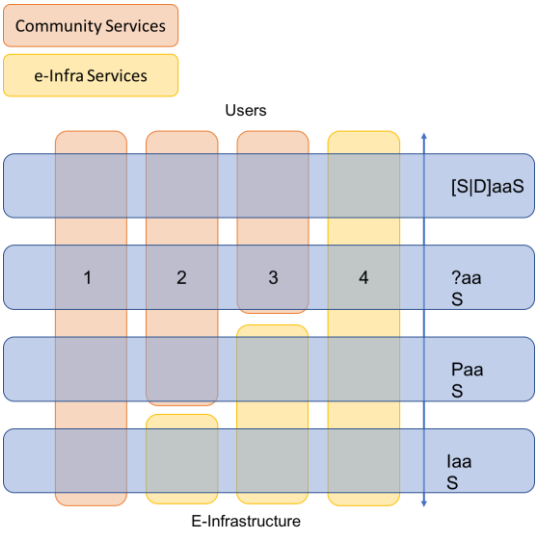

Figure 8: RI and e-infrastructure service stacking

In the first scenario the community, e.g. a RI, will build the entire service themselves. This includes buying and hosting servers, maintaining software stacks and running the user facing service. In scenario two, part of this responsibility is transferred to an e-infrastructure provider, which could e.g. host an IaaS platform on which the service is built. Scenario three shows that varying amounts of responsibility can be transferred, some communities might opt for container orchestration or having a e-infrastructure provider host a VRE on their behalf, which they will subsequently fill with data and scientific discipline specific tools. The fourth scenario shows that e-infrastructure providers will also host services themselves, which for the most part will not be scientific discipline specific.

The main advantage of service stacking is that service providers can concentrate on a subset of responsibilities, which in turn is thought to benefit service quality and costs. It does, however, mean that service providers need to be comfortable with transferring responsibility, and therefore trust, to partner organisations. This trust is something that will have to be built up over time and will grow when the model has been shown to work, which e.g. is being done with the EOSCpilot Scientific Demonstrators. It also means that service providers will need to describe their SLAs, allowing potential consumers of these services to make an informed decision. The EOSC can help this process along by grouping common SLAs and monitoring service providers to see if they meet the indicated service level and in general supporting and guiding providers towards a proper documentation system in line with the EOSC requirements regarding descriptions of procedures and services.

4.1.2. Views on the catalogue

The EOSC portfolio and catalogue will contain a large variety of services. A comprehensive list like this will, from the users' perspective, be difficult to search through. There are a number of ways that can help deal with this issue.

1. Well defined categories and search parameters in the central location. This will be facilitated by the service description template and a search engine that allows users to dynamically query service descriptions.
2. Sub-portals, potentially discipline or service type specific, that take care of query presets and only return services relevant to the context the user works in.
3. A catalogue API that lets third parties interface with the EOSC catalogue and allows them to display the information contained in the catalogue in a way most suitable for their audience.

It is important to note here that the EOSC service catalogue does not aim to be the *only* place from which a service can be consumed. Resource providers will offer their services directly to their

users without involving the EOSC catalogue, and alternative catalogues, e.g. discipline specific ones, can be created, either based on information taken from the EOSC portfolio or completely separate.

4.1.3. Service quality assessment

It is important for users to be able to easily identify the quality of EOSC services. Some quality indicators can be directly measured, like service up-time, while others need a form of certification, like e.g. ISO. Properties that can be directly measured can be facilitated through the EOSC Core Services, which will e.g. provide service monitoring, while service certification against (international) standards goes beyond the scope of EOSC. This model, with EOSC not itself certifying compliance with certain quality levels or fit-for-purpose labels (e.g for certain disciplines), can only work if such certifications or labels can be applied for, and 'owners' of such quality requirements issue tokens of proof to providers of the service to certify the service is matching 'their' quality level.

EOSC can flag the importance of relevant quality requirements being in place and maintained. It can ensure it recognises and incorporates established quality levels in its compliance approach, and can flag the importance of service quality certification – in general, or concerning specific aspects of use, user-groups, purpose of service use or other that matter to the EOSC users - to realise optimal conditions for smooth SPM.

In terms of quality assessment, the FAIR principles deserve special mention. Although useful in defining the principles to which data and services must adhere, they currently lack the specificity needed to assign a degree of compliance. Work is currently undertaken to make the principles more concrete and, once finished, these can be used as a measure of quality. As goes for other measures, it is preferable the evaluation of FAIR compliance is done by parties external to EOSC. A methodology similar to ISO certification, where one or multiple entities can evaluate applicants' compliance, could enable further FAIR adoption.

4.2. Base model description

In the EOSC SPM process, the Service Provider is in charge of every step of the process. As indicated in figure 9, it is assumed the SP has its own internal SPM process, either informal or formalised using an ITSM standard. The SP can choose to enter a service into the EOSC Portfolio, for which it needs to comply with minimal portfolio requirements described below in section 4.6. If there is dispute on the quality of the description of the service, the EOSC Technical Committee will decide whether it can be included. The EOSC portfolio might not be the only portfolio in which the service is entered, this is left up to the SP to decide. Once the service is in the EOSC portfolio, the SP can choose to expose the service through the EOSC catalogue. On modification of the service, the SP needs to update the information in the portfolio and catalogue accordingly. When the SP decides to no longer offer the service, the service can be removed from the catalogue but stays in the portfolio.

As can be gathered from the text above, entering the portfolio or the catalogue are not measures for service quality. This is done on purpose, as the quality of a service is best established by the community it was meant for. This is the reason for introducing Service Labelling, which can be done both by the EOSC Technical Committee as well as by Community specific committees.

The EOSC Technical Committee can be requested by the SP to establish the EOSC Compliance of a service. These will be quality measures applicable to a large variety of services and are not discipline specific. This can e.g. be uptime guarantees, which can be monitored through an EOSC Core Service dedicated to accounting, AAI integration, service longevity (established by evaluation of the business model), etc. Some of these measures will apply to individual services, e.g. the Data Seal of Approval certification (currently being replaced by its successor the CoreTrustSeal *certification)*, while others apply to entire organisation, e.g. ISO20000. EOSC will reuse existing

standards and methodology as much as possible to establish compliance, i.e. EOSC will not perform the check for compliance with certification requirements but requires the SP to provide proof that an external agency has checked this.

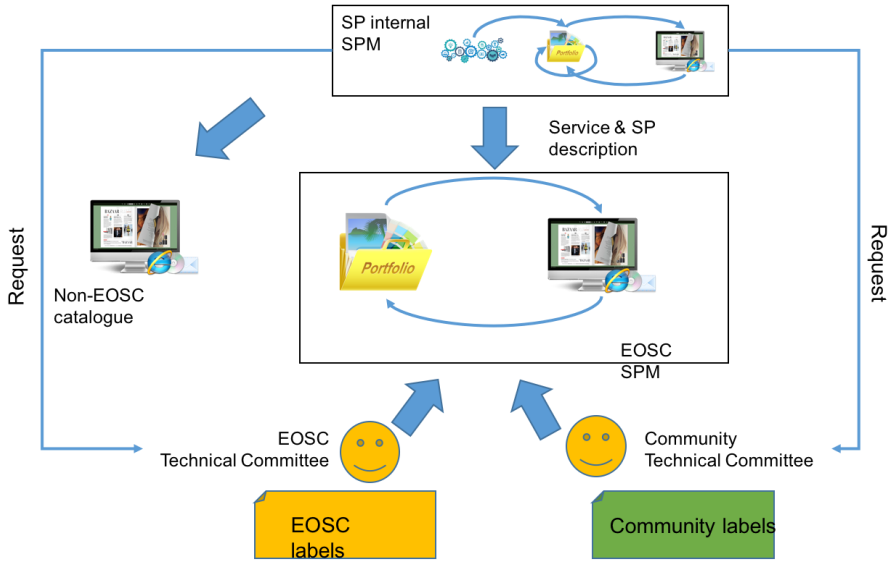

Figure 9: Layout of the EOSC SPM process.

The labelling methodology described above lacks community specific requirements. These can be provided by community specific Technical Committees. They will establish rules for offering services in their discipline. An example of this is how services deal with privacy sensitive data, a requirement relevant to services in the life sciences but not directly applicable to astronomy. Again, the SP is in charge of this process, requesting a Community Technical Committee to evaluate the service. It is to be expected that, over time, requirements from different communities align and either merge into overarching Community Labels, as for example could happen between the high-energy physics community and the astrophysics community, or are made generic to be fed into EOSC labels. This process will either come from bottom-up initiatives, or could be started by the EOSC technical committee.

4.3. EOSC Technical Committees

A team of experts needs to be made responsible for assigning and monitoring service quality within EOSC. This will come in two types: those quality measures that are generic across all (or, at least, many) EOSC services, and those that are scientific discipline specific.

For the first group, a team needs to be put together that will handle quality assignment requests and is responsible for monitoring the agreed upon quality measures. This technical committee will work on behalf of the EOSC Governance Board and report to them. The team will rely on internationally set standards that can be audited by external parties and relies on their input for quality assignment. They will also keep track of service quality monitoring. The last task of this group is to do ITSM for the EOSC Supported Services, which includes portfolio management.

The second group (scientific discipline specific TC) will consists of multiple committees that define and check quality measures on behalf of a scientific community. These committees can be formed by any community that can sustain such an effort for longer periods of time. They will report to the EOSC TC but assign and maintain quality measures independently.

4.4. Service status

Adding services to the EOSC portfolio will be a gradual process. Some communities and service providers will be early adopters while others might join later on, or not at all. To ease this process, two status tiers are introduced, which link to the SPM process described above.

4.4.1. EOSC Compatible

Only services compatible with the PoE of the EOSC portfolio can be part of the EOSC catalogue, which can only be done when they meet the minimum requirements as described in section 4.9. These services can be pre-existing or new. They are provided by Service Providers, which could be e-infrastructures, RIs, commercial parties etc. The business model of these services must be flexible: some might be paid for by RIs, some through national funding, some through EOSC and yet others through a pay-as-you-go method. EOSC Compatible in this model only indicates that the service meets the requirements to be in the EOSC portfolio.

4.4.2. EOSC Compliant

Service providers can apply for 'EOSC labels' which indicate compliance to certain standards or technical specifications. Compliance to technical specifications can be of a variety of types: Service Providers can allow EOSC to monitor their services using EOSC Core services and publish the results, they can provide access to standardised APIs, support metadata standards, etc. The point of this compliance is on one hand to be able to monitor quality and adherence to the specified SLA and, on the other hand, to create uniform interfaces for other service providers to plug-in to. This will enable a system-of-systems to be created through the use of interchangeable services.

Service providers can also demonstrate their compliance with international standards, such as ISO27001 (information security). This compliance will be assessed by entities outside of EOSC but can be made part of the labels in the EOSC catalogue when proof is provided. The combination of compliance to standards and technical specifications is a measure for the overall compliance to EOSC.

4.5. Service types

The EOSC portfolio management methodology will oversee a wide range of services and service providers. A 'one-size-fits-all' approach will not be sufficient to deal with this diversity, therefore, a separation of service types is proposed. Services and their providers are grouped according to the target audience of the service in question. Some services will be used directly by scientists, these are referred to as 'End-user Services', some are intermediary services that will be built on top of or combined to create new end-user services, these are referred to as 'Service Components'. Some services might be developed by or commissioned through EOSC, which are called 'EOSC Supported' services. To keep the EOSC manageable a final category of services is introduced: the 'Core Services. They are described, in reverse order, below.

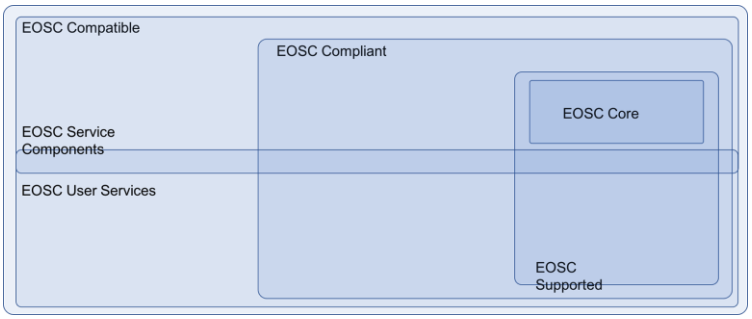

Figure 10: Overview of EOSC service types

4.5.1. Core Services

The Core Services are the fabric on which the rest of the EOSC is built. They come in predefined service types which include AAI, web catalogue, accounting, monitoring, etc. As they are at the core of EOSC, they are provisioned and paid for by EOSC, and therefore all part of the 'EOSC Supported Services'. As they are building blocks for setting up user facing services they are part of the EOSC Service Components group. There are a limited set of instances per service type and, as these services will be the middlemen between service providers, consumers and funding agencies, their operation needs to be carried out by well trusted parties. These services need to be flexible and able to 'plug-in' to services on any of the other levels. Services added to this layer will need to undergo rigorous checking. The EOSC Technical Committee will decide on service inclusion, modification and removal.

4.5.2. EOSC Supported Services

The EOSC needs to be able to steer service development for services that are expected to be useful for multiple communities but would otherwise not come about. These are services that could be unappealing for individual providers to provision, due to high initial investments or due to the required leap in innovation. The EOSC Supported services could both be service components, referred to as 'Core Service' or could be user facing and therefore part of the End-user Services group. What these services have in common is their funding through centralised means. Management of these services will be overseen by the Technical Committee.

4.5.3. Service Components

These are services that can be combined and built-upon to create user facing services. This includes 'raw storage', cloud platforms, VRE generators etc. These services are traditionally delivered by e-infrastructure partners and large Research facilities, both on a European and regional level. They can be compared with 'B2B' services. Quality control should be promoted but not enforced. This might change over time, as the EOSC becomes more mature. Potential consumers of these services (e.g. RIs or other e-infrastructure providers) can specify their own acceptable service levels and negotiate these with service providers. When commonly used SLAs appear, these can be formalized and implemented across the EOSC.

4.5.4. End-user Services

End-user services are Services that scientists will use to do research. Services will include data repositories, web platforms, VREs (either generic or discipline specific), compute systems, etc. These can be considered B2C services. These services are often offered by RIs within their own communities, by e-infrastructures offering services on a European level, by SMEs, or by national / regional institutes.

Note: Some services might both be part of the 'Service Components' as well as of 'End-user Services'. Here, the deciding factor is who the provider interacts with: another service provider who will build on top of the service or an end-user who uses the service to do science. As services in EOSC can be both end-user service and service component, SPM within EOSC must be able to deal with services that are in both categories.

4.5.5. Service type in relation to portfolio management

Between the services in EOSC, one major distinction can be made: where the responsibility of developing, running and maintaining a service resides. The vast majority of services will be the responsibility of EOSC Service Providers, who have their own, internal, portfolio management methodology and add their service to the EOSC portfolio as described previously. However, for EOSC Supported Services (which include the Core Services), this is not the case and the portfolio management therefore needs to be done by EOSC itself, a likely candidate would be the Technical Committee. The methodology for the portfolio management of these services will be akin to the process described by EGI and GÉANT.

4.6. Entering the service portfolio: minimal requirements

To enter the EOSC Service catalogue, a minimal set of requirements needs to be met. As described in the 'EOSC Service Portfolio Vision' section above, the aim is to make the portfolio and catalogue as inclusive is possible. The set of requirements is therefore kept minimal. More elaborate constraints can be placed on services available in the catalogue through the labelling system described above.

A good example for a minimal set of requirements can be taken from the MERIL project[5], which has a similar set[6] of requirements for Research Infrastructures to enter their catalogue. Some of the requirements MERIL poses do not apply in the context of EOSC and were therefore left out. As the EOSC catalogue has a different focus some additional requirements were added. The description of the various requirements is given below.

Provide service & service provider descriptions
The EC-funded eInfraCentral is aiming to create a harmonised service catalogue view across a number of European e-Infrastructures. In order to achieve this goal, the project developed a common service description template that builds on top of previous works (e.g. e-Infrastructure Catalogue of Services[7]) and evolve to create a common vocabulary to describe services. This format is reused within EOSC pilot as it sufficiently covers the information need of this project.

The service description template[8] is structured in various sections some of which can be disclosed to the customers as part of the service catalogue, others are private to the service providers and are needed for the internal management of the service. The sections are:

- Basic Service Information: identification of the service, description of the key functionalities and the possible options, description of the target customers and the value for them
- Service Classification Information: information about the maturity of the service (e.g. lifecycle status or Technology Readiness level), category, relationship/dependency with other services
- Service Support Information: contact information for ordering, support, feedback or for accessing training material or user documentation
- Service Contractual Information: description of service level agreements, terms of use, price and funding streams
- Service Performance Information: list of key performance indicators related to the service
- Service Operations Information: information related to the organisation of the internal operations of the service such as internal contact and documentation, monitoring and accounting information, user support contacts
- Advanced Service Information: user requirements, current and upcoming features, organisation of service components
- Service Business Case information: description of the business case, competition, cost to build and run and risks

Many of the sections above address the crucial requirement that services can only work optimally if users are involved and consulted in all phases of the life cycle of the service. As the services in EOSC will be part of a federated infrastructure, this will be true even more. One of the main conclusions of the recently published report 'The Evolving Landscape of Federated Research Data Infrastructures' by Knowledge Exchange stated: '*The involvement of users is also a crucial*

[5] http://portal.meril.eu/meril/
[6] MERIL Self-Assessment form for Prospective New Entries: http://portal.meril.eu/meril/downloads/MERIL_Self-Assessment_form.docx
[7] https://doi.org/10.5281/zenodo.165467
[8] https://www.dropbox.com/s/g22hylk8kkq8lqf/eInfraCentral-WP3-JNP-ServiceDescriptionTemplate-v1.00-2017-09-17.xlsx?dl=0

imperative, and infrastructures are careful to nurture their relationships with numerous partners within the academic sector and beyond.

Only include actively supported services
Services in the EOSC catalogue need to be actively supported by their providers. This means that the services should be in the service catalogue of the service providers that are responsible for them. When a service provider decides to remove the service from its catalogue the same needs to be done in EOSC. Providing user support and a point of contact are parts of this requirement as well.

Provide access route for international users
Services need to provide an access method for international use. The EOSC does not prescribe what that model should be. It can be 'free at point of use', excellence driven (through e.g. a peer-reviewed granting procedure), 'pay as you go' or anything else. It does, however, mean that this access method is uniform for researchers across Europe.

Be compliant with EU rules and regulations
Being part of EOSC requires service providers to submit to European legislation. This e.g. includes the GDPR[9], which concerns data privacy.

[9] https://www.eugdpr.org/

5. DISCUSSION & FUTURE WORK

This document started out by describing the current landscape of e-infrastructure services in Europe and the way service providers do portfolio management. The complexity has been noted, not just in this text but elsewhere too, many times over. Due to this complexity it is important, in the course of this project, to keep monitoring service and service delivery developments, as not to be behind in understanding the current service landscape.

The last part of this document presented a methodology for portfolio management in EOSC. The aim has been to make it as lightweight as possible while still allowing service quality to be established, in order to both maximise uptake by service providers and users. To see if this model will work for different scientific communities it still needs verification with those communities. This can be worked on in the second (and final) year of the EOSCpilot project.

The proposed methodology for managing the EOSC portfolio tries to unify the management of different types of services. Whether this is the best approach remains to be seen. One alternative would be to work on a collection of portfolios and catalogues, separating services based on their target audience. Development of the portfolios could then also be timeboxed, with priority given to the category that would need to be in place first, which will likely be that of service components. This might be good for EOSC as a whole, limiting the number of things that are being worked on simultaneously.

Furthermore, the proposed methodology needs to be made more concrete and needs to be verified & tested with various communities. One example of this is establishing a number of labels that service providers can apply for and formalising which capabilities a service provider or service must have to obtain them. This applies to both EOSC and community specific labels. Defining what the Core Services are and which features they need to provide is also something that needs to be taken up, as is refining the minimal requirements for an EOSC service, which is something that is expected to be part of the Principles of Engagement.

ANNEX A. STAKEHOLDERS T5.1 ARCHITECTURE

Mapping of the stakeholder roles and sub-roles identified in Task 5.1, the European Open Science Cloud Architecture, Anatomy and Physiology, in relation to Services perspective.

1. EOSC Client is the role of the actors that exploit the facilities offered by the EOSC system as a mean to support their working activities. Three major client sub-roles are envisaged:

- **Scientist**. The actors with this role perform scientific activities in an 'open' way, and will **use** services offered by EOSC for the entire scientific workflow and for reuse of existing assets and collaboration with others. The EOSC service portfolio must contain services to: simplify access; share and (re-use) scientific artefacts produced by others, facilitate publishing of any research artefact; facilitate FAIR data management, and facilitate 'alternative' research productivity metrics.

  Two sub-roles of Scientist have been identified, both will **use** a particular (sub)set of the above services: **Data Scientists** (analysis and data processing services); and **Citizen Scientists** (using services to access and assess scientific production and to contribute to scientific campaigns and initiatives).

- **Research Manager / Admin**. Actors within this role will **use** EOSC services for collecting and monitoring research related information, to assess research productivity. Services aimed at metadata management or IPR management will be wished for in the Services Catalogue.

  Two sub-roles of Research Manager have been identified, both will **use** a particular (sub)set of the above services: **Research Output Manager/Administrator** (curation services); and **External Service Provider** (to develop and operate their own services, they will **use** a particular subset of the services above.

2. **EOSC [Resource] Supplier.** These actors will **provide** services that the EOSC client can use. EOSC [Resource] Suppliers will also **use** services, to make them available and accessible through EOSC, to enter the EOSC service catalogue and for checking the compatibility of their policies with the EOSC ones.

Four sub-roles have been identified: **EOSC Service Component(s) Supplier** will **provide** their own services to EOSC that federate/integrate them with others to enact an EOSC Service. There is a similar but more complex relation between EOSC serviced Components Suppliers and Service Catalogue/Service portfolio Management, than between EOSC [Resource] Suppliers and this sub-role; the second sub-role, **Data (Service) Supplier** will **make available** their own data to EOSC to enact an EOSC Service. This is a specific instance of an EOSC Service Components Supplier; also with a more complex relation; the third sub-role **EOSC Service Component(s) Developers** will **contribute** the technology/ software) needed to operate an EOSC Service Component. This role does not have a direct relation to the Service Catalogue or Service portfolio Management (unless the software used has impact on interoperability issues). In most cases such issues will be part of the responsibility of the EOSC Service Component(s) Supplier; the fourth sub-role **EOSC Service Developers**.that will **contribute** the technology to combine selected EOSC Service Components and complement them to realize the service specific "added-value" / "federator role". This role does not have a direct relation to the Service Catalogue or Service portfolio Management either.

3. EOSC Manager is a wide comprehensive umbrella role for all the actors that manage and operate EOSC and its services, They will **use** services to efficiently and effectively perform their Service Catalogue and Service Portfolio Management tasks **using** the EOSC Service Management System's services.

Three sub-roles have been identified: the **EOSC Owner** is the role played by the actors accountable for the development and maintenance of the EOSC system as a whole. No direct relation to Service catalogue and Service Portfolio Management; the **EOSC Top Manager** role is played by actors responsible for the continuous planning, implementation, and revision of the overall EOSC system. No specific relation to Service catalogue and Service Portfolio Management; and thirdly the **EOSC Service Provider** role that **is responsible** for everything pertaining the development and operation for a specific EOSC Service, including the establishment of the needed underpinning agreements. This suggests a direct link between the EOSC Service Provider and both the EOSC Service Catalogue and the Service Portfolio Management.

ANNEX B. STAKEHOLDERS T2.2 GOVERNANCE STRUCTURE

Mapping of stakeholders identified in the WP3 Governance Framework in relation to services. For all ten stakeholder a summary of the original description is followed by *[assessment of relevance with regards to services offered/used]*

Researchers (including science and technology professionals) who'll be offered a virtual environment to store, share and reuse the large volumes of information generated by the big data revolution. *[so will directly be exposed to/should have influence on the services offered, at Service Catalogue level]*

Service Providers functioning nationally or at a larger scale, with commercial, non-profit or public status, can have 2 roles in the EOSC: providers or also builders. *[so will directly contribute to/should have influence on the services offered at Service Catalogue level, if also builder also as Service Portfolio Management level]*

Research Producing Organisations, Academic Institutions and Research Libraries will be the core users of the European Open Science Cloud/or will be significantly involved in promoting, supporting and enabling research-production activities *[so will directly be exposed to/should have influence on the services offered at Service Catalogue level]*

Learned Societies, Research Communities, Scientific and Professional Associations are key allies to build, use and promote the EOSC *[so will be indirectly involved in services on a more generic, quality, 'good research behaviour', ethical level, will - although indirect - influence how these dimensions enter the Service Catalogue and Service Portfolio Management approach]*

Enterprise Small and Medium sized (SMEs), large enterprises, dynamic European start-ups and entrepreneurs-to-be, researchers, developers, deployers, providers, distributors, etc., also sectors that can benefit or contribute to the EOSC, for example healthcare, transportation, energy, manufacturing, education, analytics, etc. *[so will be involved in, be exposed to, should have influence on the services offered, both as users and/or providers of services, at Service Catalogue and Service Portfolio Management level but in a special 'external, non-public sector capacity]*

Research Infrastructures can be traditional large physical installations, as well as distributed facilities which "include networked resources and skill / capacity building initiatives. They provide several types of services to the EOSC, including cloud and data services and expertise. *[so will be involved in, be exposed to, should have influence on the services offered, both as users and/or providers of services, especially with regard to the specifications, integration/interoperability of services - this is related to both Service Catalogue and Service Portfolio Management]*

E-infrastructures, VREs and other pertinent H2020 projects are key building blocks of the European Open Science Cloud – offering/using bundled and shared services. *[so will indirectly (directly via their researchers) be exposed to/should have influence on the services offered, similar levels as Research Infrastructures.]*

General Public will be participating In the EOSC created cross-border and multi-disciplinary open innovation environment with the aim of delivering its benefits to the final citizen. *[For this group new open science services must be linked with the everyday challenges, that citizens are sensitive to and therefore may influence the set-up of Service Catalogue]*

National, Regional or Local Government Agencies will move, share and reuse data seamlessly across European borders, among institutions and analytical facilities and between different research and data disciplines *[services used by government should comply to certain government requirements – not to be confused with data regulations! - to the Services in the Catalogue]*

Research Funding Bodies make research grants available to researchers, demanding insight in the cost of services that will be used to perform the research in an 'open science' way. *[so the cost*

of services must be trackable for funding bodies, which poses requirements to the Service Catalogue]