EGI-Engage

EGI Sustainability: Business Development and EGI Governance Report

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Abstract

This report presents the results of the business development activities that aim at ensuring growth and sustainability of EGI. It also provides a final report on the strategic planning, implementation, evaluation activities of EGI, the related governance structure and it offers an impact assessment. Finally, it offers an inside look to the updated EGI long-term strategy that is underway.

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TERMINOLOGY

A complete project glossary and acronyms are provided at the following pages:

- https://wiki.egi.eu/wiki/Glossary
- https://wiki.egi.eu/wiki/Acronyms

Contents

Executive Summary

The EGI Federation is dedicated to enabling all researchers from all disciplines to have easy, integrated and open access to the advanced digital capabilities, resources and expertise needed for collaboration and data/compute intensive science and innovation. This is done through creating and delivering open solutions for research by federating access to compute, storage, data, knowledge and expertise.

The EGI sustainability and business development report serves as an opportunity to reflect and report on the progress of implementation against the strategy defined in 2015 as well as its future evolution. The EGI-Engage project was instrumental in supporting EGI to continue to innovate and expand services that ~50,000 researchers use daily such as improving cloud and data services, enlarging the spectrum of its user base by engaging with large Research Infrastructures (RIs), the long tail of science and industry/SMEs and validating its professional service delivery through international standard certifications ISO 9000 (quality management) and ISO/IEC 20000 (service management).

EGI has not been a monolithic project for several years, and recognition of the ISO certifications has gone a long way to demonstrating to the wider EGI Community and to prospective new users that it is a long-term service provider upon which it can rely. This is only made possible by the efforts of the entire EGI community to continuously stabilise the EGI organisational, governance and business model.

Therefore, in order to ensure the long-term availability of the infrastructures and the services, a multi-facet approach is taken. Coordination is provided by the EGI Foundation through participant fees paid by the EGI Participants (e.g., NGIs and EIROs). This is one of the main sources of revenue that binds the national infrastructures making a true European wide infrastructure in addition to paid professional consultancy services (e.g. FitSM training and certification courses). Physical resources and additional human support are sustained through national funding while also ensuring regular maintenance and operation via the NGIs and EIROs, and more than 300 data centres. For part of the EGI Federation, capital investments, operational and access costs are complemented through newly developed pay-for-use models. Innovation and development take place via targeted R&D projects (e.g. European Commission H2020 Programme and research performing organizations). In-kind effort through strategic partnerships provides additional support by the participating organizations around areas of mutual benefit.

The EGI Strategy, defined in 2015 and looking towards 2020, was built on five strategic themes to ensure each part of the overall EGI business model is delivered: 1.) Engage and support user communities; 2.) Design, develop and deploy solutions; 3.) Serve, support and improve live (in production) services, 4.) Influence policies and 5.) Ensure a sustainable future. Business development activities are thus aimed at ensuring growth and sustainability of EGI via the defined strategy.

Delivery towards these themes starts by organising existing high-level services through a formal service portfolio based on or in line with the EGI 2020 strategy, which are categorised as Compute, Storage, Data Management, Applications and Training. These services are delivered to different types research disciplines such as high-energy physics, life science, earth science, groups comprising research infrastructures like CERN, and research infrastructures like ESFRIs. In addition, they are

integrated by a rich portfolio of discipline-specific scientific applications that are provided to end-users as Software as a Service. EGI has been active with emerging research infrastructures and have formed eight Competence Centres to better understand requirements and co-develop solutions.

Strategic partnerships have been established with other e-Infrastructures such as EUDAT, GÉANT, Helix Nebula, OpenAIRE and PRACE, as well as Infrastructure Agreements with Research infrastructures (e.g. Compute Canada, XSEDE) to expand the infrastructure, Policy and standards bodies (e.g. e-IRG) and commercial entities (e.g. CloudSME, Terradue, UberCloud).

Much focus has been on identifying opportunities, expanding the infrastructure and business development. However, an important aspect of sustainability is ensuring that the services offered are consistently maintained, supported and improved upon. This has been covered through a couple different ways, whether the advisory Solutions and Service Board to streamline and guide evolution of the services and solutions portfolio, through the establishment of formal SLAs with communities, or in how the services are managed. In fact, EGI started with the implementation of the FitSM service management standard, and over the course of 2016, the necessary processes and procedures were put in place to aim at both ISO 9001 (quality management) and ISO 20000-1 (service management) certifications. Such certifications were achieved.

New business models have moved from proof of concept to production such as with EGI pay-for-use and the delivery of commercial FitSM training and certification courses to diversify revenue streams.

Finally, an essential component in demonstrating the value of EGI is by assessing its impact. This was done looking at key areas such as scientific excellence (then formalising attractive use cases), adoption of services (measuring usage), implementation of the European Research Area and contributing to the European Open Science Cloud (responding to EU polices/initiatives).

Moving forward, a planned revision of the strategy is underway through a special editorial board from the EGI Council that will look beyond 2020 to ensure EGI is well-positioned in the future to play a pivotal role in the setup of the European Open Science Cloud (EOSC) and continue to deliver value added services throughout Europe and beyond.

The EGI Foundation celebrated its seventh birthday in February 2017, which is a testament to its staying power. This document highlights not only how EGI has achieved this, but also how it will continue to ensure the services offered will evolve and expand over the coming years.

1 Introduction

This report presents the results of the business development activities that aim at ensuring growth and sustainability of EGI. It also provides a final report on the strategic planning, implementation, evaluation activities of EGI, offers an impact assessment, as well as an inside look to the updated EGI long-term strategy that is underway.

The main objective of the EGI-Engage project[1] was to support EGI in providing federated access to compute, storage, data, applications, knowledge and expertise complementing community-specific capabilities. The project also supports service innovation and expands the capabilities offered to researchers (e.g. improved cloud or data services) and the spectrum of its user base by engaging with large Research Infrastructures (RIs), the long tail of science and industry/SMEs. However, as EGI is not a single project, thus this report covers a number of initiatives that have supported the sustainability and evolution of EGI.

Therefore, this report uses the following structure:

- Section 1 introduces the document and its structure.
- Section 2 reiterates the EGI vision and mission as well as its current organisational and governance model to ensure sustainability.
- Section 3 details business development activities carried out to implement the strategy according to defined strategic themes.
- Section 4 focuses on assessing impact and risk.
- Section 5 offers a first glimpse at the revised EGI strategy looking beyond 2020, providing the key discussion points that have resulted from direct consultation with the EGI Council and some ongoing efforts running in parallel at the time of this report.
- Section 6 concludes the document summarising key points and outlines future work.

Further details regarding communication, dissemination and engagement activities are reported in D2.14[2].

[1] https://www.egi.eu/about/egi-engage
[2] https://documents.egi.eu/document/3036

2 EGI Sustainability and Governance

2.1 Vision and Mission

Vision

"Enable all researchers from all disciplines to have easy, integrated and open access to the advanced digital capabilities, resources and expertise needed for collaboration and data/compute intensive science and innovation."

Mission

"Create and deliver open solutions for research by federating digital capabilities, resources and expertise between communities and across national boundaries."

2.2 Organisation and Governance Model

In February 2017, the EGI Federation, through the establishment of the EGI Foundation, celebrated its 7th anniversary, which demonstrates not only its staying power, but the value that its intergovernmental and national participants see as well as approximately 50,000 researchers that rely on the compute, storage, data management and applications that support their research and innovation in their daily lives. The professionalism in which services are managed and delivered was acknowledged through the recent certification received according to ISO 9001:2015 and ISO 20000-1:2011.

EGI in Numbers*

EGI: 22 countries + CERN

EGI Federation: 47 countries

Virtual Organisations: ~250

Users: ~50,000

Resource centres: ~300

Federated CPU cores: 730,000+

Federated storage (disk): ~300PB

Computational Jobs (grid): ~1,8M/day

Virtual Machines (cloud): ~1K/day

*(*Jul 2017)*

EGI has built a proven long-term federated infrastructure that delivers unprecedented data analysis capabilities to many disciplines and sectors comprising more than 300 data and compute centres worldwide, and sustaining an exponential demand in advanced computing services by a large portfolio of research disciplines. Besides this, today, EGI continues to provide both technical and human services, from integrated and secure distributed high-throughput and cloud computing, storage and data resources to consultancy, support and co-development.

EGI is coordinated by a not-for-profit foundation established under Dutch law in the Netherlands, called the EGI Foundation (aka EGI.eu), and funded through a combination of participant fees, national and EC funding, and commercial services.

The Foundation has participants and associated participants drawn from NGIs[3], EIROs[4], ERICs[5], and other such legal entities. These entities participate in the Foundation independently or as the representative of a national e-infrastructure consortium. EGI participants form the governing body, called the EGI Council.

Participants and associated participants also provide the physical and human resources and shared services that enable EGI Federation to deliver, improve and innovate services for research communities. The EGI Foundation coordinates areas such as overseeing infrastructure operations, user community support, contact with technology providers, strategy and policy development, flagship events and dissemination of news and achievements.

The EGI business model has been quite stable for some years, which can be summarised as:

- Coordination is provided by the EGI Foundation through participant fees paid by the EGI Participants (e.g., NGIs and EIROs). This is one of the main sources of revenue that binds the national infrastructures making a true European wide infrastructure in addition to paid professional consultancy services (e.g. FitSM training and certification courses). The EGI Foundation also provides coordination and support roles in H2020 EC programme projects.
- Physical resources and additional human support are sustained through national funding while also ensuring regular maintenance and operation. For part of the EGI Federation, capital investments, operational and access costs through new pay-for-use models added.
- Innovation and development take place via targeted R&D projects (e.g. European Commission H2020 Programme and research performing organizations).
- Strategic partnerships provide in-kind effort from participating organizations in areas of mutual benefit.

2.2.1 Policy Groups

A policy group is an internal EGI body created to define policies and procedures within a specific functional area (strategy, operations, user community, technology, security and administration). They are responsible for developing EGI's strategic and operational policy framework and, thus, for ensuring the stability and availability of a European generic e-Infrastructure.

Each policy group has well-defined responsibilities, composition and operational procedures. It is chaired by an elected or appointed member of the community who is an acknowledged expert in the appropriate subject area. The chair reports the progress of the group's work to the EGI Foundation management.

Each active group is summarised below followed by a diagram outlining the composition of each group and how it is positioned in respect to the EGI Foundation and Council.

[3] NGI: Organisation representing a national e-infrastructure which provides long-term distributed compute and storage resources for research and innovation
[4] EIRO: European Intergovernmental Research Organisation
[5] ERIC: European Research Infrastructure Consortium

Strategy and Innovation Board (SIB)

The SIB is an external advisory body that provides advice and guidance to the EGI council and to EGI.eu leadership about the strategy in the area of: relationship and service provision to user communities, relationship to other e-Infrastructures, relationship to industry, technology and innovation; e-Infrastructure organisation and management. The SIB has ownership of strategy and innovation recommendations, which are intended to be formalised within a living document that will be maintained and updated through regular meetings. Members of the SIB have been appointed during 2017 by the EB.

Services and Solutions Board (SSB)

The SSB is responsible for managing the portfolio of services and solutions regarding EGI.eu and the EGI federated services. This includes all services and solutions that are planned, active or to be retired. The SSB also conducts regularly scheduled management reviews of both services and solutions portfolios and related ITSM processes. It also collects inputs from the UCB concerning the services and solutions for the research communities, from the TCB concerning the evolution of technology and how this can affect services and solutions; from the OMB concerning the services and solutions for resource providers.

Operations Management Board (OMB)

The OMB is an advisory body, which develops strategy and technical priorities concerning the deployment and operation of the production infrastructure, oversees the status and progress of the global EGI operational services and of the NGI operational services. Responsibilities of the OMB include the development of policies and procedures that require formal consensus from the NGI operations managers and their respective resource providers, the collection of requirements from the EGI resource providers, the definition of work plans the long-term development of the EGI operations.

User and Community Board (UCB)

The UCB gathers feedback from the user community relating to the quality of the production infrastructure and prioritises issues requiring management attention for resolution through the OMB. It also defines and prioritises requirements relating to new functionality in the production infrastructure or the user facing operational tools. The UCB includes representatives from the research communities and projects served by EGI.

Technology Coordination Board (TCB)

The TCB provides the focus for the technologies that will be used within the EGI production infrastructure to deliver distributed computing services for the research communities. The TCB carries out strategic activities, such as coordinating the technology evolution and insertion across platforms deployed in the EGI production infrastructure, act as a liaison hub to connect with Research Infrastructure technology coordinators, source components in UMD through bi-lateral relationships with technology providers in the community. The TCB is under reorganisation is under preparation.

Security Policy Group (SPG)

The SPG is responsible for developing the policy needed to provide a secure, trustworthy distributed computing infrastructure. The SPG output defines the behaviour expected from NGIs, Sites, Users and other participants to maintain a beneficial and effective working environment. The SPG also seeks to prepare and maintain simple and general policies which are not only applicable to EGI, but that also to other distributed computing infrastructures.

Computer Security and Incident Response Team (CSIRT)

The EGI-CSIRT provides operational security for the EGI Infrastructure. This includes responding to computer security incidents affecting the infrastructure, which is carried out by co-ordinating the incident handling activities in the NGIs/EIROs, RCs, VOs, and where applicable interacting with partner Infrastructures CSIRTs and CSIRT communities with which EGI-CSIRT has a trust relationship. If needed RCs are provided with expert level forensics support for the incident resolution. EGI-CSIRT also provides preventive and educational services such as security monitoring, vulnerability assessment, advisories to mitigate risks due to vulnerabilities, and security training. To improve collaboration in the field of IT-Security EGI-CSIRT actively reaches out to CSIRT communities and is an active member of Trusted Introducer TF-CSIRT and has been certified since 2014 (accredited since 2012)[6]. The EGI CSIRT is led and coordinated by the EGI Security Officer.

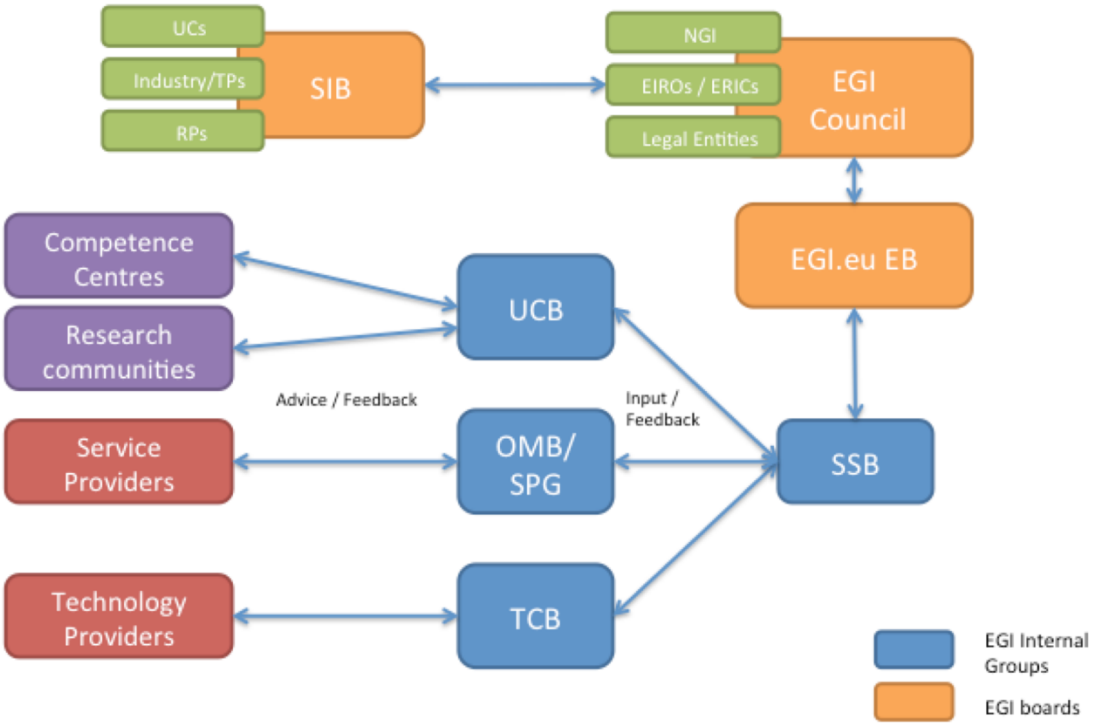


Figure 1 – EGI Policy Boards and Relationships

[6] https://www.trusted-introducer.org/directory/teams/egi-csirt.html

2.2.2 Values of being EGI Participants

Area	Value	Description
Strategy & Policy	Influence European-level policy on e-Infrastructure	Improve your access to policy makers, ensure your issues are considered, e.g. to H2020 work programmes, with the support of EGI.eu. Increase your policy impact as part of a pan-European collaboration. Ensure your efforts are aligned with other countries, simplify international collaboration and support transnational access
	Improve your transfer of innovation to the private sector	Simplify your engagement with the private sector to achieve impact for your research and demonstrate resulting innovations. Be seen as more commercially relevant by funding bodies
	Influence EGI strategy to better support your international users	Influence the evolving joint European service portfolio; check that it matches the needs of your local/national research groups
Funding	Improve access to H2020 funding	Take a leading role in H2020 calls, benefit from the shared reputation of the EGI community, get invited to proposals directly or as a third party due to your EGI participation
	Explore innovative revenue generation models	Benefit from new revenue generating activities, such as acting as an EGI subcontractor or participating in the 'pay for use' programme to receive money in return for resource access
Skills Development	Improve the skills of your personnel through accessing community knowledge, expertise and training	Share knowledge with other EGI participants and increase your community skill levels through working with European experts in many areas, e.g. service management and data science
Technical	Access common tools, services and processes to operate a federated infrastructure	Benefit from a suite of technical tools, internal services and management processes that support federated operations. Avoid building your own alternatives and facilitate cooperation
	Promote your services in a shared marketplace	Get access to a common marketplace supporting a wide range of commodity services, also supporting independent use by smaller communities and the long tail
Community Building	Improve your access to requirements from ESFRIs and emerging user communities	Use strong connections of EGI to user communities and ESFRIs to better understand needs and serve their users
	Connect your local users with international collaborations	Help your local research communities grow to a European or global scale. Help them finding collaborators and highlight their successes

2.2.3 Comparison of Full versus Associate Participant

	Full Participants	Associate Participants
Advertised on EGI website, according to type of membership	✓	✓
Attend Council meetings	✓	✓*
Vote on any decision submitted to the council	✓	
Participate to working groups	✓	✓
Be elected as chair of the Council or as EB member	✓	
Access the member benefit	✓	✓
Be part of the "linked third party" mechanism to join proposals (e.g., projects in H2020)	✓	
Benefit from the new EC regulation about public procurement	✓	
Access Strategy and Policy Decision Support briefing and document reports	✓	
Compensate Infrastructure Fees with in-kind contribution**	✓	

* As observer only and unless otherwise decided by the Council participants

** In the form and conditions defined by the council and supervised by the in-kind committee

2.3 Strategic Planning

Last year's report focused on presenting the EGI strategy for 2020 and the progress with its implementation. This year's report focuses on the implementation activities and results within the given strategic themes.

Figure 2 below shows the "Strategy Map" that depicts EGI's high-level goals, target groups, service offerings and major themes. Emphasis is placed on supporting existing EGI research communities and attracting new ones linked to emerging research infrastructures and outreach to SMEs/industry. To serve these communities better, EGI consolidates existing IaaS capabilities while expanding into PaaS and SaaS domains with pre-configured and customisable platforms that can be easily deployed and managed. This makes it easier to share, discover and process distributed data (either with open or controlled access).

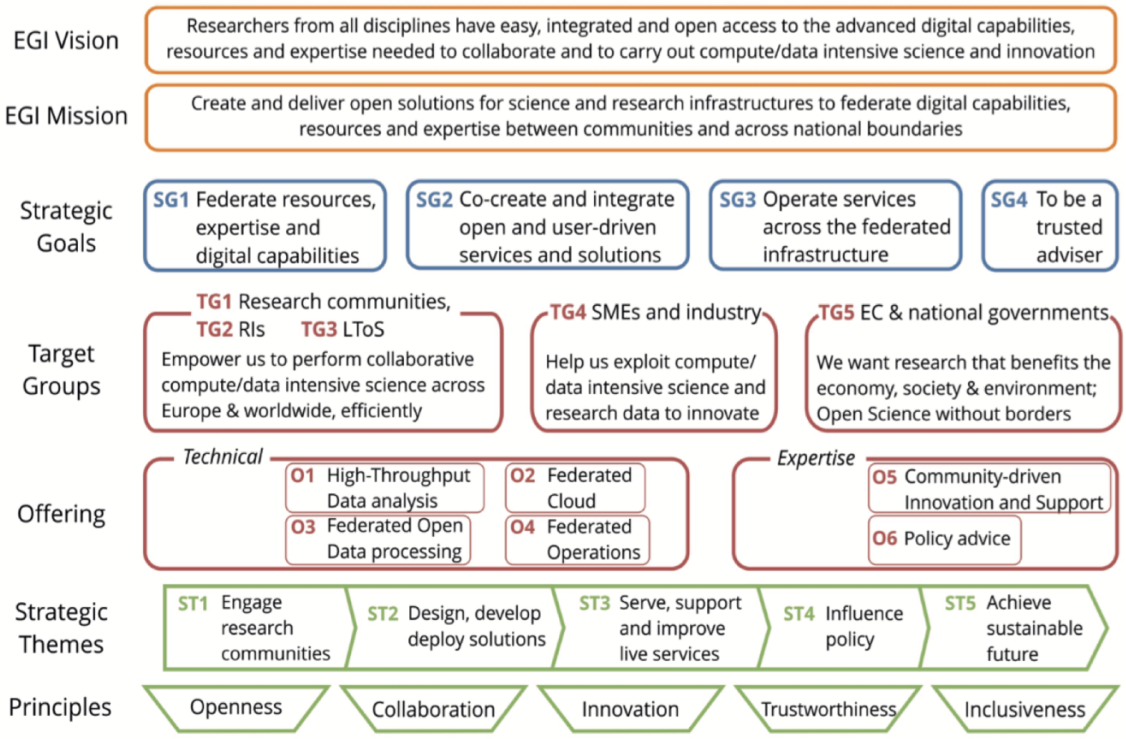


Figure 2 – EGI Strategy Map

Priorities that aim to improve processes and capabilities within the EGI federation are grouped in five strategic themes:

i) **Engage and support user communities -** consolidate outreach networks and create a network of dedicated competence centres for long-term engagement with research communities.

ii) **Design, develop and deploy solutions -** promote open innovation processes and source the best ideas from the community for advancing current EGI services; strengthen skills in managing distributed teams and reinforce adoption of and compliance to open standards.

iii) **Serve, support and improve live services -** continuously improve the maturity of service management throughout the federation; regularly review user satisfaction and collect suggestions to implement through innovation projects.

iv) **Influence policies -** continue to develop competences in digital infrastructure and open science policy while improving the engagement with the European Commission and the Member States; continue to develop and promote the vision for an Open Science Commons.

v) **Ensuring sustainable future -** continue to develop the EGI strategy collaboratively to improve cohesion; work towards long-term, sustainable funding for operating EGI core services while at the same time focusing on raising funds for innovation; continue to explore different business models, while improving discoverability and reuse of services and solutions.

For further details see full EGI Strategy 2020[7].

[7] EGI Strategy - 2015-2020 - https://documents.egi.eu/document/2417

2.4 ISO Certifications

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; a sign of its maturity and of the competence of its actors. The certifications demonstrate that EGI management systems regarding the EGI Service Catalogue are compliant to the requirements and include all activities of planning, implementation, monitoring and continual improvement of all processes.

In short, this means that EGI can offer better services to the EGI consumers and more value to the EGI Council participants. This was enabled by a strategic commitment from the EGI Council to establish efficient processes to manage EGI's service offer. The first step began in 2015 with the full implementation of FitSM, a lightweight version of ITIL and the ISO/IEC 20000 standard.

Having had FitSM in place and all the EGI Foundation staff trained and certified in service management according to this standard meant that EGI service management was already complying with about 80% of the ISO standards. The preparations for the two rounds of audits in October and December 2016 ensured that the remaining 20% requirements were also met.

This work helps to ensure that EGI is operating improved, high-quality and reliable services to better serve its user base and is done with consistent, clear, streamlined processes that assure our stakeholders a better return on investment.

The certifications are another achievement thanks to the support of the EGI-Engage project.

Figure 3 – EGI ISO 9k and 20k Certificates

3 Business Development

Business development activities carried out to implement the strategy according to defined strategic themes outlined in the EGI 2020 Strategy. Therefore, these activities are structured according to those strategic themes.

3.1 Strategic Themes

3.1.1 Strategic Theme: Engage Research Communities and Innovation Actors

This theme focuses on improving an understanding of user needs, and translating these needs into sound projects or services that deliver effective solutions, which is a critical part of our strategy.

3.1.1.1 Stakeholders understand the value of EGI

Website

The EGI website is the main communication channel to and from the EGI Community outside of direct engagement. It serves as the shop window to the EGI services and gives visibility to EGI's resource providers and users. The website was completely renovated during the period of EGI-Engage. The old website was structured around a project model and failed to convey EGI as a service provider that it was. Therefore, in September 2016, the website was substituted both in terms of platform (moved to WordPress) and with updated graphics and structure that better showcases EGI services and increase service visibility.

Use Cases

The best way to show people the value of EGI is to show them how others have leveraged services and the results they have achieved. Over the last several years, the EGI communications team has scoured research publications and engaged directly with researchers to write use cases about their research stories[8]. A compilation of the best stories has recently (July 2017) been published on the EGI website[9].

Other communication channels

- Blog: event reports, announcements by other/external people, opinion pieces, etc.
- Newsletter: community-related in-depth stories, future trends, reflections
- Publications: information to convey the added values of EGI services, or information in a nutshell to stimulate interest
- Social Media: a means to amplify the other communication channels (EGI's social media channels are: Twitter, Facebook, and LinkedIn)

[8] https://www.egi.eu/use-cases/research-stories
[9] http://go.egi.eu/usec

3.1.1.2 Effective Outreach Network

Engagement activities

During the 3 years of the project, the consortium engaged with and supported 40 communities in total (including 8 research infrastructures via a competence centre structure). Out of the 40 cases, 25 are active - i.e. either concluded or in technical development. The remaining 15 are early engagement cases, i.e. a joint agreement on required support is still needed.

The project organised two Digital Infrastructures for Research (DI4R) events with European e-Infrastructure initiatives: EUDAT, GÉANT, OpenAIRE, PRACE and RDA Europe. The first DI4R included one session on research engagement, helping the e-Infrastructures exchange experiences from this area, and improving and harmonising support for new communities. The EGI-Engage project organised two "Design Your e-Infrastructure" workshops in 2016, co-located with the EGI Conference and with the 1st DI4R event. These interactive workshops designed and prepared implementation plans for e-Infrastructures to serve emerging scientific communities. The project engaged with and supported several user communities that wanted to use services from both EGI and EUDAT in an interoperable way: ICOS, EPOS and ENES. A generic use case was defined and implemented for these use cases, then was customised for each community. This generic use case demonstrated basic interoperability between the EGI Federated Cloud and EUDAT data services.

NGI International Liaison (NILs)

EGI members (NGIs and EIROs) as well as EGI partner states/regions delegate International Liaisons to EGI. These International Liaisons (NILs) have a key networking role in the EGI community. NILs work together with the EGI Foundation and with each other to link non-operational activities from their own country/institute/region with the rest of the EGI community. One of the most important of these non-operational activities is Engagement with new communities. With the NIL acting as a spearhead, each country (or EIRO or region) is able to connect its non-operational activities to the European landscape to facilitate services and support for new communities together, and to demonstrate the added value of the country to new communities and to other NGIs. NILs connect the following activities from the national level to the European level:

- Proactive outreach to new communities
- Marketing and communication
- Training
- Support for new users/communities

EGI forms and implements its Engagement Strategy within the NGIs through the NILs.

In June 2017, a survey was sent to the NILs to re-evaluate the network in order to collect updates on discipline/community priorities, and to understand what can be done better especially in countries where EGI does not have active NILs. Responses are starting to come in and will continue into September.

3.1.1.3 *Create a range of dedicated competence centres*

The main engagement instrument was a network of eight Competence Centres, where Research Infrastructures joined forces with National Grid Initiatives (NGIs), user communities, technology and service providers to collect requirements, integrate community-specific applications into state-of-the-art services, foster interoperability across e-Infrastructures, and evolve services through a user-centric development model. The project also coordinated the NGI efforts to support the long tail of science by developing ad hoc access policies and by providing services and resources that will lower barriers and learning curves.

The engagement work itself (for new communities) included the following activities:

1. Reaching out to structured, international scientific communities and projects and discuss e-Infrastructure usage scenarios with them. Target groups included Research Infrastructures and FET initiatives (Future Emerging Technologies), as well as H2020 projects, particularly VRE projects (Virtual Research Environment).
2. Support scientific communities in becoming active users of EGI services[10]. The two 'Design Your e-Infrastructure' workshops in 2016, as well as regular teleconferences with community representatives were the key instruments in this work.
3. Engaging with service providers to integrate their offerings into the EGI catalogue. This work was performed in collaboration with WP2 (task NA2.2 Strategy, Business Development and Exploitation) and WP5 (task SA1.3 Integration, Deployment of Grid and Cloud Platforms).
4. Negotiate SLAs and OLAs to secure services and service configurations for communities.
5. Promote new EGI services for potential target groups. Promotion of the 'Applications on Demand' service and the Open Data Platform were particularly important in this work area.

Competence Centre	Domain	Services Used	Status
BBMRI	Biobanking/ Biomolecular	- Cloud Compute	Prototype
ELIXIR	Life Science	- Cloud Compute - Online Storage - Operational tools - Configuration database - Check-in	Prototype
MoBrain	Translational Research from Molecule to Brain	- High-Throughput Compute - Cloud Compute - Online Storage - Accounting	Production
DARIAH	Digital Arts, Humanities, and Social Sciences	- Cloud Compute	Production

[10] https://www.egi.eu/services

Competence Centre	Domain	Services Used	Status
LifeWatch	Biodiversity and Ecosystems	- Cloud Compute - Online Storage	Production
EISCAT_3D	Next-Generation Radar for Atmospheric and Geospace Science	- High-Throughput Compute - Cloud Compute	Pilot
EPOS	European Plate Observing System	- Cloud Compute - AAI (per-user sub-proxies)	Pilot
DMCC	Disaster mitigation	- High-Throughput Compute - Online Storage - Operational tools	Production

Moving forward, the EOSC-hub project proposed via EINFRA-12 published an open call for Research Infrastructures, Research Collaborations, Projects and SMEs to express interest in participating in the implementation. 48 Competence Centre proposals were received, out of which 8 competence centres were selected and will be used to implement the initial version of EOSC between 2018-2020.

3.1.1.4 Engage and support private sector

EGI-Engage

The first year of EGI-Engage focused on defining the overall business engagement programme. This initially started within a deliverable (D2.2)[11] to describe purpose and scope, objectives, areas of collaboration, benefits, and approval processes, which was used as a basis for developing a dedicated webpage[12] and promotional material[13]. The second year concentrated on outreach, relationship building and on-boarding. This happened at both the European and the national level (further details provided in the following sections).

Activities also addressed key recommendations from the first EC review to reduce scope and target a specific sector to develop concrete use cases while providing suggestions for increasing success and shaping the future Work Program or Framework Program to better support in working with SMEs. This was done through a dedicated webinar held in partnership with UberCloud targeted the manufacturing sector resulting in the NUMECA use case. Individual feedback regarding experience in engaging the private sector was provided in D2.14.

One of the objectives of EGI-Engage task NA2.2 was to ensure that the business engagement model/framework was able to be reused by NGIs. Therefore, a dedicated webinar was held in May 2017) "How to engage SMEs for national e-Infrastructures"[14]. Based on involvement within EGI-Engage, NGIs have started to specify local business engagement programmes with national funding and overall better understanding of how to engage SMEs/Industry.

[11] https://documents.egi.eu/document/2548
[12] https://www.egi.eu/business
[13] https://www.egi.eu/wp-content/uploads/2016/08/EGI_open_for_business-1.pdf
[14] https://www.egi.eu/news/egi-webinar-how-to-engage-smes-for-national-e-Infrastructure-providers

In total, 150+ business related contacts (100+ of which are SMEs) have led to at least 8 concrete use cases[15] with ~20 actively ongoing. In order to structurally analyse opportunities, an initial questionnaire for private organisations was prepared where 14 companies reached out via this form.

EOSC-hub

EGI-Engage has allowed EGI to not only formalise its business engagement strategy, but start to create concrete partnerships, which is evolving into a Joint Digital Innovation Hub (DIH) to continue the foundation laid through the EOSC-hub project where 30 business pilots were submitted through an open call during the project proposal preparation. Six business pilots were ultimately selected, which will serve as initial demonstrators of the DIH. The pilots represent different domains and have different technical requirements, while introducing added value services and clear exploitation and long-term business plans. Activities comprise enabling access to e-Infrastructure services by maximising the use of provided resources, providing first level support and monitoring progress, defining pre-commercial agreements and IPR and assessing and validating results. Though not directly funded by EGI-Engage, it demonstrates the level of outreach and scale of interest from the commercial sector to engage with EGI and its providers.

Innovation Hub

Described in Section 3.1.5.3, the EGI Council approved an EGI Strategic and Innovation fund that will be available for a 3-year period that will be used as seed money to stimulate new or improved products and services. This fund will be available and promoted through our industry network of contacts as an additional engagement mechanism.

Policy recommendations

The below list is a summary of key policy recommendations provided by the individual partners involved in project business engagement activities (NA2.3). Further information is available in D2.14.

- It is evident that there is still a lack of clarity within the research service providers regarding the line between supporting industry, needing to recuperate costs (e.g. pay-for-use) and state-aid and competition laws. It is suggested that the EC provide information and support e.g. creation of a dedicated HLEG.
- EC to provide guidance to member states that SME engagement should be explicitly added to national funding mandates as many are reluctant to provide support or get involved if they are unsure they should or if they will get credit for doing so.
- Direct feedback from industry regarding the top 3 benefits/value they see in using/collaborating with EGI (in order), which should be further promoted:
    - Access infrastructure and platforms with dedicated support
    - Increase visibility (marketing) on a national/European scale
    - Connect to a highly specialised community of experts to develop new products and services

[15] https://www.egi.eu/business/business-use-cases

- SMEs, and start-ups in particular, are in desperate need of access to funding with the limited availability of venture capital in Europe. Many find it difficult to navigate the public funding space and require support in this area. Continue with programmes that target SME involvement, European exposure is a great importance to smaller companies looking to grow. As SMEs conservatively assess the possible benefits of collaboration, it is highly desirable to have some kind of seed funding or seed resources available.
- Incentives for providers are needed to make the physical resources available (e.g. piloting), which can be a catalyst for longer-term business relationships.
- Consider funding program such as Factories of the Future where the funded projects launch open calls to support new experiments focused in several types of technologies, problems, sectors so that SMEs do not feel lost in the complexity of H2020,

3.1.2 Strategic Theme: Design, Build and Deploy New Services and Solutions

3.1.2.1 Manage new services

Business Development & Stakeholder (BDS) Process

A new process was introduced in the last two years with the goal to have an entry point and mechanism for managing:

- High-level definitions of stakeholder categories and their needs
- Relationships with the Council participants and funding agencies/policy makers
- EGI Strategy and its implementation
- The Strategy and Innovation Board
- Memoranda of Understanding (MoUs) between the EGI Foundation or EGI Foundation led projects and other partners
- Input into Customer Relationship Management

Service and Solutions Board (SSB)

A key component to ensure that research communities understand the value of EGI, is from the beginning of service design and delivery. In order to ensure this objective, a strategic body was formed in July 2015, called the Services and Solutions Board (SSB), which oversees and manages the creation and maintenance of the EGI internal and external service portfolios. This includes all services and solutions that are planned, active or to be retired.

As part of its service management responsibilities, a formal Service Design and Transition Package (SDTP) was introduced as a mechanism to evaluate any new service idea to ensure that there was a true business case and customer need. The SDTPs cover 4 main areas, each with its own verification and approval process: Value Proposition; Business Case; Technical Architecture; and Transition Plan. In total, the SSB has:

- Held 32 meetings since its inception.
- Coordinated 16 Service Design and Transition Packages (SDTPs).
- Has been responsible for the revision of the EGI Service Portfolios, and has supported the

publication of the EGI Service Catalogues (Internal to the EGI Federation and External to any relevant customer)[16].

- Improved the interfaces between several processes such as Service Level (Service Catalogue), Customer Relationship (Customer Needs), Supplier and Federation Member Relationship (Providers) and Change Management (Major Changes).
- Conducted a formal review of the service portfolio resulting in the publication of the EGI Service Catalogue in a print and downloadable brochure in the Autumn 2016.

New Services and Management

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, which was documented in both EGI-Engage M2.4[17] and M2.7[18].

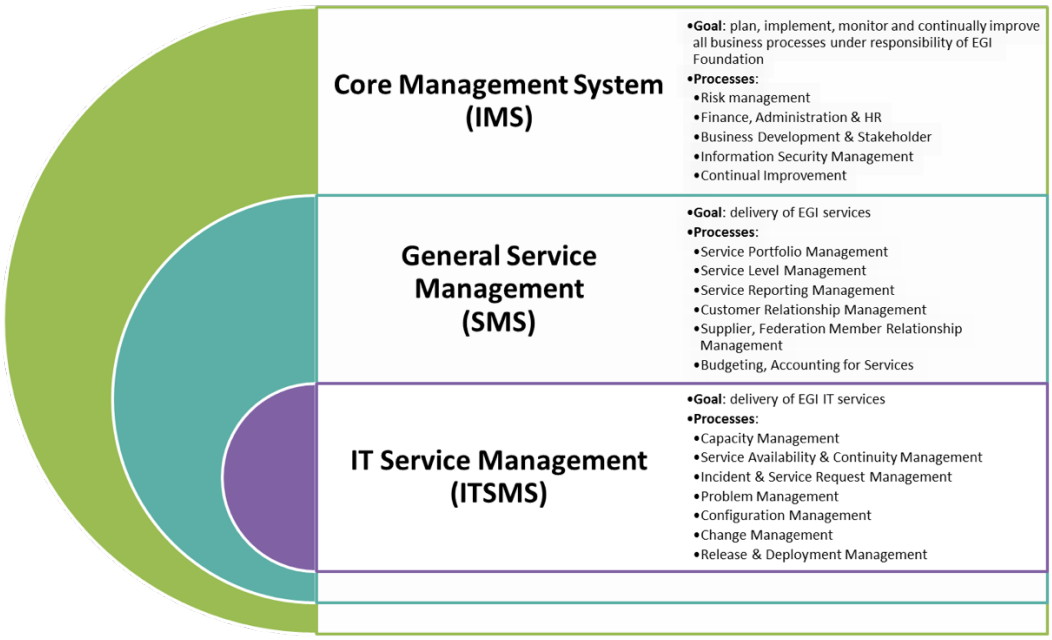


Figure 4 – IMS Process Structure

The IMS includes a dedicated process for Service Portfolio Management, which 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.

[16] https://www.egi.eu/services - https://www.egi.eu/internal-services
[17] M2.4 EGI Service management practices are audited - https://documents.egi.eu/document/2835
[18] M2.7 EGI Service management practices are audited - https://documents.egi.eu/document/2807

- 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 proper evaluation, define the necessary pieces of information regarding the service design, delivery and transition planning. A template for creating an SDTP is provided in order to structure the necessary information, as well as service as a record for future reference and/or re-use. The template also includes:

- **Value Proposition:** Customer/User Profile, Service Overview, Success Criteria
- **Business Case:** Demand assessment, Assumptions, Expected Impact, Cost, Revenue, Risk, Suppliers, Constraints, Access Policy)
- **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 Check-list

The Service Solutions Board (SSB) serves has the initial analysis body with the EGI Council holding final approval. There is a total of 16 SDTPs under various stages of development, of which 5 are planned for publication by the end of October 2017. New services include: Federate Data Manager, Workload Manager, Marketplace, and Check-in (as an internal service and as an external service).

Thematic service portfolio

Research communities have grown accustom to using domain specific services that are more tailored to their needs or provide specialised functionality that isn't possible for an individual infrastructure to provided. Therefore, it is much more strategic to integrated a series of thematic services that sit on top of the infrastructure while allowing the individual research communities to continue to enjoy the services they want and like.

Therefore, EGI has been partnering with both the public and private sector to develop and/or provide thematic services that support open science research workflows. Thematic services are expected to serve the needs of specific science domains and/or of multidisciplinary research. These services are technically and operationally integrated with generic compute, storage, data management and security, to provide a richer set of digital capabilities to the European and international research collaborations.

There are currently 20 thematic services with the EGI thematic service portfolio covering domains such as, but not limited to, life sciences, structural biology, bioinformatics, data analytics, music, virtual research environments, manufacturing and engineering.

3.1.2.2 Develop professional project and virtual team management skills

Establishing lightweight project management system

As part of quality management activity, it was planned to collect lessons learned from the project and organized outcome in a form of Project Management Office (PMO) system. The purpose of this system is to create a single space with all relevant information how to effectively and efficiently run a project.

This way knowledge gathered during the project can be reused in the future as well as be easier shared. Currently the system contains such information as: procedures, plan, guidelines and checklists, templates, and lessons learned.

The content of PMO will be checked against suggestions included in "A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition"[19] and other publications related to Project management office released by Project Management Institute (PMI).

Organize trainings

The EGI-Engage project provided foundational training services and coordination to training activities across the whole EGI collaboration. The main goal of this activity was to operate a framework that enables members of EGI community as well as external partners to effectively create, deliver, share, reuse and benefit from training services in the context of e-infrastructures and e-science. The 'SA2.1 Training' activity of EGI-Engage provided core training services and facilitation of training activities conducted by Competence Centres, NGIs, partner projects and partner infrastructures (including e-infrastructure and Research Infrastructures). Also, this activity provided effort for conducting training on key topics to facilitate uptake of EGI services within scientific communities.

Federated Cloud Training

Development and delivery of training for researchers and communities interested in using the EGI Federated Cloud or building community-specific cloud federations based on the EGI technology.

- 14 events were delivered during the project, ranging from 1h webinars to half-day tutorials, and attended by around 400 people in total.

Design your e-Infrastructure workshop

Interactive workshops where EGI partners up with other e-Infrastructures to help scientific communities to identify suitable generic solutions for addressing community-specific needs.

- 2 workshops were organised, one in 2015, one in 2016, participated by approx. 90 people in total. A similar third workshop was organised with INDIGO-DataCloud in 2017, attended by 20 people.

Security Training

Development and delivery of trainings about the security operations of an online service centre, and/or EGI site.

[19] https://www.pmi.org/pmbok-guide-standards/foundational/pmbok

- 8 events were organised during the project, attended by nearly 150 people in total.

Addressing Innovation and Exploitation in H2020

The EGI Foundation organised a training on "Addressing Innovation and Exploitation in H2020" in December 2016. The goal was to improve staff skills in addressing IPR, Innovation, Dissemination, Exploitation and Impact. The training included both theoretical and practical parts.

FitSM Training and Certification

FitSM is a lightweight service management standard, which was a result of an FP7 project called FedSM (ended Sept 2015). Delivery of FitSM training and certification courses was added to the EGI service catalogue in Oct 2015, which includes 2 types of training courses 1.) open registration courses for individual participants to attend a fixed date and location; and 2.) in-house training for organisations to request. The training scheme offers a range of course levels from Foundation, two Advanced (Service Planning and Delivery; Service Operation and Control) to Expert.

To date (Aug 2017), some key statistics include:

- 18 paid training courses delivered since Sept 2015 (7 in-house; 11 open registration).
- ~200 certifications backed by TUV SUD
    - All EGI non-admin staff with at least both Advanced levels and 10 with Expert level certificates
    - 10 from commercial organisations

Exchange of best practices

As EGI continues to implement service management best practices, opportunity arose through discussions with GEANT to have an exchange of knowledge through having a GEANT representative attend a FitSM trainings (Nov 2017), and an EGI representative attend a course offered by them called “Managing People in Virtual Teams” (Sept-Dec 2017)[20].

The aim of the course is to enhance the skills and knowledge of Activity and Team Leaders in order to strengthen the communication and project management within our teams, leading to greater levels of efficiency, effectiveness and motivation. It also aims to build even stronger relationships across the community and encourage a coaching culture and the sharing of best practices in relation to managing people, running effective team meetings, managing performance, coaching and motivation. One of the outputs of the training was a virtual meeting best practices checklist and guide[21].

Discussions are ongoing with service offers provided to delivery FitSM training for the following organisations: CESSDA; CNR; EBI-EMBL; GÉANT SIG-NOG; INFN; Open Science Grid (USA); PRACE AISBL.

[20] https://wiki.geant.org/pages/viewpage.action?pageId=47909292
[21] http://go.egi.eu/virtual-meetings-guide

3.1.2.3 Stimulate innovation within and outside our community

Organise thematic open innovation campaigns, and stimulate implementation of the best ideas

- In preparation of the EGI-Engage project an open call was organised to select RIs. We received 25 answers. 8 were selected and at the end of the project results were included in a thematic service portfolio[22]. Mature ones are published in the EGI website[23].
- In preparation of the EOSC-hub project, 3 open calls were organised to select: thematic services (60 received, 9 selected); Competence Centres (50 received, 8 selected); and business pilots (30 received, 6 selected).
- Other calls in the future may be connected to the establishment of the Strategic Innovation Fund (see Section 2.1.5.3).

3.1.2.4 Research communities contribute to technical development of new features

Co-develop new features

To engage a broad range of research infrastructures within the ERA supporting them to better serve their research communities, activities focus on the larger RIs and establish dedicated competence centres for co-creating solutions and long-term relationships. This enables the promotion of software products developed by the EGI community to research infrastructures that want to develop services on top of in-house infrastructures and to offer products, services and expertise for federating and operating infrastructures. This also leads to organised pilots to evaluate requirements and subsequently add capabilities for research infrastructure that want to adopt infrastructure or platform as a service (EGI-Engage SA2 Competence Centres).

3.1.2.5 Promote modular and open solutions based on standards

Standards adoption

EGI has a long history of not only adopting available standards, but participating in standard development organisations (e.g. OGF). Almost every aspect of the EGI infrastructure and related technologies are standards, open source based such as Information Messaging (e.g. AMQP, LDAP, STOMP), Information Model (e.g. GLUE 2.0), Storage Management (e.g. CDMI, SRM), Storage File Transfer (e.g. GridFTP), Network Transport (e.g. IPv6), Virtual Machine Management (e.g. OCCI, OVF, TOSCA), Compute Job Execution (e.g. JSDL), Compute Parallel Job Execution (e.g. OpenMP, MPI), Security Authentication (e.g. X.509, SAML, OpenID, OAuth, SSH).

A complete list can be found here[24].

Technology Coordination Board (TCB)

The Technology Coordination Board (TCB), through its working groups, provides the forum for EGI to coordinate the requirements, assessment, delivery and verification of software technology as it moves

[22] https://confluence.egi.eu/display/EGI/Thematic+Service+Portfolio
[23] https://www.egi.eu/use-cases/scientific-applications-tools/
[24] https://wiki.egi.eu/wiki/Standards

into the production infrastructure, as well as to define technical roadmaps and contribute to continual service improvement. Over the last couple years, the TCB evolved to the point that it was more efficient to create subgroups within it to focus on specific areas. There are currently 3 TCB sub-groups (Cloud, AAI, Data).

Technical Roadmaps

Various roadmaps have been produced:

- EGI AAI Roadmap
- EGI Check-in Architecture and Documentation
- EGI Cloud Roadmap
- EGI Cloud Architecture

These are accessible on the dedicated wiki page[25].

3.1.2.6 Provide certified and tested technologies

Unified Middleware Distribution (UMD)

Unified Middleware Distribution (UMD) is the integrated set of software components contributed by Technology Providers and packaged for deployment in EGI after being validated as production-quality.

UMD4 is the current supported UMD distribution. It supports the following Linux distributions: CentOS7, SL6 and Ubuntu 16 (Xenial). UMD3 will still receive security or critical updates for SL6. UMD3/SL5 and UMD3/Debian are not supported anymore.

The yaim component, a common configuration management script used by many HTC middleware components, is not supported anymore. Yaim has been replaced by component-specific documented procedure to install, configure and test the product. Examples of alternative configuration tools are Puppet recipes, Ansible recipes, or custom scripts and step-by-step guides mainly for products with simple configuration. Puppet recipes are currently the most popular standardized configuration mechanism provided by the product teams.

UMD4/SL6 started as a mirror of UMD3/SL6, without the products that were about to reach or have already reached end of life. Products based on SL6 are now distributed through UMD4/SL6, and only security updates are distributed through UMD3/SL6.

Cloud Middleware Distribution (CMD)

The Cloud Middleware Distribution (CMD) aims at distributing OpenStack and OpenNebula integration components (not the cloud management systems themselves) that are products that are deployed on top of OpenStack/OpenNebula mainstream distributions, other products that enable the IaaS federation, even if they're not directly dependent on OpenStack/OpenNebula. The main reason to release separate distributions from UMD is that the release cycle of OpenStack and OpenNebula is

[25] https://wiki.egi.eu/wiki/Technology_Coordination_Board#Documents

different from the UMD one; hence basically whatever depends on it is moved to a different dedicated distribution. The client components, will be distributed through UMD.

In summary, CMD is actually organized in two different distributions:

- CMD-OS (OpenStack)
- CMD-ONE (OpenNebula)

and components are released as follows:

- OpenStack specific components, in CMD-OS
- OpenNebula specific components, in CMD-ONE
- Common cloud components (information provider, accounting, appliance synchronization management), in both CMD-OS and CMD-ONE

Every CMD major release is associated to a specific OpenStack release or OpenNebula release and follows the respective release cycles. The first version of CMD-OS supports OpenStack Mitaka, the first version of CMD-ONE (to be released) supports OpenNebula 5.

All the products in CMD must be available both as CentOS7 and Ubuntu Xenial packages.

The software distributed in UMD and CMD goes through the Software Provisioning process, which goal is to validate the software to be production-ready, and to reduce as much as possible the probability that the new released deployed in production cause problems to the services. The UMD Software Provisioning process can be summarized by the following steps:

1. Technology Providers submit new software releases to the EGI software provisioning process
2. Software Assessment through Quality Assurance and Staged Rollout
3. Provide early feedback to the developers about outcome of the software provisioning process
4. Release in UMD and CMD the products that successfully completed the validation steps, to be deployed in production services

In particular, the Software Assessment step is done in two phases:

1. Quality Assurance, consisting in the software to be installed and configured by the UMD team using the documentation and procedures provided by the software development team; if everything is OK, the software goes through the next step, called
2. Stage Rollout, consisting in testing the software on a given Resource Centre interested in trying the software in advance, and so acting as Early Adopter.

The FedCloud components developed in JRA2 for OpenStack and OpenNebula integration are in production.

Containers

At the moment UMD and CMD are releasing in repositories supporting rep and deb package management systems, being these the most common and popular both among the developers and the resource centres. In parallel to the traditional packages management systems, containers installations are increasing in popularity among the technology providers, in particular the INDIGO

DataCloud project that is delivering components for the federated cloud portfolio. Docker containers have several advantages for both developers and system administrators, and they are expected to increase in demand in the future.

The containers are already used in the FedCloud, the federation layer software is available as containers to be deployed inside a dedicated virtual machine, which images is made available by the EGI cloud team.

To support containers EGI will have to apply a Software Provisioning process similar to what is implemented for the packages, subject to the same requirements.

The Technology Provider must provide the same (or equivalent) information. For the development team: TP Leader and Contacts; about the releases provided through containers: Contact, Documentation, Release Notes, Verification Procedure, GGUS Support Unit and QoS Level, support calendar.

The Verification procedure will consist in successfully starting and running the container on the supported Operating Systems (say CentOS7 and Xenial), to demonstrate compatibility with a set of hosting solutions.

The Staged Rollout report of the software released in the container must be available, but it can be provided by an early adopter deploying the same software using packages, if the same software release has been submitted, for example, to UMD both with containers and rpms.

The successfully validated containers will be then made available in a dedicated DockerHub repository managed by EGI, and containing only validated containers. Ideally the EGI resource providers should use only this repository to download docker images.

3.1.3 Strategic Theme: Support, Serve and Improve Live Services and Solutions

3.1.3.1 Continuously improve service management across the federation

Service Management

EGI has defined a system to plan, implement, monitor and continually improve all business processes under the responsibility of EGI Foundation. This resulted in:

- The implementation of an Integrated Management System (IMS)[26], which integrates all of the organization's systems and processes into one complete framework, enabling an organization to work as a single unit with unified objectives.
- The ISO 9001:2015 and the ISO/IEC 20000-1:2011 certifications for the EGI Foundation. The certifications show that the EGI management systems put in place to plan, implement, monitor and continually improve all processes regarding the EGI Service Portfolio follow the requirements of the ISO 9001:2015 and ISO/IEC 20000-1:2011 standards. The ISO 9001:2015

[26] https://confluence.egi.eu/spaces/viewspace.action?key=IMS

certificate covers all business processes including administration and finance, human resources, quality management, risk management, business relationships and continuous improvement. ISO/IEC 20000-1:2011 certification is a specialization of the previous designed to cover all IT-related services including compute, storage and data as well as internal services enabling Federation.

- Certification of EGI Foundation staff as Auditor to support the adoption of ISO standards by the service providers.

Another aspect was to ensure legal compliance with the regulations around the data privacy. The new GDPR regulation adds new requirements that need to be met by May 2018. Therefore, we decided to start the work to ensure compliance with the remaining budget of EGI-Engage by performing an assessment of the needed actions and by defining a roadmap for implementation.

3.1.3.2 Develop a services and solutions portfolio in collaboration with user communities

EGI services cannot be developed top-down. Customer input is essential if EGI wants to continue to deliver value added services for the long-term. Therefore, mechanisms need to be put in place to ensure the user communities have a communication channel to not only provide requirements, but user satisfaction as well. Procedures for regular review of customer satisfaction are included in an established process within Customer Relationship Management (CRM). In addition, SLAs also include service reviews with the customer, which is part of Service Level Management.

EGI-Engage provided support to experiment and prototype new services e.g. Applications on Demand; Check-in; DataHub; Marketplace; Galaxy and Jupyter as a Service.

For each community, there are agreed indicators that relate to their relationship with EGI and have established mechanisms for monitoring and reporting in the coming months. By the end of 2016, an annual review of customer satisfaction will be carried out.

3.1.4 Strategic Theme: Influence Policy

3.1.4.1 EGI as a trusted source of policy input for the EC

Research Infrastructure Sustainability

EGI contributed to EC consultation activities on long-term sustainability of Research Infrastructures. EGI contributed to the discussion with experts and stakeholders on the main challenges identified in the online consultation on Research Infrastructures long-term sustainability and to collect suggestions and comments that could contribute to the development of a dedicated Action Plan. More than 170 persons coming from Member States, funding Agencies, stakeholder Organisations and Research Infrastructures, belonging to all the different scientific dimensions, contributed.

European Open Science Cloud (EOSC)

EGI offered trusted advice to the EC for the shaping of the EOSC and policies around open science in three main ways: authoring position papers, contributing to public consultations and active

contribution in workshops and events. These activities were possible thanks to a series of internal and external consultation activities which involved the EGI members and key stakeholders like researchers, research collaborations, ESFRI projects and cluster in public workshops co-located with the main EGI events. With regards to the position papers:

1. EGI co-authored the paper “European Open Science Cloud for Research” with other leading European initiatives EUDAT, LIBER, OpenAIRE and GÉANT, sharing their joint vision for the European Open Science Cloud for Research. The joint publication sets out the partners’ strategic vision for the European Open Science Cloud’s organisation and identified 8 elements for the EOSC success;
2. EGI co-authored the paper "Report on the governance and financial schemes for the European Open Science Cloud" in the context of the OSPP by providing chairing of the sub-group and leadership. The paper provides high-level recommendations for shaping the future EOSC and it was presented at the Competitiveness Council and at the EOSC Summit.

Concerning the consultations, EGI provided contributed to several EC consultations and also initiatives from other policy bodies such as e-IRG[27].

In preparation to the first EOSC consultation meeting that was organised by the EC in October 2015, EGI actively contributed a position paper which defines the main EOSC challenges and the role of EGI in addressing these.

With regards to the contribution to events and workshops, representatives from EGI attended key events like the open workshops of the High-Level Expert Group on the EOSC, the meetings of the Open Science Policy Platform, the EOSC summit[28], e-IRG workshops[29] and other relevant events.

EOSC implementation Roadmap

In March 2017, EGI led a project consortium mobilising various e-infrastructures and more than 18 research collaborations, infrastructures and projects to realize the EOSC “Hub”. The EOSC-hub project aims to create the integration and management system of the future European Open Science Cloud that delivers a catalogue of services, software and data from the EGI Federation, EUDAT CDI, INDIGO-DataCloud and major research e-infrastructures. This integration and management system (the Hub) builds on mature processes, policies and tools from the leading European federated e-Infrastructures to cover the whole life-cycle of services, from planning to delivery. The Hub aggregates services from local, regional and national e-Infrastructures in Europe, Africa, Asia, Canada and South America. The Hub acts as a single contact point for researchers and innovators to discover, access, use and reuse a broad spectrum of resources for advanced data-driven research. Through the virtual access mechanism, more scientific communities and users have access to services supporting their scientific discovery and collaboration across disciplinary and geographical boundaries.

[27] Feedback to e-IRG roadmap revision: http://e-irg.eu/roadmap-consultation/-/message_boards/message/327718
[28] EOSC Summit, June 2017 http://ec.europa.eu/research/index.cfm?eventcode=44D86060-FBA1-1BD1-9355822B162BB0EE&pg=events
[29] e-IRG Workshop in Malta, June 2017, http://e-irg.eu/workshop-2017-6-programme

The project also improves skills and knowledge among researchers and service operators by delivering specialised trainings and by establishing competence centres to co-create solutions with the users. In the area of engagement with the private sector, the project creates a Joint Digital Innovation Hub that stimulates an ecosystem of industry/SMEs, service providers and researchers to support business pilots, market take-up and commercial boost strategies. As mentioned, six pre-selected business pilots will initiate the digital innovation hub with additional pilots to be onboarded during the project.

EOSC-hub builds on existing technology already at TRL 8 and addresses the need for interoperability by promoting the adoption of open standards and protocols. The EOSC-hub project leverages and expands the EGI-Engage key results, existing international collaborations, the EGI Federation infrastructure and the EGI-Engage competence centres by opening them to an unprecedented scale of user communities.

ERA Stakeholders Organisation (ERA SHO)

EGI, as member of the European-level Research Infrastructure Facilities - Association Internationale Sans But Lucratif (ERF-AISBL) Board of Directors, represents the latter in the ERA Stakeholders (ERA SHO) Platform to advise and support the European Commission in its implementation of the ERA.

3.1.4.2 Promoting the Open Science Commons

The promotion of the Open Science Commons continued in several contexts. The overall concept will be published in a dedicated chapter of the book "Earth Observation, Open Science and Innovation"[30]. In the latest part of the project, with the gained importance of the European Open Science Cloud, we focused mainly on working to develop this policy action and defining our role within it.

3.1.5 Strategic Theme: Ensure a Sustainable Future

3.1.5.1 Collaboratively develop the EGI strategy

Monitoring and updating the strategy

The EGI strategy for 2020 was adopted in May 2015 after several months of development through a collaborative process that involved the EGI Foundation staff, EGI senior management and the EGI participants at large. Over the last two years, the focus has been on the implementation of that strategy, which was tracked via a dedicated spreadsheet that included milestones for each area, deadlines and individual milestone owners. The plan was to review the implementation at least yearly during EGI Council meetings (in practice, was more frequently) with the strategy itself to be reviewed every two years.

That means that a formal review and subsequent update of the strategy is to take part during 2017. In order to do so, a dedicated survey was prepared and circulated prior as input to the EGI Council meeting that took place 29-30 June 2017 in Amsterdam. Feedback was presented, breakout sessions were held by strategic themes, and group discussions in a plenary setting were held. It was agreed

[30] http://www.springer.com/de/book/9783319656328

that an editorial board will be formed to analyse all of the feedback from individual council members in order to articulate an updated version of the EGI Strategy during the summer and autumn. A summary of work to date is provided in Section 4.

Strategy and Innovation Board

The Strategy and Innovation Board (SIB) provides advice and guidance to the EGI council and to EGI.eu leadership about the strategy in terms of relationship and service provision to user communities, other e-infrastructures, industry, technology and innovation, and/or e-infrastructure organisation and management.

Members are appointed for a 2-year term renewable once. Every 2 years, a call for nomination is issued and publicised through EGI council representatives and EGI communication channels and will stay open for a period of one month. Applications are open to anyone and should include a short statement of interest (1 paragraph) and brief CV (1 page). Applications will be reviewed by the EGI.eu Executive Board (EB).

Attendance to SIB meetings is open to EGI council and Executive Board members, EGI.eu Director, EC representatives and invited guests under EB supervision to provide the SIB with information of current direction, achievements and foreseen strategy.

Members of the group are treated as individual experts who do not formally represent any constituency and their recommendations does not imply any approval or endorsement by their respective organisations.

First meeting was held in September 2017 with the main topic of discussion to review the current update of the EGI Strategy.

Current SIB members are:

- **Prof. Ian Foster:** Distinguished fellow and senior scientist in the Mathematics and Computer Science division at Argonne National Laboratory; Professor in the department of Computer Science at the University of Chicago; Lovelace Medal of the British Computer Society; Gordon Bell Prize for high-performance computing (2001); IEEE Tsutomu Kanai Award (2011); Fellow of the British Computer Society in 2001; Fellow of the American Association for the Advancement of Science in 2003; Fellow of the Association for Computing Machinery in 2009
- **Michela Magas:** Director, Stromatolite Innovation Lab; Founder #MusicTechFest, #MusicBricks, #Sonaris_tech; EU Woman Innovator of the Year 2017; Advisor, Innovators' Strategic Advisory Board on People-Centred Innovation to G7 Leaders; Advisor, Innovation, Connect Advisory Forum, Digital Agenda for Europe (CAF); Advisor, Open Innovation Strategy and Policy Group, European Commission (OISPG)
- **Prof. John Wood:** Secretary-General of the Association of Commonwealth Universities and High Level Expert Group on Scientific Data Information Chair & European Research Area Board Chair; Dean of Engineering at Nottingham University; Visiting professor at Oxford University and Imperial College; Non-executive director of a number of companies including Bio-Nano Consulting and sits on the advisory board of the British Library; Founder member of the

European Strategy Forum for Research Infrastructures (ESFRI) and became chair (2004); Commander of the British Empire for "services to science" (2007); First chair of the European Research Area Board (2008); Fellow of the Royal Academy of Engineering (1999) and current member of their Council and International Committee; Currently on the board of the Joint Information Services Committee responsible for the UK academic computing network and chairs their Support for Research Committee.

- **Prof. Giorgio Rossi:** Professor of Physics at the Università degli Studi di Milano; Leads the APE (Advanced Photoelectric Effect Experiments) and NFFA group at CNR-IOM and Elettra in Trieste performing research in surface and interface science and operating advanced synchrotron radiation beamlines and in-situ growth laboratories that are open to users. ESFRI Chair since July 1st, 2016; Chair of the GSO-G8+5 group on Global Research Infrastructures in 2017

Additional representatives, such as from industry, is under evaluation.

3.1.5.2 Long-term funding sources for operations of EGI core services

Core activities have been funded and provided to the EGI Infrastructure members independently from project funds since several years.

Core activities are the technical services and human activities, mostly operational, that are needed to enable the EGI federations and for the daily provisioning of the services to EGI customers. The list of the core activities is approved by the EGI Council and then provided in cycles of two or three years. There are processes to add new services during the cycle, in this way EGI federation can be agile to answer to new requirements.

Once the list of core activities to be funded is defined, EGI operations prepare a detailed description with the technical requirements for every one of these activities and it is made available to the EGI council members. EGI Council members interested to participate to the core activity provisioning prepare an expression of interest, which includes a technical specification of the service they would provide, and all additional information to evaluate the proposal and submit to EGI Operations.

Expressions of interest are then evaluated technically and ranked using the priorities as described in the wiki page dedicated to the bidding process[31]. The service providers selected, for the bid period, in the preliminary assessment are then finally approved by EGI Council.

The funding of the core activities is co-funded by the EGI Foundation and the service providers: a percentage of the allocated effort for the activity is funded by the EGI Foundation, supported by the council fees, and another percentage of the effort is co-funded by the service provider as in-kind contribution to the core activities.

This funding scheme does not exclude other sources of funding, such as for example EC projects, core activities can be supported by projects for developments and evolutions or operations. In this case, the allocated effort for the service provisioning is distributed across three funding sources: EGI Foundation, service provider in-kind contribution, and EC projects.

[31] https://wiki.egi.eu/wiki/EGI_Core_activities:Bidding

3.1.5.3 Attract funding for innovation

EC Projects

Summary of current EC projects in which the EGI Foundation is participating.

Project	Description	Start Date	End Date
EGI-Engage	Engaging the EGI Community towards an Open Science Commons	01 Mar 2015	29 Aug 2017
EDISON	Building the Data Science Profession	01 Sep 2015	31 Aug 2017
INDIGO-DataCloud	Integrating Distributed Data Infrastructures for Global Exploitation	01 Apr 2015	29 Sep 2017
HNSciCloud	European pre-commercial procurement (PCP)	01 Jan 2016	30 Jun 2018
ELITRANS	Facilitating the transformation of ELI from ERDF	01 Sep 2015	31 Aug 2018
EOSCpilot	First phase in the development of the European Open Science Cloud (EOSC)	01 Jan 2017	31 Dec 2018
AARC2	Design an AAI framework to develop interoperable AAI	01 May 2017	30 Apr 2019
ENVRI+	Environmental Research Infrastructures Providing Shared Solutions for Science and Society	01 May 2015	30 Apr 2019
eInfraCentral	European E-Infrastructure Services Gateway	01 Jan 2017	30 Jun 2019
AENEAS	Advanced European Network of E-infrastructures	01 Jan 2017	31 Dec 2019
AGINFRAplus	Accelerating user-driven e-infrastructure innovation in Food Agriculture	01 Jan 2017	31 Dec 2019
RISCAPE	European RIs in the International Landscape	01 Jan 2017	31 Dec 2019
NextGEOSS	Next Generation GEOSS for Business & Innovation	01 Dec 2016	31 May 2020

EGI Strategic and Innovation Budget

The principle of creating an EGI Strategic and Innovation fund has been accepted by the EGI Council for a 3-year period during its last meeting in June 2017. The approved budget for 2018 is €235.000 that will be used as seed money, thus allowing to raise about €600.000. The final terms of reference and procedures are under discussion and should be validated by the Council before the end of 2017.

Future Work Programmes

Within the EGI Council, we have discussed the possible areas of involvement for EGI within the next H2020 Work Programme 2018-2020. The directions will be consolidated when the final version will be available.

3.1.5.4 Develop complementary business models

Pay-for-Use

From a thought experiment in 2013 to production in early 2017, the EGI pay-for-use activities have consistently matured culminating in the first financial transaction facilitated by EGI via collaboration between IBM Research and PSNC[32]. One of the biggest changes was the decision to move from e-

[32] https://www.egi.eu/about/newsletters/egi-data-centre-helps-the-ibm-research-lab-to-model-an-exascale-computing-system/

GRANT as the pay-for-use interface to the EGI Marketplace, therefore the focus during the last year has been on providing all of the technical and user functionality requirements as well as all business processes. This shift impacted the activities carried out and ultimately delayed any real promotion of the activity until the Marketplace comes online. As an intermediate solution, a dedicated wiki page was created in order to have publicly referenceable information of all providers, services, resource and pricing available[33].

From a legal and policy perspective, it was important that each provider formally stated its ability and willingness to offer services on a pay-for-use basis given the publicly funded nature in which the EGI Federation operates, to cover contractual insurances (e.g. in case of SLA breach), as well as specify under which/if any constraint (geographical location, commercial organisations, commercial activity, etc.). This is ensured via signed Letters of Intent by each organisation from an authorised representative. To date, seven such letters have been secured with a few others under internal discussion.

The concept of pay-for-use was originally met with scepticism as the majority of providers were not sure of the feasibility and potential use cases, but over the last few years, many are now seeing the opportunities and are starting to participate more and more over time. This has been demonstrated through different areas such as:

- Funded changes: Funding has shifted from resources to services and many providers are experiencing difficulty in having resources funded through projects and are thus being forced to explore different cost recovery options.
- Tenders: EGI has been gaining experience in acting as a demand aggregator through participation in a number of tenders such as via the European Space Agency, which has stimulated providers to understand costs of the services.
- Business Engagement: As EGI's business engagement activities and overall business model development have taken shape over the last couple years, as use cases are brought in, many are now evaluating the opportunities more on what business options are available after any pilot phase before getting involved. This is coupled with the first point on funding shifts.

One of the most evident examples was the EGI Foundation's involvement within the NextGEOSS project where EGI was allocated external budget to purchase services from within the EGI Federation during the project to support a number of pilots. This funding model was only available to those providers who were able to provide prices for the services offered and have an ability to invoice for them. This exercise is pushing a number of new providers into the pay-for-use pool and is a potential new model moving forward to ensure that both the EGI providers are reimbursed for the resources and services offered and EGI continues to demonstrate value to its participants.

Moving forward, members of the pay-for-use activity coordinated requirements that fed into the EGI Marketplace work in order to display pricing information and enable pay-for-use access modes.

[33] https://wiki.egi.eu/wiki/Pay-for-use

FitSM Training and Certification

FitSM Training allows participants to learn the fundamentals of IT service management and how to implement formal service management in any organisation through a combination of lessons and examples. The training programme is structured in three levels: Foundation, Advanced and Expert and was accredited by TÜV SÜD, a global leader in standardisation and certification.

The EGI Foundation offers 2 types of courses for all 3 levels:

1. FitSM Open Training: Individuals to attend a pre-determined location and date (e.g. Amsterdam)[34]
2. FitSM In-House Training: Held within requesting institution premises at a mutually agreed time/place; Cost effective when needing several individuals to be trained[35]

[1]Training module	Duration	[2] Max. participants	[3]Regular training base price per course	Discounted training base price (EGI participants)	[4]Certification & Examination fees per participant
FitSM Foundation	1 day	15	1,600€	1,360€	80€
FitSM Advanced (SPD or SOC)	2 days	15	3,200€	2,720€	160€
FitSM Expert	2 days	15	4,000€	3,400€	240€
FitSM Expert Bridge*	2 days	15	5,000€	4,250€	400€

Figure 5 – Example of EGI FitSM In-House Course Offer

Market Research

Marine Fisheries

The data managed in the fishery and marine sciences sector is growing exponentially in both size and frequency, and it is expected to keep this pace in future years. Technological innovations, such as mobile phones and satellites (to e.g. monitor and detect illegal fishing activities), require big data collection, management and processing, and interoperability across current institutional and infrastructure boundaries. The following sections provide an overview of activities carried out by FAO over the last year that includes a continuation of legal interoperability and data sharing, as well as a first outline of a concrete service delivery model between FAO, D4Science/CNR and EGI.

FAO worked over the last year was to document a concrete Service Delivery Model (SDM), bringing together:

- FAO as the end customer with the need for legal interoperability;

[34] https://www.egi.eu/services/fitsm-training/calendar/
[35] https://www.egi.eu/services/fitsm-training/in-house-training/

- The D4Science infrastructure as a mediator for data services (developed in the BlueBRIDGE H2020 project), and
- EGI as the infrastructure and computational resource provider.

With the legal interoperability objective in mind, FAO reviewed two agreements:

1. The SLA between D4Science[36] and the EGI Foundation on e-Infrastructure computing resource provisioning, and
2. The MoU between FAO and CNR to enable communities to exploit e-infrastructure services. These agreements in particular were selected due to their legal character. The SDM model provides a template against which these agreements can be assessed to identify gaps in the legal framework.

The figure below presents the SDM with for each step in the 'value chain' the minimum required agreement along with a brief description.

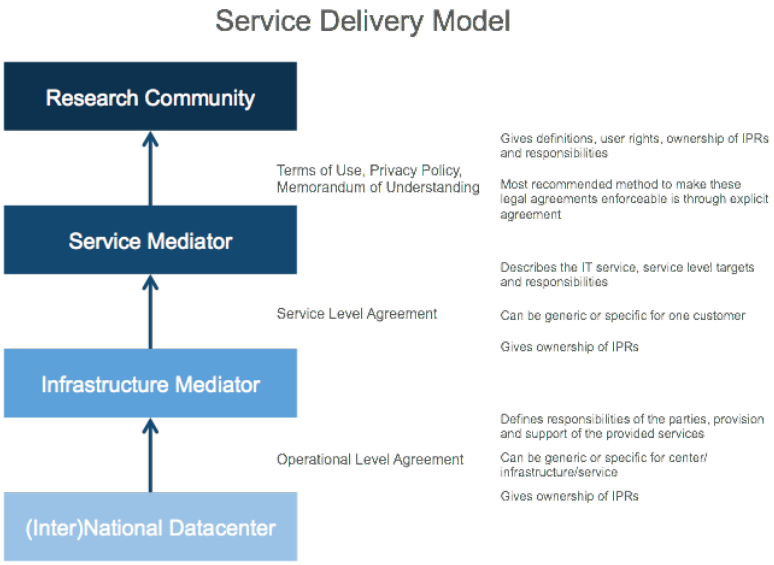


Figure 6 – Example Service Delivery Model, Roles and Agreements

Several gaps were identified such as there are no concrete legal terms on relevant fields such as ownership of IPRs in both the document itself and the reference to EGI's Policies and Procedures website, these should be secured from back-end to front-end, and there is a lack of concrete consequences when the Provider does not meet the service level targets.

Other recommendations to be included in all agreements within this SDM are:

- Include a fine-grained identity policy within all agreements. Research in the fishery and marine sciences sector is mostly subject to international organizations which can have different statuses with regard to IPRs. For example, the status of FAO in this respect is more extraterritorial than

[36] https://documents.egi.eu/document/2875

the status of the International Maritime Organization (IMO). Such choices are reflected by policy-decisions of these Organizations;

- Develop and document a standardized process to analyse whether standards for ownership of IPR are included in the metadata;
- The Infrastructure Mediator together with the Service mediator should approach the Research Community to collaborate on user-based management. D4Science is the ideal partner since the decisions with respect to software are being made in this layer.

These current agreements can be modified to develop a complete and concrete SDM. Overall, organizations that wish to exploit cloud-based services, often find it difficult to obtain an overview of the options and opportunities. With a SDM, they can obtain a quick overview of the implications of a specific architecture, but also avoid overlap or even conflicts between different legally relevant documents. A quick scan of an emerging exploitation of EGI resources by a community through an intermediate showed the benefits of the approach.

Further details are provided in a dedicated report[37].

Agrifood

A market analysis was conducted (D2.10), which described the potential of the AgTech sector, the actors and value chains, the results of the data requirements analysis and reports on the competing offerings including technical perspectives and specific recommendations for future business development within EGI[38]. Since SME engagement is of high importance for the EGI community, a requirements collection and validation process was provided in order to profile new and enhanced EGI services and propose recommendations for big and/or open data services targeting the industry and academia. This activity also focused on developing personas (descriptions of typical users) and scenarios described in detail, and then these assumptions were validated in a series of interviews with potential users from the AgTech communities.

As a result of this work and involvement within EGI-Engage, the EGI Foundation invited to participate in the AGINFRA+ project to put into practice this initial analysis. EGI will support the uptake of the e-Infrastructures in the agriculture domain and will do that via three use cases: Food security, Agro-climatic and Economic modelling and Food safety risk assessment. A handful of SMEs are involved in the project and discussions are underway with BfR (German Federal Institute for Risk Assessment) to purchase services in support of a project kicking off in 2018. Interestingly, the proposed model is the same as the model developed in support of Marine Fisheries via D4Science.

Earth Observation

EGI is collaborating with the European Space Agency in different sectors. The most advanced one is those related to the Thematic Exploitation Platforms (TEPs), the ESA's answer to deal with the unprecedented amount of data that will be delivered by the Sentinel missions[39], along with the

[37] https://documents.egi.eu/document/2699
[38] https://documents.egi.eu/document/2843
[39] https://sentinels.copernicus.eu/

Copernicus Contributing Missions[40] as well as Earth Explorers[41] and other, Third Party missions[42] in the next years. ESA has started in 2014 the EO Exploitation Platforms (EPs) initiative, a set of R&D activities that in the first phase (up to 2017) aims to create an ecosystem of interconnected Thematic Exploitation Platforms (TEPs) on European footing. Furthermore, EGI just started a collaboration with the ESA group working on the Collaborative Ground Segment:

- TEPs: EGI and ESA worked together to understand how EGI services could facilitate the implementation and deployment of the ESA TEPs. This led to the first concrete activity of integrating two TEPs, Geohazard and Hydrology, within the EGI Federated Cloud in order to guarantee enough computational power for their use cases. Such task was performed in collaboration with Terradue, an Italian SME, members of the consortium appointed by ESA for the design and development of these platforms, and was successfully completed developing an interface between the Terradue Cloud framework and the standard OCCI interface of the EGI Federated Cloud. A cloud resource pool with 7 providers from Italy, UK, Greece, Germany, Poland, Belgium and Spain was setup and secured with SLA and OLAs[43]. 161 VMs were instantiated that consumed almost 220,000 CPU-hours until July 2017[44].
- Collaborative Ground Segment: The Collaborative Ground Segment is the layer that manages data coming from the satellites. Its main duty is make them available to third party for exploitation. An exploratory activity started in the last months to analyse possible collaborations with EGI, in particular to understand if resources of the EGI Federated Cloud could be used to process and disseminate EO data.

EGI has set up a collaboration with a group of SMEs (RHEA, SixSq, EOproc) to develop demonstrator for an open integrated platform that delivers a multi-cloud EO data processing service, with the main objective to prevent cloud vendor lock-in situations while addressing end-to- end processing of EO data in multiple clouds environments. The aim is to offer a generic and open service, intended to work with any EO data located anywhere and with any EO processor, that can be rapidly deployed with flexibility, scalability, and at low cost, and which provides services accessed via public and standardised APIs.

3.1.5.5 Increase internal competences in collective bidding

Cross-Border Procurement

The vision of EGI is to establish a market of service providers and consumers that can operate according to a variety of business models, where services are delivered under a contractual framework and according to measured SLAs. EGI-Engage has analysed opportunities and barriers for cross-border procurement of e-Infrastructure services from Research Infrastructures and large research collaborations. The output of this study will be of importance to funding agencies and policy makers

[40] https://copernicusdata.esa.int/
[41] https://earth.esa.int/web/guest/missions/esa-operational-eo-missions
[42] https://earth.esa.int/web/guest/missions/3rd-party-missions/overview
[43] https://documents.egi.eu/document/2763
[44] Data from http://accounting.egi.eu

to define the role of e-Infrastructures for the European Research Area (ERA), to ensure persistency of services and shape the landscape of future partnerships.

A series of barriers to procurement of e-Infrastructure services have been identified that directly impact the public research sector and the ERIC legal structure that is used to coordinate many Research Infrastructures. Case studies of existing procurement actions are documented and a number of best practices are derived that can help overcome the barriers that deter procurement and the pay-for-use model.

The analysis of the identified barriers, best practices and use-cases led to an examination of a set of potential opportunities for cross-border procurement:

- Procurement Framework: Selection and validation of services on conformance with legal, business and technical requirements;
- Service Catalogue: Organise conformant services into a catalogue through which they can be more easily procured;
- Joint Procurement: Group of procurers commit to collectively procure conformant services;
- Service Credit Scheme: Multi-year procurement commitment at a European level in the context of the European Open Science Cloud.

Each successive opportunity represents increasing added value for the stakeholders with the key questions being 'who pays?' and what risks are the participating parties ready to accept. The potential role of EGI in the opportunities is highlighted concluding with a number of recommendations to prepare a cross-border procurement scheme with the European Commission that could be used to establish an Open Science Commons. This cross-border procurement scheme would offer service credits to ESFRI Research Infrastructures and their associated user communities in a hybrid environment that brings together their own resources, publicly funded e-Infrastructures and commercial service providers. The scheme could make use the EGI Pay-for-Use pilot, service catalogue and e-GRANT portal as a basis for its implementation.

More info in D2.11[45].

3.1.5.6 Enable service providers and consumers to easily find the best match

EGI Marketplace

The EGI Service Registry and Marketplace (in short Marketplace) has the ambition of becoming the platform where an ecosystem of EGI-related services, delivered by EGI providers and partners, can be promoted, discovered, shared, ordered and accessed, including EGI offered services as well as discipline and community-specific tools and services enabled by EGI and/or provided by third parties under defined agreements. EGI-Engage D2.13[46] details the work done by the EGI Service Registry and Marketplace activity during the whole project lifetime (March 2015 – August 2017).

[45] https://documents.egi.eu/document/3013
[46] http://marketplace.egi.eu/

Initially, the work started with the definition of the concept of the EGI Marketplace. After that, the activity focused on the assessment of technologies to implement the EGI Marketplace. This evaluation was completed with the development of the two prototypes based on Open IRIS and PrestaShop frameworks. The two Marketplace demonstrators have implemented the required specifications and adequately covered the requirements. Therefore, other factors were considered to choose the technology such as its long-term sustainability, availability of expertise, ready-to-use features that could be helpful in the future. As a final decision, PrestaShop was selected

Before starting the implementation, the Marketplace technical architecture was defined with a focus on the workflows, the data model and the customisations applied to the adopted technology. The workflows describe the main actions a customer can perform in the EGI Marketplace, log in, discover services, select service options and related attributes, and submit orders.

During this activity, the role of the Marketplace as tool to automate service order management and its relationship with EGI Integrated Management System (IMS) processes and other tools was also studied. The workflow to manage service order through the Marketplace was deeply analysed including correlations and impact on the other EGI tools. As result, interactions between EGI tools in the service order management workflow were identified and clear duties were assigned to each tool. In addition, features missing at that time were discovered and plans to provide them defined, as for example the need of an SLA/OLA management tool that will be implemented as a plugin of the Operations Portal. A complete semi-automatic workflow to create orders for the Applications on Demand service (AoDs) was designed and implemented. The AoDs is the EGI's response to the requirements of researchers, scattered across Europe, without dedicated access to computational and storage resources, as well as other facilities needed to run scientific applications.

Activities to deploy the Marketplace into production, enhancing the PrestaShop prototype and reaching the beta phase according to EGI IMS, are progressing. A mechanism to pre-process and group service orders, according to the IMS process that should take care of them, was integrated in the Marketplace and the first version of the Service Order Management tool was implemented. The PrestaShop customer dashboard was customised to satisfy EGI needs and the integration of the AoDs with the Marketplace is almost complete. Plans to enable the pay-for-use access mode and to integrate the Marketplace with the EGI website were defined. All the activities needed to deploy the Marketplace into production will be completed by the end of the project.

Analysis on publishing thematic community services[47] in the Marketplace progressed and the data model was consequently extended. AoDs can be seen as the first thematic service published by the Marketplace. Indeed, integration of other thematic services will be based on the data model extension defined for AoDs. Work was also done for the definition of the criteria and policy to publish such services in the Marketplace. When the Marketplace will become operational, after a first testing phase

[47] As thematic community service, we intend all the services and platforms that make use in some form of the EGI services and are discipline or community specific by offering computing pipelines, research data and analytics tools. The thematic community services are fundamental enablers of research and mediators of access to the EGI services.

where only EGI services will be published, it will be opened to the whole EGI collaboration and partners.

Finally, Open IRIS, although it was not selected for the EGI Marketplace, has demonstrated itself to be a good tool for instrument and resource management. Originally, Open IRIS was primarily used in Switzerland, however, through its evaluation in EGI-Engage, its use was extended to several other countries.

The EGI Marketplace will become a key component of the future European Open Science Cloud (EOSC) facilitating the discovery, the order and the access of a large set of services provided by several stakeholders. To reach this aim, several activities are already planned in the future in four main areas:

- Technical enhancements on the Marketplace: development of interfaces to retrieve and publish service data to/from other tools (e.g. a Service Portfolio Management tool and the eInfraCentral[48] service registry);
- Publishing of thematic community services: a campaign to on-board services will start after the Marketplace will be deployed into production;
- Service order management automation: enhancements on the designed model and related developments;
- Pay-for-use: launch of first commercial offers.

3.2 Strategic Partnerships

EUDAT

EUDAT collaboration is driven by a set of selected use cases that exploit both EGI and EUDAT services: ICOS, EPOS and ENES. These are built on top of the generic use case that covers the basic user needs with respect to the integration of the two infrastructures: manage VMs on EGI Cloud service that are able to interact with EUDAT services for data staging (B2STAGE) between long term preservation service (B2SAFE) and the VMs started on the EGI Cloud. The ICOS and EPOS use cases are still under development but are already able to exploit both infrastructures for delivering services to their final users. The third use case, ENES, was added recently to further explore new usage patterns. This use case is starting to test both infrastructures.

The harmonisation of the two infrastructures in terms of authentication and authorisation has been achieved for X.509 certificates. However, EGI and EUDAT are migrating their AAI system to use federated authentication mechanisms and a plan for the integration of those has been defined so EGI users can seamlessly access EUDAT services and vice versa. EGI and EUDAT integration activities were led by the requirements and workflows of two key Research Infrastructures: ICOS and EPOS.

[48] http://einfracentral.eu/

GEANT

EGI has collaborated with GEANT on a number of topics over the last several years. Current opportunities the centred around aligning service provisioning activities for federated trust and identity provisioning, cloud compute and joining forces to share expertise in the area of cross-border procurement. In May 2017, EGI evolved its partnership with GEANT through a signed an MoU[49] to:

- Exchange information related to individual long-term strategies, sustainability and business models.
- Investigate common strategies and synergies in a number of key areas including cloud computing, procurement, service catalogues, security and incident response handling, standards and interoperability of services, federated identity (not already covered by AARC project), outreach to research and education (R&E) communities and industry, training and events.
- Increase awareness of the GÉANT service offering within the EGI community, and of the EGI service offering within the GÉANT and NREN community.
- Enable better overall user-requirement gathering from across the EGI and GÉANT/NREN communities to benefit joint user communities.
- Establish communication channels and processes to pass requirements or support requests from one Party to the other.
- Establish joint dissemination activities to increase awareness and promote the results of the collaboration.

Helix Nebula

Helix Nebula is the leading strategic initiative for EGI to push the state of the art of commercial cloud IaaS services to support large scale scalable data access, federated AAI and the needs of the long tail of science.

The main involvement with this initiative took place in the framework of the H2020 project HNSciCloud that sees the involvement of the EGI Foundation to coordinate the use cases. EGI Federation's participants also participate as buyers or providers.

Big Data Value Association

On March 29 2015, EGI became a member of the Big Data Value Association (BDVA), a public private partnership created to boost the value of European Big Data research.

The BDVA is a non–for-profit organisation with 24 founding members from large and SME industry and research and several universities across Europe.

The association is part of the European Commission's Digital Agenda plan to generate value (jobs, growth, income) from the research data produced in European facilities. As a full member, EGI is involved in the BDVA's meetings and working groups.

[49] https://documents.egi.eu/document/3118

The Managing Director of the EGI Foundation has recently joined the board of directors of the Big Data Value Association for a two-year mandate.

By being part of the board of directors of BDVA, the EGI Foundation is able to actively participate in defining the European Strategic Research and Innovation Agenda, but will also strengthen the collaborations between big data initiatives and activities in the EGI community and the European agenda.

4 Impact and Risk Assessment

4.1 Impact Assessment

Indicators are instrumental to support the communication of the EGI value and impact to key stakeholders through the various communication channels. The goal of this activity is to define a number of qualitative and quantitative indicators to assess the impact of the EGI federation. During the coming year they will be organised in a lightweight compendium with EGI.eu leading efforts with represented NGIs to collaborate on the definition of the indicators, which will require information from all NGIs part of EGI and from the researchers. So far, we have identified four key dimensions of impact to be considered for EGI:

1. Scientific Excellence
2. Adoption of services
3. Implementation of the European Research Area
4. Contribution to building the European Open Science Cloud

4.1.1 Research

Following the discovery in July 2012 of the Higgs boson by the ATLAS and CMS experiments at CERN, during EGI-Engage, the EGI Federation confirmed its role of enabling instrument of ground-breaking scientific discoveries. Thanks to the distributed nature, data management and compute services of EGI provided scalable access to large-scale research data repositories to research collaborations in all scientific areas. Among all, natural sciences were the discipline that benefited the most from the project results because of their data-intensive computational needs.

According to OpenAIRE statistics, the scientific production of research projects and collaborations enabled by EGI services and EGI-Engage key results, amounts to 2,600 peer-reviewed papers in 2015 and 4,000 ones in 2016[50].

25,860 is the total number of publications attributed to projects and research collaborations that have been using Compute and Data Management services of the EGI Federation since 2008.

Almost 30 use cases have been written about how researchers are using EGI to conduct their world-class research[51]. 2 dedicated use case publications[52] have been produced to highlight some of the most notable ones such as the discovery of gravitational waves with LIGO and VIRGO and Novel phenomena in proton collisions discovered by ALICE.

[50] https://www.openaire.eu/egi-stats
[51] https://www.egi.eu/use-cases/research-stories
[52] https://www.egi.eu/wp-content/uploads/2017/08/EGI_Use_Cases.pdf
https://www.egi.eu/wp-content/uploads/2016/08/EGI-Case-studies.pdf

4.1.2 Adoption of services

Through the Competence Centres, technical support, training and engagement towards new research groups, EGI-Engage succeeded in bringing new scientific communities to become testers and early adopters of advanced computing services.

During EGI-Engage active users directly registered as members of an official Virtual Organization, increased from 23,520 to 30,508 (+30%). The total estimated number of users increases to approximately 61,000 users (+61% during EGI-Engage).

The EGI registered users is a subset of the actual user community: the total number of users is much higher if we also include user groups registered through scientific gateways, virtual labs and other community virtual research environments.

The increase of the user base largely benefited from cloud PaaS integration activities (e.g. the Geohazards Thematic Exploitation Platform, iMarine and gCUBE enabled within WP4), from support provided to the competence centres and through technical support and porting activities to new engaged research collaborations enabled in WP6.

Through the Competence Centres:

- The DARIAH data repository was fully integrated with EGI Compute services.
- EISCAT_3D tested and co-designed DIRAC-based solutions for acquisition, curation, access to and processing of research data.
- ELIXIR prototyped a data analysis infrastructure to serve some high-impact life science scientific user cases.
- EPOS demonstrated the use of IaaS, PaaS and SaaS services for data exploitation.
- WeNMR brought to production novel tools to run molecular dynamics simulations and other suited image processing tasks on accelerated computing nodes.
- LifeWatch became an active user of distributed cloud computing for the analysis of distributed heterogeneous data sets.

KPI.5.SA2.Users. Estimated total number of researchers served by EGI		
Registered users	23,520 (PM0) → 30,508 (PM30)	+30%
Total estimated users	38,000 → 61,074	+61% Target: 50,000

38 Additional Virtual Organizations (VOs) where created during the project. Following the PY1 project recommendations, the technical support activities were primarily focused on large international user groups from Research Infrastructures via Competence Centres and support provided to external partners.

User communities that completed the engagement process, where further supported in full production by 'connecting' them to service providers interested in long-term support.

10 Service Level Agreements were defined during the project, and 34 additional corporate agreements were defined with users of the Applications on Demand, currently in Beta phase.

The new service level management process defined and adopted by during the project, aims at maintaining a service catalogue, and at defining, agreeing and monitoring service levels with customers by establishing service level agreements (SLAs), supportive operation level agreements (OLAs) and underpinning agreements (UA). The process is part of the Integrated Service Management framework set up to comply with ISO 9000 and 20000 standards, which got formally audited and certified at the end of 2016.

Increasing adoption of data-intensive computing service was supported by the following project activities.

- The provisioning of a portfolio of scientific applications as Software as a Service through the Applications on Demand beta service, allowing individual researchers and small research teams to perform compute and data-intensive simulations on large, distributed networks of computers, and currently offering 13 different applications.
- The piloting of a cutting-edge service, the DataHub, offering the possibility to access, store, process and publish data using global data storage backed by computing centres and storage providers worldwide with transparent access to distributed data sets, without unnecessary staging and migration.

4.1.3 Implementation of the European Research Area

EGI-Engage contributed to the advancement of the implementation of the European Research Area by:

- Strengthening the national systems – the national e-Infrastructures, NGIs, which were better 'connected' to an increasing number of international research collaborations.
- Optimizing transnational cooperation by enabling access to national resources and services via an integrated service management system and an internal catalogue of services for providers of the EGI Federation.
- Allowing knowledge circulation and sharing by connecting experts from different research infrastructures, service providers and technology providers in a network of 8 Competence Centres.
- Enabling international cooperation through various new cooperation agreements involving Compute Canada, GEANT and PRACE. These enriched the existing portfolio of collaborations agreements involving major digital infrastructures from all over the world53.
- Addressing grand societal challenges and United Sustainable Development Goals54 by: promoting research data exploitation in the agri-food and marine health sectors in collaboration with the AGINFRA initiative and the BlueBRIDGE H2020 project, and providing specific support to the Health sector via the ELIXIR and BBMRI competence centres. In addition, EGI-Engage

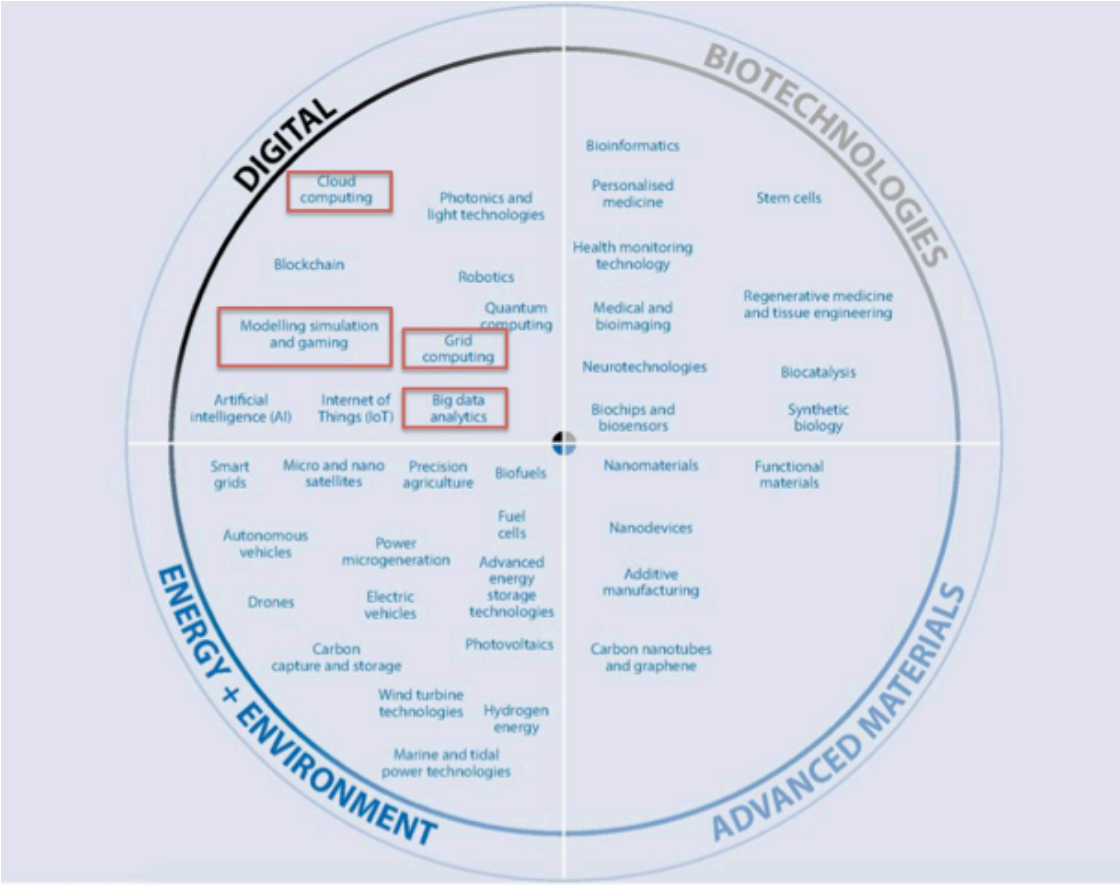
[53] https://www.egi.eu/about/collaborations/
[54] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

worked closely with EMSO - a Research Infrastructures in the ESFRI roadmap dedicated to a better understanding of marine ecosystems. Through the establishment of an SLA with EGI cloud providers, EMSO was able to develop and deploy the prototype of their Data Management Platform, a key tool for their mission of creating new knowledge from the data collected by a network of thousands of ocean float observatories.

Contribution to Digital Innovation Megatrends

'Megatrends are large-scale social, economic, political, environmental or technological changes that are slow to form but which once they have taken root, exercise a profound lasting influence on many if not most human activities, processes and perceptions'. The project contributed to the further development of various major megatrends identified among the digital innovation areas mentioned in the Organisation for Economic Co-operation and Development (OECD) 'Science, Technology and Innovation Outlook 2016 report'[55].

Among these, EGI-Engage was active to bring innovation to researchers through Cloud Computing, Grid Computing, Modelling Simulation, and Big Data Analytics.



[55] http://www.oecd.org/sti/oecd-science-technology-and-innovation-outlook-25186167.htm

Figure 7 – The EGI-Engage contribution (red rectangles) to the development and adoption of emerging future technologies according to the OECD Science, Technology and Innovation report 2016

Cloud computing

KPI.4.SA1.Cloud. Number of providers offering compute and storage capacity accessible through open standard interfaces		
PM0 → *PM30*	20 → 20	Target: 25

In the area of Cloud Computing EGI-Engage established a blueprint consisting of best practices and reference standards to achieve interoperability across multiple publicly-funded and commercial cloud providers. To date, the EGI Federated Cloud is the only existing publicly-funded distributed research cloud in Europe, offering on average provides 7 Million CPU hours per year to researchers from all disciplines.

Natural Sciences, Health and Medicine and Art and Humanities are the disciplines that mostly benefited from EGI-Engage support actions as shown in Figure 8.

The EGI Federated Cloud is a multi-national cloud system that can integrate community, private and/or public clouds into a scalable computing platform for research (Figure 9). EGI-Engage developed key software components, services and policies to enable federated access to multiple cloud providers via federated identity provisioning, authentication and authorization, and to enable portability of applications and data across a hybrid cloud federation. To date, the EGI Federated Cloud comprises 21 publicly funded clouds and 1 commercial cloud.

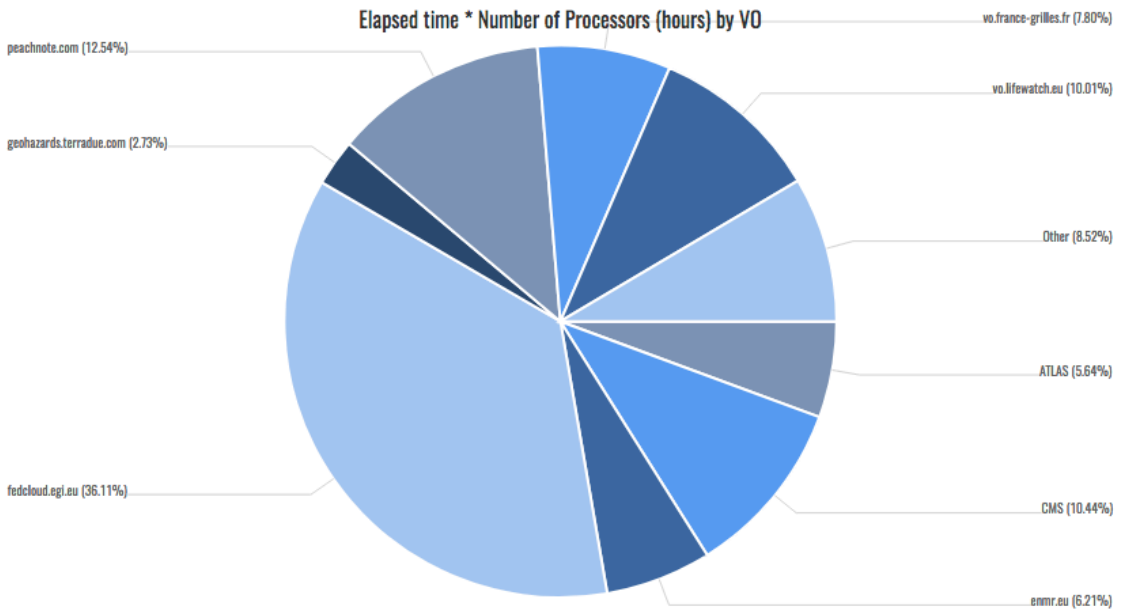


Figure 8 - Utilization of Cloud Compute across the main EGI Federated Cloud research communities including the 'FedCloud' catch all group (unit: Elapsed time * Number of Processors (hours) by VO and Year, Jan 2015-August 2017). Source: EGI accounting portal.

The EGI Federated Cloud pools IaaS, PaaS and SaaS services from a heterogeneous set of cloud providers using a single authentication and authorization framework that allows the portability of workloads across multiple providers and enable bringing computing to data. EGI follows a Service Integration and Management (SIAM) approach to manage the federation with processes that cover the different aspects of the IT Service Management. Within the EGI-Engage SIAM, providers in the federation keep complete control of their services and resources.

Figure 9 - EGI Federated Cloud infrastructure and the contributing European cloud providers

Grid computing

The EGI Federation is the largest HTC distributed computing infrastructure in the world, which federates data centres from Europe but also the Asia Pacific region, the Africa Arabia region, Canada and Latin America and interoperates with the Open Science Grid e-Infrastructure in the USA.

The EGI Grid Federation comprises European national e-Infrastructures (NGIs), data centres from European research organizations, and other major cyber infrastructures from other regions of the world.

The largest HTC infrastructure in the USA is the NSF-funded Open Science Grid (OSG)[56], which federates about 100 distributed centres. EGI and OSG are partners in supporting international research collaborations like the LHC experiments, LIGO and VIRGO, structural biologists (WeNMR and

[56] https://swc-osg-workshop.github.io/2015-03-03-iupui/novice/DHTC/01-IntroGrid.html

SBGrid[57]) and the Large Synoptic Survey Telescope project (LSST). Altogether EGI and OSG respectively provide large scale scientific computing of 7.9 million and 2 million core CPU hours per day.

Through EGI-Engage EGI continuously worked with e-Infrastructures in the world to ensure an integrated service catalogue for research collaborations.

Thanks to this, during EGI-Engage the overall consumption of HTC scientific computing in EGI saw an enormous increase equal to +40% each year.

EGI has established service exchange programs in various regions of the world to ensure data processing and advanced computing are accessible regardless of the country of origin.

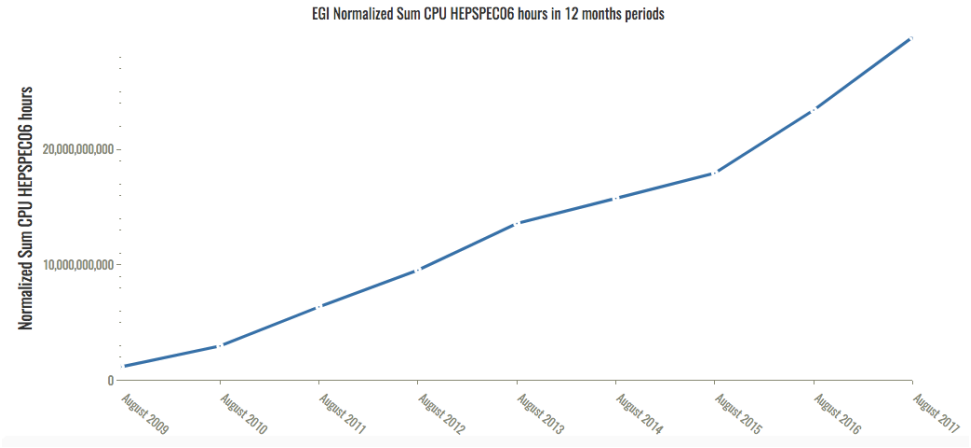


Figure 10 - Utilization of EGI HTC compute service from 2009 to date from all user communities. The diagram shows a dramatic change of trend from 2015, when demand started to grow exponentially as a response to the increasing production rate of research data to be processed.

Modelling Simulation and Big Data Analytics

The Applications on Demand (AoD) service – one of the key results of EGI-Engage launched as beta service at the end of the project – offers many application and data analysis frameworks, and is expected to evolve over time by adding new features according to the user demand: Jupyter Notebook, Docker, Apache Tomcat, Hadoop, Marathon, and Chronos (generic applications); Galaxy, ClustalW2, Chipster, NAMD and AutoDock Vina (Life Sciences); GnuPlot, Octave and the Statistical R for Computing (for data analysis) and the parallel Semantic Search Engine (Humanities).

AoD provides user-friendly access to compute, storage and applications services in order to carry out data/compute intensive science and innovation. It allows the reuse of existing technology building blocks, requiring minimal new developments; it also allows the hosting and sharing of custom applications.

[57] https://www.opensciencegrid.org/sbgrid-uses-the-osg-to-accelerate-structural-biology-research/

In addition, in collaboration with many partners, EGI provides a reach portfolio of scientific applications and virtual research environments using EGI Compute and Data Management services. These are ready to use tools offering compute, storage, data, collaborative tools and much more[58].

4.1.4 Contributing to the European Open Science Cloud

EOSC Principles

According to the EGI vision researchers from all disciplines should have easy, integrated and open access to the advanced digital capabilities, resources and expertise needed to collaborate and to carry out data/compute intensive science and innovation. In order to achieve this vision, the mission of EGI is to create and deliver open solutions for advanced computing for science and research infrastructures by federating digital capabilities, resources (compute, storage, data) and expertise between communities and across national boundaries.

EGI endorsed the principles of the EOSC and advocates the European Open Science Cloud to be the initiative addressing the needs of open access, sharing within and across research communities, ensuring sustained funding to digital research infrastructures.

EGI commits to the following actions that altogether contribute to the implementation of the European Open Science Cloud:

Governance and funding

- Support the definition, implementation and operation of the governing structure benefiting from its long-standing experience with more than 300 data centres worldwide.
- Contribute its best practices and experience to the definition of the EOSC "rules of engagement", i.e. the policies for the EOSC actors (e.g. end-users, customers and providers) leveraging for the lightweight federation of services capabilities ensuring interoperability among multiple suppliers at worldwide scale.

Data culture and FAIR data

- Provide and improve implementation guidelines for FAIR services in the area of advanced compute, federated identity provisioning, authentication and authorization, and contribute to the definition of the EOSC minimum set of reference standards and interoperation agreements and service accreditation models for EOSC.
- Develop the skills and certification schemes necessary to become users or operators of digital research infrastructures and EOSC through a network of community-lead competence centres involving multiple research communities, technology experts and service providers.

Research data services and architecture

[58] https://www.egi.eu/use-cases/scientific-applications-tools/

- Operate the EOSC Hub, the Service Integration and Management system (SIAM) accountable for ensuring that all EOSC service providers perform to provide a seamless service that is compliant to contractual obligations made with customer organizations. Activities include: communicate/manage alignment of services to defined policies and standards, define/maintain/review service level agreements, conduct service audits and quality assurance reviews, manage end-to-end service level management performance retaining overall accountability, provide the tools for aggregating demand and supply, make services and research artefacts discoverable and accessible at European level etc.
- Operate an open hybrid e-infrastructure offering data-driven advanced compute (Cloud and HTC) and data services from publicly funded and commercial organisations and maintain/evolve the related implementation guidelines to make the related services FAIR.
- Operate a federated identity provisioning, authentication and authorization services for the EOSC users and service providers.

EGI-Engage contributed to the definition and maintenance of policies, best practices and tools, to make the services of the federation compatible with the FAIR principles. The EGI-Engage contribution to the establishment of FAIR principles for services is outlined below.

- Findable: during the project a marketplace (https://marketplace.egi.eu/) was designed, implemented and rolled to production. In addition, the EGI internal service catalogue and external service catalogue were defined.
- Accessible: accessibility was improved via federated identity provisioning (eduGAIN), and federated authentication and authorization via the Check-in service, and by defining access policies applicable to EGI services.
- Interoperable: EGI-Engage defined guidelines for Compute (HTC and Cloud) and Data Management interoperability across heterogeneous facilities and multiple suppliers. These resulted in a community-defined standards roadmap. In addition, FAIR principles were concretely supported by distributing validated software products adopting the defined standards roadmap. The EGI Federation was integrated with relevant services from the EUDAT CDI (B2SAFE, B2SHARE, and B2ACCESS).
- Reusable: the project produced an updated body of security policies for users and providers including the general e-Infrastructure security policy, and the Acceptable Use Policy and Conditions of Use and others. In addition, the project enforced adherence to the reference standards roadmap via a lightweight service provider certification procedure.

4.2 Risk Assessment

The goal of Risk Management is to ensure systematic and regular identification, assessment and treatment of risks of any type, including risks related to information security, (IT) service continuity and overall quality. Within EGI, Risk management activities are aligned to the requirements and recommendations from ISO 9001, ISO 31000 and ISO/IEC 27005.

The EGI Foundation considers risk management to be fundamental to good management practice and a significant aspect of governance. Effective management of risk provides an essential contribution towards the achievement of the EGI Foundation's strategic and operational objectives and goals. Risk management is also an integral part of the EGI Foundation's decision making and routine management, and is incorporated with in the strategic and operational planning processes at all levels. Risk assessments are conducted on new ventures and activities, including projects, processes, systems and commercial activities to ensure that these are aligned with the EGI Foundation's objectives and goals. Any risks or opportunities arising from these assessments are identified, analysed and reported to the appropriate management level. EGI Foundation maintains a risk registry, which is hosted within the EGI Integrated Management System (IMS). A dedicated report (D1.5) outlines the risk management process and update on risks foreseen and unforeseen in further detail.

An important evolution over the last year, was the ISO certifications that pushed EGI to mature in several areas. One was expanding Risk Management beyond any given project to cover EGI as a whole, which also complements feedback from the first EC review of EGI-Engage.

Below are a few risks from the registry regarding sustainability and business development.

Risk	Risk Level	Consequences	Mitigation
The EGI production infrastructure and service offered to EGI-Engage does not meet the needs of the research communities	High	The user communities move to some other infrastructure provider or will set up own infrastructure without the use of EGI services	Through the CCs, EGI will collect requirements from the users that are part of the project and committed and fed into the innovation processes to expand the capabilities of EGI. EGI will also liaise with external technology providers to ensure that the evolution of the technology will follow the needs of the new user communities and service providers, and that it can be successfully exploited. Engage partners and EGI Council must ensure sufficient level of resources are available for the CCs. SLAs should be in place to clarify expectations and measure fulfilment.
Research infrastructures are not able to efficiently purchase capacity from the EGI providers	Medium	EGI is not able to capitalise on the investment made on developing the research communities; research infrastructure cannot benefit from pan-European e-infrastructure	EGI-Engage will evolve the business models (WP2) and technology (WP5) to support cross-border procurement and enable research infrastructures to acquire capacity from EGI affiliated service providers. If this fails then EGI needs to be repositioned from a capacity provider to other type of provider - e.g. technology and user support provider.

Risk	Risk Level	Consequences	Mitigation
A security incident could spread within the production infrastructure	Medium	A security incident could lead to service attacks on high profile websites that could bring bad press to European DCIs	The infrastructure as a whole, each NGI, and each resource provider must provide a security officer and backup. They will liaise the EGI Security Officer to act on security issues for promptly implement any mandated changes. This protocol will be tested with regular security challenges. The Software Vulnerability Group will proactively assess the impact of reported issues on the infrastructure, and the Software Security Group will work to improve the quality and coherence of security related grid specific code. A new risk assessment will be run during Engage, including also the new technologies.
Communities develop and adopt different services that have similar functionality	Low	In the worst-case scenario, the production infrastructure has to deploy different services with the same functionality, thereby multiplying the cost of supporting different user communities	The coordination of SA2 will record duplication of functionalities, trying to minimize at least for common functionalities, the implementations adopted. Even if multiple services exist with the same functionality, the maintenance and operation of community services is outside of EGI-Engage therefore have little impact on the project.

5 Updating the strategy towards 2025

The current EGI strategy was approved in 2015. The EGI Council agreed to review the strategy on a two-year basis to ensure that we align the strategic direction with the fast-evolving landscape. Therefore, in May 2017, the task NA2 supported the activity of updating the EGI strategy with the following set of actions:

- May 2017: Launched a survey with the EGI Council participants to collect inputs in preparation for a face-to-face meeting; the survey remained open for the full month of May and 16 Council participants provided a complete answer
- Jun 2017: Prepared a summary report with the analysis of the answers from the survey; Organised and chaired a 1,5-day face-to-face meeting with the EGI Council participants to discuss the outputs of the survey and collect further inputs on how to update the strategy
- Jul-Sept 2017: Formed an editorial board with members of the EGI Council and drafted a new version of the strategy
- Sept 2017: Held online meeting with the Strategy and Innovation Board (SIB) to gather external advice from the key experts; plan to finalise the new strategy document
- Oct 2017: Will present the updated strategy at the EGI Council and propose a vote for adoption

The following section presents the latest draft of the new strategy under development.

5.1 Main trends/drivers

In defining our strategy, we are considering the following major trends in science, policy and technology.

5.1.1 Science

The increasing digitisation of ‘everything’ is also transforming the way we conduct research. Terms like open science, open access, open data, transparency and collaboration are widely discussed in the scientific community, among policy makers and citizens.

Open science can be considered as a production and dissemination system that needs (I) integrated, easy and fair access to several types of shared resources (physical, digital, intellectual), (II) an engaged community that contributes to the scientific process and collaborates in the management and stewardship of those resources, (III) a suitable governance structure that manages access and resolves potential conflicts, and (IV) financial support for long-term sustainability. At the same time, open science calls for broad engagement in the scientific process, from production to dissemination. If successfully implemented, open science will stimulate larger collaborations and accelerate scientific discovery, ultimately bringing greater benefits for society.

5.1.2 Policy

The European Open Science Cloud (EOSC) is a vision for a federated, globally accessible, multidisciplinary environment where researchers, innovators, companies and citizens can publish, find, use and reuse each other's data, tools, publications and other outputs for research, innovation and educational purposes. Making this vision a reality is essential to empower Europeans to tackle the global challenges ahead. The EOSC is one of five broad policy action lines of the European open science agenda endorsed also by the EC Communications on the European Cloud Initiative part of the Digital Single Market (DSM) strategy.

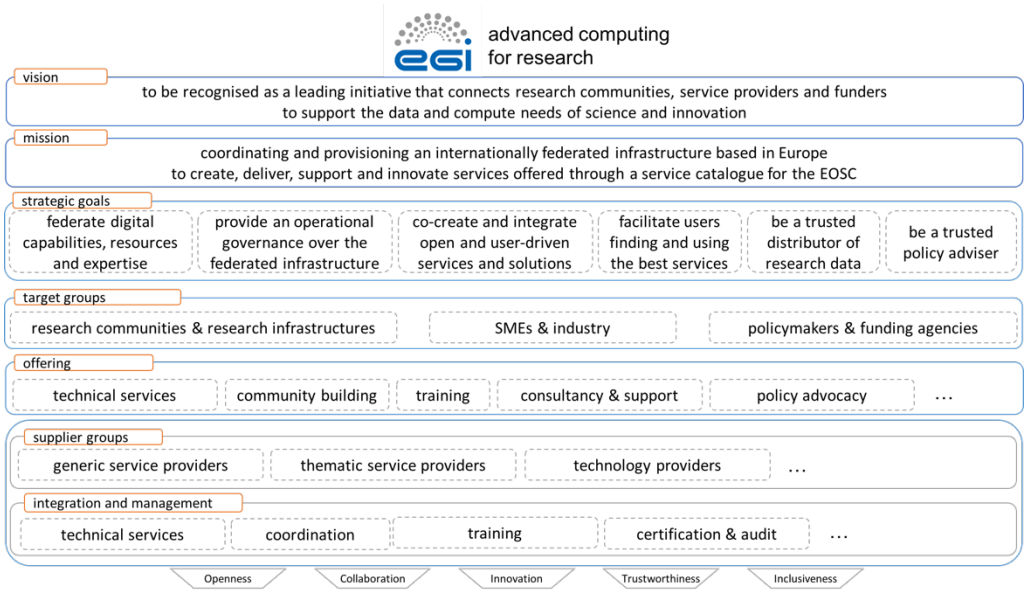
The European Data Infrastructure is one of the three pillars of the European Cloud and aims to combine world-class supercomputing and High-Performance Computing (HPC) capabilities with high-speed connectivity and leading-edge data and software services for science, industry and the public sector.

The FAIR principles are also another emerging concept the science area that is gaining traction at the policy level. FAIR is an acronym for Findable, Accessible, Interoperable and Reusable and can be applied to both data and services. The EC has already embedded those principles in the latest H2020 guidelines for data management and more is expected to come.

5.1.3 Technology

Technologies evolve and open up new possibilities for conducting, sharing and managing digital research. The cloud delivery model has enabled Infrastructure as a Service (IaaS) with a high degree of autonomy for users to acquire on demand and configure computing resources from a shared pool. On demand access to configurable resource pools is expanding from servers to different types of resources such as networks, storage pools, applications and services.

5.2 Strategy at a glance



As EGI Federation, we aim to be recognised as a leading initiative that connects research communities, service providers and funders to support the data and compute needs of science and innovation. Our main focus is to serve European researchers and their international collaborators with technical services and resources, training and expertise.

We aim to achieve this vision by coordinating and provisioning an international federated infrastructure that pools together existing service providers from both the public and private sector in Europe. As an open initiative, we also connect service providers beyond Europe and from the commercial sector following the needs and wants of our users.

To provide greater value from the resources pooled together, we need to ensure that they are easy to discover, access and use. We achieve this by establishing an operational governance that supports the federated infrastructure with professional services needed to integrate and manage the various capabilities. We also work with user communities to co-create and integrate new capabilities, services and solutions. Finally, we aim to be a trusted policy adviser for funders and policymakers for all matters in the scope of our strategy.

Within the EGI Federation, we identify principles that underpin our cooperation. These principles support our vision, shape our culture and are the basis for our decision-making.

- Openness: we communicate clearly and with integrity; we have a transparent governance structure; we pursue an open infrastructure through adoption of open standards and open licenses.
- Collaboration: we strive to provide ongoing opportunities to cooperate, communicate and partner with others in the community to advance our goals and objectives.
- Innovation: we listen to and understand the needs of our stakeholders and users; we look for ways to improve operational performance, processes and services; we have an attitude of continuous learning.
- Trustworthiness: we are good stewards of our resources and uphold the faith and confidence our stakeholders and our research communities have placed in us.
- Inclusiveness: we strive to be inclusive and open to all countries and all research communities including those with limited resources.

5.3 Target Groups

We identify four main target groups for our offering.

5.3.1 Research communities, research infrastructures and long-tail researchers

We empower them to perform collaborative compute-/data- intensive science across Europe and worldwide. Our main priority is large communities or research infrastructures (e.g. ESFRIs) where the EGI Foundation liaises at EU level while EGI participants engage at national or organisational level. Our approach with long-tail researchers is to facilitate the providers of the EGI Federation to serve LToS users locally through a common platform and engagement framework.

5.3.2 SMEs & industry

We help them to exploit services and resources for compute-/data-intensive research and innovation (e.g. obtain computing capacity to test workflows, models, and applications; support in reusing open research data sets, tools and applications; co-design new products and services). The engagement is done via structures such as joint digital innovation hub involving also other e-Infrastructures. The EGI Foundation operates as the coordinator of the framework while resource/service/technology providers engage with SMEs/Industry.

5.3.3 Policy makers and funding agencies

We support policy makers and funding agencies with expert advice to shape policies and funding programs and we help them implement their policy priorities. We also inform policy-makers about trends and future potential developments (horizon scanning). The EGI Foundation focus is primarily on EU-level policies according to the priorities defined by the EGI Council.

5.4 Offering

Externally, as the EGI federation, we offer:

5.4.1 Technical services

We deliver a number of technical services either from horizontal or thematic service providers. They cover areas such as compute, storage, data, platform, applications, or security.

5.4.2 Community building

We develop international communities and people's networks that facilitate the circulation of knowledge and the practice of open and collaborative research and innovation.

5.4.3 Consultancy & support

As a federation of experts, we support the researchers in building platforms on top of the existing capabilities, or to build high-level services that rely on general building blocks. For larger communities, this is achieved by creating competence centres composed of experts from both the user side and the provider side.

5.4.4 Training

As technology and services are evolving rapidly, it is essential to support the research communities in developing the digital skills they need for modern IT and data use. We create baseline and tailored training programs and material, and we facilitate the sharing and access to them (e.g. online or face-to-face).

5.4.5 Policy advocacy

We mobilise the community to understand the main trends and needs in science and technology in order to advise policymakers and funders on the future directions to take.

5.5 Integration and management

Internally, within the EGI federation, we need to organise and integration and management layer that provides assurance of the performance of individual service providers and simplify access to them.

5.5.1 Technical services

We deliver a number of technical services to enable the federation to function. They belong to areas such as operations, security, monitoring or accounting.

5.5.2 Coordination

We provide coordination among the various actors in the EGI federation in key areas such as operations, security, technical, ITSM, strategy and policy development.

5.5.3 Training

As a federation, we aim to develop skills in different areas such as: IT service management, cybersecurity, service design, project and virtual team management. Therefore, we develop dedicated training programs and material.

5.5.4 Certification and audit

We ensure that service providers meet minimum quality requirements, therefore we develop certification schemes and programs. We also support them with audit services to ensure they identify the areas of improvements.

5.6 Suppler groups

5.6.1 Service providers

In order to achieve our vision and work on our mission, we identify five main strategic goals. For each strategic goal, we identify key high-level actions that support reaching the related goal. We will constantly appraise future development and our response to them.

5.6.2 Technology providers

We need to establish key partnerships with technology providers who can bring innovative software to be integrated into the EGI infrastructure.

5.7 Strategic actions

In order to work towards our vision and act following our mission, we identified five main strategic goals. For each strategic goal, we define key high-level actions that support reaching the related goal.

Federate digital capabilities, resources and expertise

1. We federate heterogeneous digital services and resources for computing, storage and data, provided for research at European scale and beyond
2. We support different level of engagements of service providers by defining different federation profiles
3. We operate community services on top of the federated infrastructures based on the needs of research communities
4. We organise networks of experts by scientific discipline or technology domain
5. We improve business models that encourage service providers to offer resources and services

Provide an operational governance over the federated infrastructure

1. We operate federation-enabling services and processes providing operational governance across the service providers
2. We adopt and promote minimum requirements for IT service management across the federated infrastructure
3. We ensure a functional security framework able to prevent and to respond to security issues
4. We work together to ensure long-term sustainability of funding for the supporting services

Co-create and integrate open and user-driven services and solutions

1. We track and analyse requirements across the participating stakeholders and communities
2. We stimulate innovation within and outside our community with idea competitions to identify and stimulate the implementation of the best ideas
3. We co-create services and solutions with users and technology providers on top of the federated infrastructure
4. We promote modular solutions and open standards to facilitate interoperability, re-use and portability
5. We attract and manage funding for innovation

Facilitate users finding and using the best services

1. We operate a joint service catalogue that improve findability and order of services, technology and expertise
2. We consult with research communities and provide these communities with high-quality technical services and the expertise they need to speed up their research process
3. We regularly review satisfaction levels so that we can learn and improve our services
4. We facilitate the purchasing of resources and services

Be a trusted policy adviser

1. We contribute to develop policies for open science and research computing with workshops, position papers and stakeholder engagement
2. We provide expert advice to policymakers to help them shaping national and European policies for compute/data intensive science

5.8 Strategic partnerships

5.8.1 With e-Infrastructures

- We need to strengthen the collaboration, integration and interoperability with other European e-Infrastructures (e.g. EUDAT, GÉANT, OpenAIRE, PRACE)
- We need to consolidate and expand peer agreements with infrastructures similar to EGI outside Europe to support European researchers to collaborate with their international peers

5.8.2 With research infrastructures

- We need to engage with both national and international research infrastructures (for example ESFRIs) not just as pure consumers of services, but as co-creator of solutions that can be easily reused

5.8.3 With technology providers

- We need to establish key partnerships with technology providers who can bring innovative software to be integrated into the EGI infrastructure

5.8.4 With industry associations and other private sector multipliers and companies

- We create partnerships with SMEs/industry, innovation clusters, accelerators and investors that stimulate innovation (new products, services), such as regional and pan-European networks of Digital Innovation Hubs and other top-level industry associations that can accelerate identifying trends and areas of collaborations with the private sector.
- We facilitate access to e-Infrastructure resources to support prototyping, scaling-up, design, performance verification, testing, demonstration, development of pilot lines, validation for market replication, including bringing innovation to investment readiness and maturity for market take-up.
- We need to establish collaborations with commercial cloud providers to facilitate our supported communities to combine publicly funded and commercial resources into a hybrid model.
- We share best practices and competencies for knowledge transfer between the public and private sector, including business-oriented coaching with the mission to accelerate market uptake and results in exploitation of the both the pilots and Competence Centres.
- We develop long-term business relationships outside of any project structure.

5.8.5 With policy bodies

- We need to engage with key policy bodies that are influential in shaping recommendations for our domain

5.8.6 With projects

- We need to establish collaborations with projects that generates exploitable outputs of interest (e.g. software, standards, services, knowledge)

6 Conclusions

The EGI sustainability and business development report was intended to present an update on the strategic planning and evaluation activities of EGI that focused on the implementation of the strategy defined in 2015 and its future evolution. It is important to note that the content of this report is a snapshot in time.

This document demonstrates that to ensure the long-term availability of the infrastructures and the services in which more than 50,000 researchers rely, a multi-facet approach is required.

EGI has had a well-defined strategy for several years and is now starting to look at beyond 2020, through planned revision of the strategy is underway through a special editorial board through the EGI Council to ensure EGI is well-positioned in the future to continue to deliver value added services throughout Europe and beyond.

Over the last several years, thanks to the efforts of the entire EGI community, the organisational model has stabilised through refinement to the governance structure allowing a stronger focus on service development and innovation matched to defined target groups. Formal service management is now standard practices, which has been proven through the EGI Foundation achieving ISO 9001 (quality management) and ISO 20000-1 (service management) certifications.

Existing high-level services have been organised through a formal service portfolio based on or in line with the EGI strategy, categorised as Compute, Storage, Data Management, Applications and Training. These services are delivered to different types research disciplines such as high-energy physics, life science, earth science, groups comprising research infrastructures like CERN, and research infrastructures like ESFRIs. EGI has also been active with emerging research infrastructures and have formed eight competence centres to better understand requirements and co-develop solutions.

Strategic partnerships have been established with other e-Infrastructures as well as Infrastructure Agreements with Research infrastructures and SMEs/Industry through a dedicated business engagement programme.

New business models have moved from proof of concept to production such as with EGI pay-for-use and the delivery of commercial FitSM training and certification courses to diversify revenue streams.

An impact assessment was conducted to demonstrate the value of EGI in key areas such as scientific excellence, adoption of services, implementation of the European Research Area and contributing to the European Open Science Cloud (responding to EU polices/initiatives).

This document highlights not only how EGI has achieved this, but also how it will continue to ensure the services offered will evolve and expand over the coming years.

Moving forward, EGI plans to play a major role in the European Open Science Cloud, that started through involvement within the EOSCpilot project and will continue through EOSC-hub (Jan 2018).

Appendix I. Glossary

Term	Definition[59]
EGI Foundation (or EGI.eu or Stichting EGI)	The legal entity whose objective is to coordinate and develop, in collaboration with its Participants, an open e-infrastructure that provides long-term distributed compute and storage resources for performing research and innovation activities. The foundation seeks to attain said objectives by amongst others: coordinating relevant e-infrastructure activities between its Participants; coordinating and participating in e-infrastructure projects; encouraging proposals for e-infrastructure projects; supporting and facilitating initiatives in the field of relevant e-infrastructures; encouraging and coordinating innovation in the field of e-infrastructures; all which is connected or which could be conducive to the above, in the widest sense of the word
EGI Foundation Participant	Participants and Associated Participants can be NGIs, EIROs, ERICs and such other legal entities, in their own capacity or as representative of a consortium, that contribute to the objective of the EGI Foundation
EGI Council	Supervisory authority consisting of Participants and Associated Participants of the EGI Foundation
EGI Federation	EGI Foundation, EGI Foundation Participants and Associated Participants, their linked organisations (e.g. service and resource providers) represented within EGI Foundation that contribute to the objectives of the foundation
EGI infrastructure	The federated e-infrastructure composed national and intergovernmental computing and data centres from the EGI federation providing advanced computing services for research and innovation
EGI community	The EGI Federation plus the served research communities, the technology providers or any other organisation linked via an agreement with the EGI Foundation and contributing to the mission of the EGI federation
EGI	Can be used as a short version of “EGI Infrastructure” or “EGI Federation”[60]

[59] Mainly taken from the EGI Foundation statutes: https://documents.egi.eu/document/18

[60] The meaning should be clear from the context, otherwise the full name should be used

Integrated resource provider	Resource provider part of the EGI infrastructure, complying with all policies adopted by the EGI Council and linked to the EGI federation via an MoU with the EGI foundation
Peer resource provider	Resource provider not part of the EGI infrastructure having collaboration activities with the EGI federation defined in a Memorandum of Understanding with the EGI Foundation
e-Infrastructure	An environment to share research and educational resources (e.g. network, computers, storage, software, data) so that these resources can easily be accessed and used by researchers as required