National Nodes – Getting organised; how far are we?

Implementing e-Infrastructure Commons and the European Open Science Cloud

e-Infrastructure Reflection Group

http://e-IRG.eu/catalogue/eirg-1006

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Dear reader,

with this document e-IRG is responding proactively to the Council Conclusions on the European Open Science Cloud of May 2018, which CALL [..] to make optimal use of ongoing projects, existing expertise and knowledge available via existing initiatives, such as ESFRI, eIRG, GO FAIR and others.

e-IRG is a recognised strategic body composed of national delegates to facilitate integration in the area of European e-Infrastructures and connected services, within and between Member States, at the European level and globally. This e-IRG policy document addresses the role of the national nodes - including their coordination with the thematic ones - in the implementation of the e-Infrastructure Commons and its instantiation as the European Open Science Cloud (EOSC). This document thus covers both the situation within and between member states and should be considered as a snapshot at the time of publication. e-IRG is overlooking the whole e-Infrastructure spectrum, from networking and computing to data and other services (such as middleware, software and related tools/services), covering not only short-term but also longer-term aspects, advising both Member States and the European Commission. Thus, the document covers all e-Infrastructure components, with emphasis on governance, funding and access policies. It should be noted that e-IRG does not undertake any operative role or implementation mandates, e.g. within EOSC or EuroHPC and keeps an advisory role.

The EOSC initiative is intended to comprise policy decisions as well as the concrete implementation to support the Open Science policy the Europe Union and its Member States or Associated Countries have committed to.

Today, in May 2019, the degree to which different e-Infrastructures are coordinated and made interoperable within the entire e-Infrastructure landscape at national and international level varies hitherto heavily from country to country in Europe. e-IRG advocates an interoperable, federated ecosystem of domain-specific (vertical) Research Infrastructure and generic (horizontal) e-Infrastructures already at national level, which will facilitate the European level federation, such as in the form of EOSC.

Gabriele von Voigt

e-IRG Chair

Introduction

Collaboration on e-Infrastructures at the European scale is essential to support pan-European research efforts. This is manifested e.g. by the fact that recent developments like the European Open Science Cloud (EOSC)[1] and EuroHPC[2] attract a lot of attention. Pooling and federating resources at European level does however require a significant effort. Generic e-Infrastructures offering their services towards all communities/disciplines (called also "horizontal") are normally structured, funded and governed at national or sometimes even sub-national/regional scale. Also, there are many European/international, but also national, sub-national or even local community/discipline-specific e-Infrastructures (called also "vertical" or "thematic") that may or may not collaborate with the generic initiatives at different levels. The focus of this document is to analyse how this complex landscape is built today and to provide recommendations on how it can be further developed to fulfil the expectations on the future collaborative European e-Infrastructure system.

In 2012, e-IRG introduced the notion of the e-Infrastructures Commons, an open ecosystem of resources and services along with its policies and governance for scientists to facilitate research and science. This laid the e-Infrastructure foundation for the European Cloud Initiative EC Communication[3] published in 2016, introducing EOSC and the European Data Infrastructure (EDI). EOSC was defined as the trusted, open environment for the scientific community to store, share and re-use scientific data and results and the EDI is built from fast connectivity, high-capacity cloud solutions and supercomputing capability systems.

After the publication of its Roadmap in 2012, e-IRG turned its attention to the organisation of e-Infrastructure at the national level, later quoted in the EU Competitiveness Council conclusions on EOSC[4], which also called on the related expertise and knowledge of initiatives such as e-IRG. One of the main conclusions of e-IRG was that coherent national building blocks or "national nodes" were essential for the development of federated European initiatives. The current national e-Infrastructure landscape is however richer and more complex than that. Not only is there a difference between countries, but also the way funding and governance of e-Infrastructure and research resources in general is organised in a country differs and has an impact on how collaborative efforts can be set up. Also, when it comes to access to resources within the national nodes, which could be exclusive and / or competitive (e.g. in case of

> *"e-Infrastructures Commons, an open ecosystem of resources and services along with its policies and governance for scientists to facilitate research and science."*

computing cycles), the national access models become important factors to be considered in the realisation of pan-European collaborative initiatives like the EOSC.

Rather than only describing the role of national nodes within the e-Infrastructure Commons, in this report e-IRG presents an inventory of how e-Infrastructures are governed, operated, financed and accessed at the national level. This inventory was based on a questionnaire (see Annex 2 - National node survey template), which was used by the e-IRG national delegates to provide information for their country. For the survey, the e-IRG delegates were assumed to interface with relevant key stakeholders in the country. The resulting inventory provides an account of the current e-Infrastructure landscape in the 28 Member States (MS) and Associated Countries (AC) that answered the questionnaire. The process also involved an iterative approach to refine the data and classifications of the different countries.

The document also presents an extended analysis of the inventory (see Annex 1 - Extended landscape analysis) and examples of good practices, which are indicators of ongoing coordination activities within countries or on the regional level. Based on the analysis and the identified good practices, recommendations are provided on how to overcome the current fragmentation at the national, regional and European level and support pan-European initiatives like the EOSC.

The mission of e-IRG[5], as a neutral strategic advisory body on e-Infrastructure policies, composed of national representatives appointed by the relevant Science/ Research ministries/ agencies, is to facilitate integration in the area of European e-Infrastructures and connected services, within and between Member States, at European level and globally. This document deals with both the "within" (national) and the "between" or across Member States (thematic, regional, EU and beyond) and should be considered a snapshot at the time of publication. e-IRG is overlooking the whole e-Infrastructure spectrum, covering not only short-term but also longer-term aspects, advising both Member States and the European Commission. It should be noted that e-IRG does not undertake any operative role or implementation mandates, e.g. within EOSC or EuroHPC.

Background

Scientific research across an ever-growing spectrum of scientific disciplines/domains is increasingly reliant on the continuous generation and streamlined analysis of vast amounts of data. The curation, analysis, sharing and re-use of such data requires the availability of suitable e-Infrastructure services, such as high capacity networks, advanced computing resources, large-scale data repositories, software/middleware, as well as digital tools and advanced user support. e-IRG has been using the metaphor of the Commons for a coordinated and coherent set of such e-Infrastructure resources and services along with related policies, which promote collaboration opportunities. The notion of the *e-Infrastructure Commons*[6] was initially presented in the *e-IRG Roadmap 2012*[7] and further developed in the *e-IRG White Paper 2013*[8] and the *e-IRG Roadmap 2016*[9].

The e-Infrastructure Commons can be defined as the integrated living ecosystem of resources and services (along with its policies and governance) that is open, user friendly and accessible to European researchers and scientists, and continuously adapts to the changing requirements of research and science.

The *e-IRG White Paper 2013* referred to the key requirements for the future e-Infrastructure Commons ecosystem, which are the interoperability and gradual integration of the e-Infrastructures services. A further proposal towards the e-Infrastructure Commons was presented by the e-IRG Support Programme in 2014, with the document *A marketplace for e-Infrastructure services*[10].

These efforts contributed to the definition of the "European Open Science Cloud (EOSC)" in 2015, as a vision of the European Commission of an infrastructure to support and develop open science and open innovation in Europe and beyond. However, the approach foreseen for the EOSC implementation is mainly "federative" rather than "integrative". The implementation of the EOSC is expected to facilitate the vision of Open Science and become Europe's virtual environment for all researchers to store, manage, analyse and re-use data for research, innovation and educational purposes.

Since then a series of documents towards the implementation of EOSC have been published and the instantiation of the e-Infrastructure Commons via EOSC is well underway. Despite its initially vague definition, EOSC is understood as the virtual environment for researchers to find and use all the tools they need to do their work,

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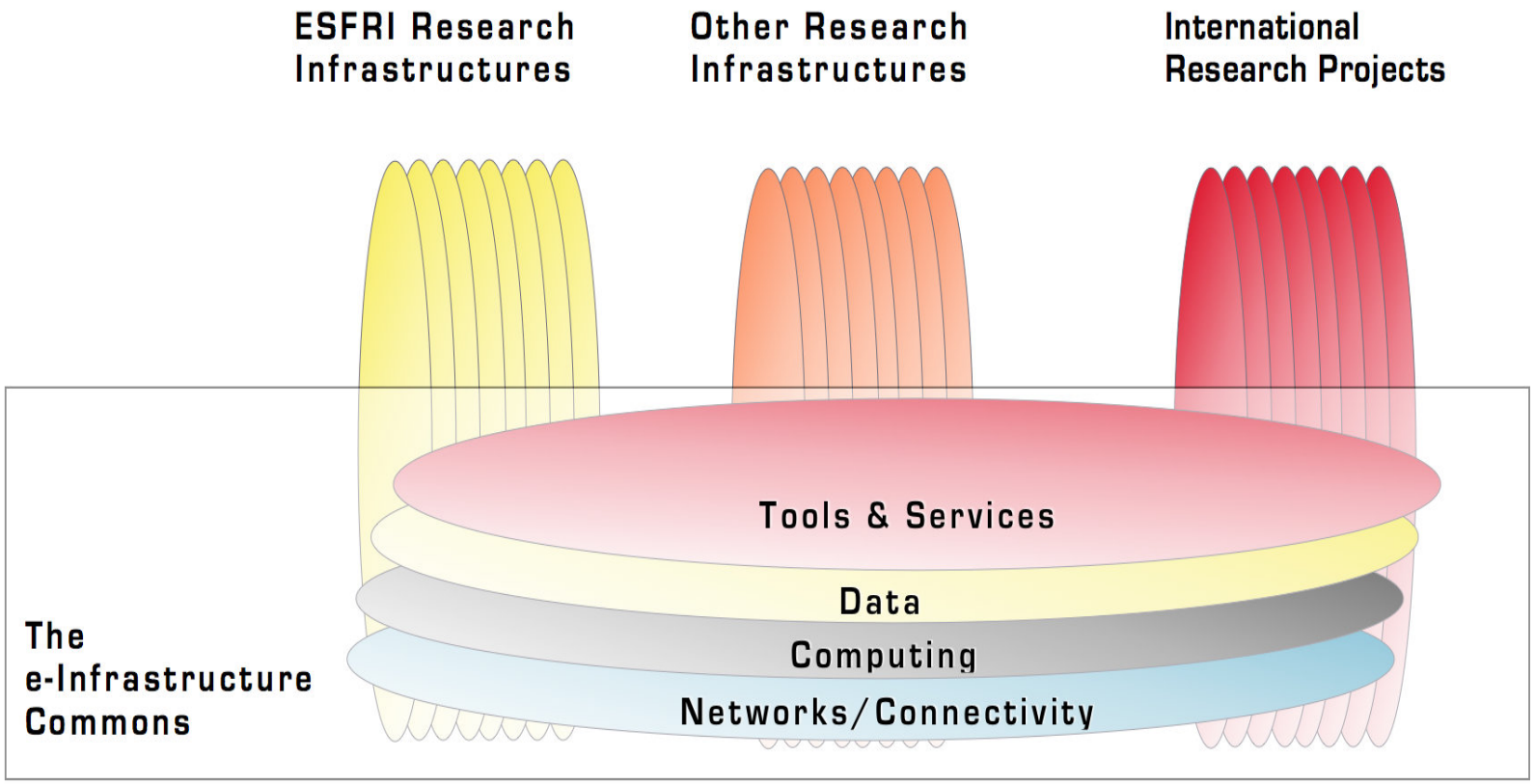


The notion of the e-Infrastructure Commons

coordinating between horizontal and vertical (domain, thematic or discipline specific) e-Infrastructure components and services under one umbrella. This does not refer to a single physical environment, rather a whole ecosystem with multiple components of both horizontal and thematic services at national and European levels. The ongoing process towards the envisioned EOSC implementation within the next few years is based on the successful coordination and federation of such national and European/ thematic research infrastructures, including e-Infrastructures. In other words – the EOSC can only be as strong as its national and thematic (i.e. domain-specific) building blocks. Coherent and efficient coordination mechanisms among service providers, as well as robust and sustainable funding mechanisms that can enable scalable and long-term development, evolution and operation of national and European e-Infrastructures and Research Infrastructures are the key factors for realising the EOSC.

The EOSC should thus evolve into an ecosystem of national and thematic views or abstractions of the EU-level services, possibly with extra services available at national, regional or thematic levels and/or a subset of the EU services based on the participation of a national constituent in EU or thematic initiatives and Research Infrastructures or possible restrictions at national/ regional/ thematic levels.

The e-IRG Roadmap 2016, aiming at turning the vision of the e-Infrastructure Commons into reality by 2020, provided a list of recommendations to all stakeholders. Two of these recommendations are directed at national governments and funding agencies, namely that they should reinforce their efforts to:

- embrace e-Infrastructure coordination at the national level and build strong national e-Infrastructure building blocks, enabling coherent and efficient participation in European efforts, especially in alignment with the FAIR principles concerning data and services;

- analyse and evaluate their national e-Infrastructure funding and governance mechanisms, identify best practices, and provide input to the development of the European e-Infrastructure landscape.

The Competitiveness Council of the European Union in its conclusions on "The transition towards an Open Science system" has in May 2016 advocated the need for *concerted actions in relevant national, EU, multilateral and international fora* to make Open Science a reality[11].

> *"Need for concerted actions in relevant national, EU, multilateral and international fora to make Open Science a reality."*

Bulgarian Minister Krasimir Valchev, chairing the May 2018 Competitive Council meeting at which the e-IRG was mentioned. See page 11. (Picture adapted from footage of the related press conference provided by EU Council press services.)

Already the first High-level Expert Group on the European Open Science Cloud, although focused on the data aspects of Open Science, recommended in its report *Realising the European Open Science Cloud*[12] to *take immediate, affirmative action on the EOSC in close concert with Member States.* The European Commission initiated the drive towards the EOSC realisation with a series of initiatives and documents in 2017, including the EOSC Summit[13] and the EOSC declaration[14], which was supported by a list of signatories/ coalition of doers[15], one of which was e-IRG.

In 2018 the EC adopted the Commission Staff Working Document (SWD) *Implementation Roadmap for the European Science Cloud*[16]. The SWD document covers 6 main areas namely a) architecture, b) data, c) services, d) access & interfaces, e) rules and f) governance. It also includes the implementation measures as part of Horizon 2020. Projects like EOSCpilot[17] (EOSC preparatory action), eInfraCentral[18] (service catalogue), OpenAIRE-Connect[19] (OpenAIRE outreach to communities), EUDAT[20] (collaborative data infrastructure services) and the European plug-in of the Research Data Alliance (RDA-Europe)[21] had been already contributing to EOSC components and the open science, open data sharing principles before 2018. Authentication and Authorisation for Research Collaborations is also a vital component for EOSC and the AARC project series[22] made significant steps in this direction. In 2018, the major EOSC integration project, EOSC-hub, started, bringing together EGI[23] (advanced computing services for research), EUDAT and INDIGO - DataCloud[24] (software services for science), along with other key projects like FREYA[25] (on persistent identifiers) and the OpenAIRE-Advance[26] (consolidating OpenAIRE services towards EOSC).

In May 2018, the Council in its Conclusion on the "European Open Science Cloud" recalls[27] *that the creation of the EOSC*, which is the infrastructure supporting the implementation of Europe's Open Science policy, *lies in the joint responsibility of the European Commission and the Member States*, taking *into account the involvement and support of the stakeholders and highlighted that the implementation and further development should […] take into account already established practices by research communities, ESFRI Research Infrastructures, e-Infrastructures as well as other relevant national infrastructures".*

Furthermore, the Commission and the Member States were invited to jointly explore the creation of a map of national research data infrastructures and initiatives in the Member States which could be federated [...]. The Council also "agrees that the EOSC model should be based on a pan-European

federation of data infrastructures in order to be flexible and adaptable to changing needs of the stakeholders with regard to enabling this federation of national and European data infrastructures, ENCOURAGES Member States to invite their relevant communities, such as e-infrastructures, research infrastructures, Research Funding Organisations (RFO's) and Research Performing Organisations (RPO's), to get organized so as to prepare them for connection to the EOSC and CALLS ON the Commission to make optimal use of ongoing projects, existing expertise and knowledge available via existing initiatives, such as ESFRI, eIRG, GO FAIR and others; ".

An initial version of the EOSC portal along with the bootstrapping EOSC governance was officially launched[28] in November 2018, while in 2019 the EOSCsecretariat.eu project[29], along with a series of EOSC Cluster projects from major thematic areas also commenced. It is clear that the level of coordination required among all the above efforts, including plain communication, is vast, and the importance of *interplay between national, EU and thematic efforts is key for EOSC success.* This was recently confirmed by the EOSC Governance Board (GB), who requested as a priority a Working Group on national initiatives (Landscape WG). It also became evident *that the member states and associate countries participating in the EOSC GB were very diverse in their state of engagement with EOSC, but even more diverse in the state of their national policy development or implementation towards Open Science or Open Data*[30]. In the same blog, it was stated that *an essential success factor of EOSC will be the level of engagement and funding that will be invested nationally*. Recently, a series of new EC-funded projects on EOSC national initiatives were approved namely EOSC-Nordic, EOSC-Pillar, EOSC-Synergy and NI4OS-Europe, which can considerably contribute towards the development of policies and their alignment across countries within their regions and throughout Europe. In addition, the project FAIRsFAIR[31] will address the promotion of FAIR principles and building competencies within the research communities.

All the above clearly show that the work done by e-IRG with this paper (and possibly via a live-document in the future) can substantially contribute towards the EOSC Governance Bodies work in the upcoming period.

1st EOSC Board meeting (Picture: Burgelman)

“As of May 2019, a total number of 28 e-IRG Member States have submitted responses corresponding to 60% of all 44 EU Member States and Associated Countries.”

Reflections on the National Nodes landscape

The e-IRG has conducted a landscape analysis of national e-Infrastructures in European countries. The aim was to map the national e-Infrastructure landscapes, understanding the currently existing organisational structures, as well as funding mechanisms, access policies and the level of coordination between generic and domain-specific e-Infrastructure services. With this knowledge as the basis, the e-IRG sets out to abstract some of the ongoing efforts and good practices towards the realisation of the e-Infrastructure Commons in Europe.

All of the 32 Member States and Associated Countries represented in e-IRG were asked to provide information about:

1. the horizontal (generic) national e-Infrastructure organisations,
2. the coordination mechanisms among these,
3. their governance,
4. how these e-Infrastructures are funded,
5. their access policies and
6. their coordination with vertical (domain specific) e-Infrastructures.

As of May 2019, a total number of 28 e-IRG Member States have submitted responses with varying levels of detail, corresponding to approximately 60% of all 44 EU Member States and Associated Countries.

Following an agnostic analysis of the e-Infrastructure landscape in European countries, it is observed that e-Infrastructures in the national public research sector are composed vastly different in the different countries. There are unique cultural and historic traits that explain why the European e-Infrastructure landscapes is different and diverse. All abstractions made in this European e-Infrastructure landscape analysis should therefore be viewed as holistic views.

It should be noted that the classifications made in this document are best estimates and a first attempt to come up with a picture of the EU

complex landscape, which may not always be accurate and the authors acknowledge that it is part of the discussion.

National e-Infrastructure landscapes, coordination and governance

In most e-IRG member countries the landscape of national generic e-Infrastructure-providing organisations consists of more than one, and often even more than three or four distinct entities. There are, however, a few examples where one single organisation is responsible for the entire national e-Infrastructure service portfolio, either as a single physical entity or as a virtual umbrella organisation. In many cases, each of the national e-Infrastructure organisations specialize on distinct e-Infrastructure services, such as either high-capacity network for science and higher education, advanced computing resources, or sometimes generic large-scale data repositories. There are cases where several distinct organisations may provide overlapping national e-Infrastructure services. On the other hand, the horizontal e-Infrastructure-providing entities in many of the countries have established functional mechanisms for coordinating the provisioning

Countries that responded to the e-IRG survey

"The number of e-Infrastructure providers per country varies from a single organisation in a few countries to multiple providers."

of related e-Infrastructure services amongst themselves. Still, it is not always easy to find out how these mechanisms have been motivated and if they are pushed by the initiatives themselves or by external top-down initiatives originating in e.g. ministries or research councils. In some of the countries there are currently ongoing processes to improve and further develop the existing national e-Infrastructure landscape and coordination mechanisms.

Observations:

- The number of e-Infrastructure providers per country varies from a single organisation in a few countries to multiple providers of the different horizontal e-Infrastructure components. Large countries usually have multiple providers, while smaller countries have fewer. A situation of multiple providers may lead to competition, and in all cases requires coordination at the national level, either bottom up (initiated by the providers themselves) or top-down (imposed by ministries or research councils).

- The more complex the national ecosystem, the more challenging the coordination towards the European constituents and initiatives.

The governance of horizontal national e-Infrastructure-providing entities is vastly different among the countries: ministries/research councils, universities and research communities are represented to varying degrees at both the structural ownership level (i.e. who is the "owner" of the organisation) and at the strategic governance level, (i.e. who is responsible for the day-to-day management usually exercised by prioritizing boards). A clear trend is observed in the structural ownership level of network-provisioning e-Infrastructure entities, which appears to be less dispersed than for computing-, data- and other e-Infrastructure service-provisioning e-Infrastructure entities. A concentrated ownership directly by the ministries in the case of networking-providing e-Infrastructures is motivated by high development costs and the criticality of national high-capacity network infrastructures. Similar attempts and intentions are experienced with respect to the HPC facilities of the e-Infrastructures. Another trend (although less pronounced and not the case for all countries) is observed for all types of horizontal e-Infrastructures at the strategic governance level for the prioritizing boards, where representatives from universities and research communities participate to a larger

degree than what is the case at the structural ownership level.

Observations:

The governance of e-Infrastructure providers varies significantly inside and across countries. The structural ownership of networking organisations usually lies with a higher-authority organisation such as a ministry, while for other e-Infrastructure providers the situation is more dispersed. The strategic governance level is in many cases exercised by boards with representatives from universities or research centres or other experts.

Once again, the more complex the governance at national level, the more challenging the coordination within the country and towards the European constituents and initiatives.

Funding for national e-Infrastructures and access policies

In most of the countries funding for the national high capacity network and generic advanced computing resources appears to be channelled directly from the ministries and/or the research councils. A few cases exist where these kinds of services are additionally co-funded through user fees, usually imposed at the institutional or research infrastructure/centre of excellence level. While funding for national horizontal large-scale data repositories and other e-Infrastructure-related services often also involves direct financing from ministries, there appears to be significant additional financing from participating research institutions and project-based funding in many e-IRG member countries. In few cases the funding for national e-Infrastructure providers also (partly) involves EU structural funds. This is typically the case in countries where a considerable percentage of available structural funds are consciously spent for strengthening competitiveness.

Observations:

- Funding of e-Infrastructure providers is less dispersed than other cases (i.e. governance, integration with vertical e-Infrastructures, etc.). In most countries, networking and computing providers are funded by ministries (and research centres) given the high budgets involved, and in fewer cases this involves user fees or EU structural funds. Data infrastructures involve more ad-hoc or project-based funding.

“The more complex the governance at national level, the more challenging the coordination within the country and towards the European constituents and initiatives.”

- The funding landscape appears to be less complex than other cases. However, sustainability of national providers with more ad-hoc funding such as data infrastructures may be complicated, which may have an impact at their European constituents and initiatives.

- EU funding for specific projects – aside from networking / GÉANT – is used for several components of the e-Infrastructure landscape, especially for the new components, such as data, and other services.

Access for national horizontal e-Infrastructure services for research and higher education in most e-IRG member countries are free for the end-users, but strictly limited to national users. Access for researchers to advanced computing resources sometimes (but not always) involves a peer-review process. In most of the countries, users from the private sector can also request access to advanced national generic computing resources (in most cases for research or pre-commercial use), but the access is often limited to a regulated quota and requires unsubsidised levels of user fees.

Observations

- Similar to funding, access is also less dispersed than other cases. In most countries, access to the national resources is restricted to national users, while there are some cases, especially in computing, where a fraction of the resources is allowed to international users or collaborations (e.g. via peer-review).

- Although access appears to be less diverging across countries, in most cases it is restricted to national users or only a fraction is open for European or international initiatives or virtual organisations. This may have a significant impact at the European constituents and initiatives.

Integration of vertical (domain-specific) with national horizontal (generic) e-Infrastructures

Most of the countries describe that coordination of vertical (domain-specific) e-Infrastructures with horizontal (generic) e-Infrastructures is facilitated to some degree. However, structured processes for this type of actions seems to be rare. Even if to date only very few cases exist where funding from vertical e-Infrastructures is channelled to the

coordinated use of horizontal e-Infrastructures, it is worth noting that in about half of all e-IRG member countries some co-operative mechanisms do in fact already exist to coordinate the interplay between these e-Infrastructure axes.

Observations

- Coordination of vertical (domain-specific) e-Infrastructures with horizontal e-Infrastructures is facilitated to some degree, yet with ad-hoc and not structured approaches, while funding is usually not channelled from vertical to horizontal e-Infrastructures.

- Coordination of vertical with horizontal e-Infrastructures is rather ad-hoc at national level, which also has an impact at European level integration.

Deliberations

The development of coherent, efficient and structured coordination mechanisms among horizontal and vertical e-infrastructure service providers, easy access to data and interoperable services, as well as establishing robust and sustainable funding mechanisms that can enable scalable and long-term development and operation of national and European e-Infrastructures and infrastructures are at the heart of realizing the e-Infrastructure Commons in Europe. The presented landscape analysis of national e-Infrastructures shows that although there are vast differences among e-IRG member countries, there are some clear trends that are already in line with the recommended actions towards the e-Infrastructure Commons, such as:

- A broad user involvement at the strategic governance level of national horizontal e-Infrastructures through representatives from the universities and research communities. This kind of inclusiveness is to be strengthened and widened in the future.

- Unstructured or ad-hoc mechanisms to coordinate the interplay between national horizontal and vertical e-Infrastructures do exist in several e-IRG member countries. Similar, or, if possible, more structured and more conscious attempts and efforts are to be gradually introduced in as many as possible e-IRG member (and EOSC partner) countries.

- In most e-IRG member countries the funding for national horizontal large-scale data repositories and e-Infrastructure services

other than network and advanced computing resources, largely involves user-fees and project-based funding in addition to basic funding from the ministries, research council and in some cases also the universities.

- A few of the e-IRG member countries mention interesting mechanisms and ongoing processes to improve and further develop the existing national e-Infrastructure landscape and coordination mechanisms. The experiences from the work with such national processes should be collected and shared among European countries to develop best practices for the way forward towards the e-Infrastructure Commons. The cost sharing models and practices applied by GÉANT and PRACE are also to be taken into consideration in the development of the widely applicable coordination, business and funding models and practices. Although perfect uniformity throughout Europe is practically impossible with respect to this coordination and financing of the e-Infrastructure development and operation, harmonization among the countries is to be attained.

Good Practices

The following examples of good practices illustrate how some of the countries coordinate their e-Infrastructure efforts within a country and on regional level:

- France – The National Plan for Open Science
- Germany – The National Research Data Infrastructure
- Italy – Italian Computing and Data Infrastructure as a coordination mechanism
- Nordic countries – Nordic e-Infrastructure Collaboration

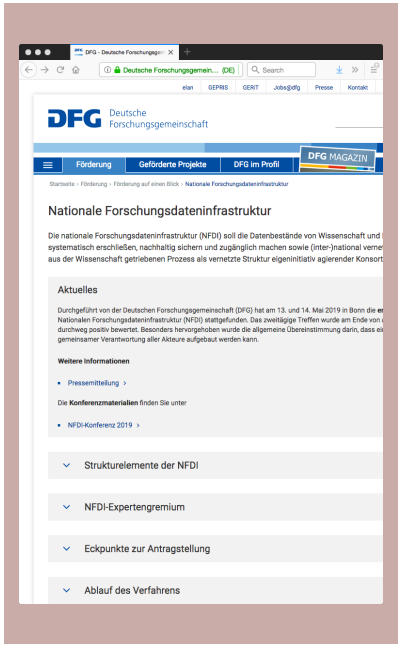
This list is neither complete nor comprehensive but gives distinct examples of coordination at national or regional level. Three of the examples were presented at the open e-IRG Workshop under Austrian Presidency[32] in November 2018 (presentations online available).

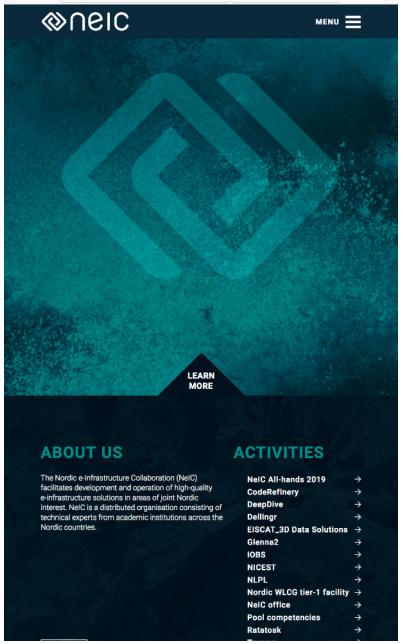
France has published a *National Plan for advancing Open Science*. The plan is concentrated around 3 main areas: The first one is to generalise Open Access to publications, i.e. making open scientific publishing the standard approach as soon as possible. The second is to structure Research

Data to comply with the FAIR principles (Findable, Accessible, Interoperable, Reusable) and make it available through Open Access. In addition, France supports RDA and its best practices on research data. The third one is to be part of a sustainable European and international Open Science dynamic. This refers to France's participation in Open Science infrastructures and initiatives (such as EOSC, OpenAIRE and RDA), but also to the development of relevant skills, certification programmes and Open Science policies within the country, and its research institutions.

The German approach to establish a *National Research Data Infrastructure (Nationale Forschungsdaten Infrastructure - NFDI)*[33] is an example for the coordination between the federal states (Länder) and the federal government in Germany to establish a national infrastructure despite the distributed structure of responsibilities and funding[34]. The main idea with NFDI is to bring together users and research data providers, so that their data will be sustainably available and re-usable across research disciplines. This will create completely new opportunities for innovation. The Federal Government and the federal states will provide significant funding for the establishment and support of the NFDI during a 10-year period. The NFDI will be made up of scientific consortia coordinated by a Directorate and a Scientific Senate. It aims of make the German science system better interconnected and internationally competitive. This will facilitate the evolution towards EOSC, offering the potential to be a core element and important actor in its development and in further international cooperation.

The *Italian Computing and Data Infrastructure (ICDI)*[35,36] brings together different national resource and service providers to take a coherent position of the Italian research community aiming to improve coordination in order to make efficient use of the resources and support high quality research. ICDI acts as a bottom-up coordination structure, aiming at promoting synergies between Italian Research Infrastructures and e-Infrastructures, and coordinating the Italian participation in national and international initiatives and programmes. In particular, ICDI aims at contributing in the creation of national strategies and at harmonising Italian participation in EOSC and EDI, optimising available resources and facilitating prioritization and sustainability. In addition, ICDI fosters the development of a national and European data network, based on data producers and on the various service levels offered by Research Infrastructures, R&E networks and advanced computing centres. ICDI is a good practice of a





loose coordination structure facilitated via an MoU among major research organisations. The Italian Ministry of Education, Universities and Research participates as an observer, but has a great interest in this initiative, especially if it can contribute elaborating the national positions to the EU initiatives.

The fourth example shows how the Nordic Countries are anchored in the regional Nordic e-Infrastructure Collaboration (NeIC), which could be seen as a paradigm of cross-country regional collaboration and coordination in the provision of e-Infrastructure services and resources. It should be noted that the national nodes in the Nordic countries are sufficiently well developed to allow for cross-Nordic collaboration. Still, almost all of the underlying e-Infrastructure resources are very much national (in terms of funding, governance and access). NeIC[37] facilitates the development and operation of high-quality e-Infrastructure solutions in areas of joint interest among the Nordic countries. NeIC is a distributed organisation consisting of technical experts from academic institutions across the Nordic countries.

Conclusions - Recommendations

The e-IRG survey has delivered one of the first reasonably extensive descriptions of the e-Infrastructure field in European countries. However, the answers provided have to be very carefully interpreted and by no means e-IRG will claim that every question has been interpreted and answered by each delegate in exactly the same way. Therefore, any attempt from the authors to derive conclusions and recommendations must be handled with care. e-IRG is perfectly aware, that simple categorisation and counting does not do justice to the survey results. One overriding conclusion is indeed that the (organisation of the) national e-Infrastructure landscape varies considerably between the countries!

With this disclaimer e-IRG hereby tries and formulates recommendations, directed as in earlier e-IRG publications to e-IRG's main target audiences: Member States / Associated Countries and the European Commission.

Members States/Associated Countries

e-IRG safely concludes, that in a sizeable number of European countries, the various cornerstones of e-Infrastructure development and provisioning (computing including HPC, data, networking), that often have differing histories and are used to act quite independently, have increased the level of coordination between themselves. There is a large variety in how this takes place. In some countries a ministry plays a central role, in others this is devolved to a Research Council or to a separate provisioning organisation or organisations.

There is also a variety in how universities and research institutions have a stake in the e-Infrastructure provisioning. This ranges from loosely-coupled forms to formal memberships of the provisioning organisations or even a shareholder position.

Funding streams to e-Infrastructure organisations also vary considerably, with again direct funding from ministries and/or through research councils, EC funding (either for dedicated e-Infrastructure projects or as in the case of GÉANT a contribution to basically every NREN in the Member States/AC). This is usually

complemented with user fees and in some cases third party revenues.

With regard to the challenging intersection of *generic* and *discipline specific* e-Infrastructure services, a few countries have provided interesting information on funding: these concern mechanisms whereby Research Infrastructures applying for funding from the national Roadmap funds are obliged to include an e-Infrastructure paragraph (and budget) that they need to have discussed in advance with their national horizontal e-Infrastructure provider(s). This closely resembles the way in which ESFRI Roadmap proposals need to provide information on the handling of their 'e-Needs'. Further coordination across funding streams of horizontal and vertical e-Infrastructures within the countries appears increasingly important. The overall coordination of the two within a common framework or structure such as EOSC needs to be encouraged by both sides.

Discussion

National e-Infrastructure organisations have a pivotal role in the European context. They are on the one hand the link to the national universities and research organisations (and thereby crucial in reaching the long tail of science) and on the other hand the link to the European provisioning organisations, either through memberships or other forms of participation.

In the vision of e-IRG the (generic part of) the EOSC service provisioning will consist of the federation of these national e-Infrastructure organisations. We therefore underline the importance of our earlier recommendation:

> Members states and associated countries should continue to increase the level of coordination between and consolidation of the various national players on e-Infrastructure provisioning.

We note that given the variety observed in this survey, we refrain from advising a particular instantiation for such increased coordination: there is *no one size that fits* all.

With regard to the important interplay between e-Infrastructure provisioning (including data management) by research communities themselves ('discipline specific') and the generic provisioning organisations, we note that there are still limited experiences on how to organise this. Generic e-Infrastructures have the potential of being efficient and effective, pooling hardware and software but more importantly people and expertise together. In the long run e-IRG believes

"*Members states and associated countries should continue to increase the level of coordination between and consolidation of the various national players on e-Infrastructure provisioning.*"

that strong generic infrastructures will serve the ultimate goal of the EOSC, offering professionals in science and technology a virtual environment with free at the point of use, open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines.

Important issues to be discussed in connection to national policies include coordinated governance of service delivery, life cycle management for services, and coordinated funding streams for investments and operations. e-IRG believes that the funding system must facilitate the right incentive structure to improve the current situation. Such funding structure may consist of a *balanced mix* of base funding for the innovation and exploitation of the (national) e-Infrastructure, funding by users derived from service delivery by the providers and top up funding based on (national) priorities for (demanding and well organised) research communities. And to not forget the European context: funding mechanisms should include how to provide access to the national services for cross border research collaboration. This leads e-IRG to recommend that:

Member States and Associated Countries should explore, pilot and install funding schemes, which

1. give the incentive to both research communities and provisioning organisations to collectively optimize e-Infrastructure service development and provisioning;
2. enable easy cross border research collaboration.

“Member States and Associated Countries should explore, pilot and install funding schemes, which
1. give the incentive to both research communities and provisioning organisations to collectively optimize e-Infrastructure service development and provisioning;
2. enable easy cross border research collaboration.”

European Commission

Although our analysis is primarily targeted at the Member State/AC level, there are some observations that are important for the Commission. In e-IRG's earlier policy work (White Paper 2013, Roadmap 2016) e-IRG has summarized the role of the EC to "develop the necessary harmonised scope, framework and instruments for improving Research Infrastructures, including e-Infrastructures in terms of operations, innovation and sustainability".

It is evident that in order to reach the goals of the EOSC, most of the resources need to be mobilised at the national level. This is why e-IRG considers it of the utmost importance to reach strong national e-Infrastructure coordination, because the EOSC will be most likely the federation of national (and thematic) Open Science Clouds.

Furthermore, when e-IRG advocates coordination and consolidation at the national level, this must also find its counterpart at the European level. A future EOSC governance should enable this.

"e-IRG therefore recommends, that in future Work Programmes the EC provides strong incentives for further coordination and consolidation of e-Infrastructure service development and provisioning at the national and the European level."

E-IRG therefore recommends, that in future Work Programmes the EC provides strong incentives for further coordination and consolidation of e-Infrastructure service development and provisioning at the national and the European level.

The private sector has to play a role in this endeavour. Users are already enjoying private sector resources and tools, and integration of such services into the EOSC portal and marketplace should be promoted by the EC.

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4 https://ec.europa.eu/digital-single-market/en/eurohpc-joint-undertaking
5 http://e-irg.eu/mission
6 http://e-irg.eu/commons
7 http://e-irg.eu/documents/10920/12353/e-irg_roadmap_2012-final.pdf
8 http://e-irg.eu/catalogue/eirg-1003
9 http://e-irg.eu/catalogue/eirg-1002
10 http://e-irgsp4.e-irg.eu/documents/11836/299419/e-infrastructure+services+marketplace-v1.4-30-10-2015.pdf/
11 https://data.consilium.europa.eu/doc/document/ST-9526-2016-INIT/en/pdf
12 https://ec.europa.eu/research/openscience/pdf/realising_the_european_open_science_cloud_2016.pdf
13 http://ec.europa.eu/research/index.cfm?eventcode=44D86060-FBA1-1BD1-9355822B162BB0EE&pg=events
14 https://ec.europa.eu/research/openscience/pdf/eosc_declaration.pdf#view=fit&pagemode=none
15 https://ec.europa.eu/research/openscience/pdf/list_of_institutions_endorsing_the_eosc_declaration.pdf#view=fit&pagemode=none
16 https://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf#view=fit&pagemode=none
17 https://eoscpilot.eu/
18 https://einfracentral.eu/
19 https://www.openaire.eu/openaire-connect-project
20 https://eudat.eu/
21 https://www.rd-alliance.org/rda-europe
22 https://aarc-project.eu/
23 https://egi.eu
24 https://www.indigo-datacloud.eu/
25 https://www.project-freya.eu/
26 https://www.openaire.eu/openaire-advance-project
27 http://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf
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Non-Conflict of Interest

The e-IRG policy document "Implementing e-Infrastructure Commons and the European Open Science Cloud - National Nodes - Getting organised; how far are we?" is adopted by the e-IRG plenum, which is composed of 62 national delegates representing the science community and the related ministry of 32 Member States and Associated Countries.

The members of the e-IRG Working Group on the National Nodes and the supporting members of the e-IRG Support Programme have declared and signed Non-Conflict of Interest statements.

Colophon

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All e-IRG delegates collected national information for their country.

Editors

Sverker Holmgren (Co-Chair of the Working Group, e-IRG Delegate for Sweden)
Arjen van Rijn (Co-Chair of the Working Group, e-IRG Delegate for the Netherlands)
Ulrike Jaekel (e-IRG Delegate for Norway)
Josva Kleist (e-IRG Delegate for Denmark)
Gabriele von Voigt (e-IRG Chair, e-IRG Delegate for Germany)

Fotis Karayannis (e-IRG Support Programme)
Michael Maragakis (e-IRG Support Programme)
Jan Wiebelitz (e-IRG Support Programme)

Layout and Design

Ad Emmen and Leslie Versweyveld (Genias Benelux BV, e-IRG Support Programme)

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http://knowledgebase.e-irg.eu/national-analysis
http://knowledgebase.e-irg.eu/national-maps

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Version 1.0

e-IRG secretariat

c/o Dutch Research Council (NWO)
attn. Naomi Messing (project officer secretariat e-IRGSP6)
P.O. Box 93460
NL-2509 AL The Hague
The Netherlands
email: secretariat@e-irg.eu

Glossary

AARC	Authentication and Authorisation for Research Collaborations
AC	Associated Country
e-IRG	e-Infrastructure Reflection Group
EC	European Commission
EDI	European Data Infrastructure
EGI	Advanced Computing Services for Research
ELIXIR	Intergovernmental organisation that brings together life science resources from across Europe
EOSC	European Open Science Cloud
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EUDAT	Collaborative Data Infrastructure
FAIR	Findable, Accessible, Interoperable, Reusable
FAIRsFAIR	Fostering FAIR Data Practices in Europe
FREYA	Connected Open Identifiers for Discovery, Access and Use of Research Resources
GB	Governance Board
GÉANT	Pan-European data network for the research and education community
GO FAIR	Initiative that aims to implement the FAIR principles
HPC	High Performance Computing
HTC	High-throughput Computing
ICDI	Italian Computing and Data Infrastructure
INDIGO-DataCloud	Sustainable European PaaS-based cloud solution for e-Science
MS	Member State
NeIC	Nordic e-Infrastructure Collaboration
NFDI	Nationale Forschungsdaten Infrastructure
NI4OS-Europe	National Initiatives for Open Science in Europe
NN	National Nodes
NREN	National Research and Education Network
OpenAIRE	EC-supported initiative to foster Open Science in Europe in order to accelerate research and boost innovation
RDA	Research Data Alliance
RFO	Research Funding Organisations
RI	Research Infrastructure
RPO	Research Performing Organisations
SME	Small and Medium-sized Enterprise
SWD	Staff Working Document
UK	United Kingdom

Annex 1 - Extended landscape analysis

It should be noted that the classifications made in this document are best estimates and a first attempt to come up with a picture of the EU complex landscape, which may not always be accurate and the authors acknowledge that it is part of the discussion.

The tables and pictures in this document reflect the answers received to the questionnaire and the interpretation by the authors. Answers can be traced back to a country questionnaire answer but may not always be complete and fully representative.

Answers to Question 2a

> Question 2a: Describe which organisation or organisations have been given the responsibility at the national level for provisioning e-Infrastructure services in your country. If the answers contain multiple organisations, describe (if applicable) how these organisations coordinate their activities amongst themselves.

Analysis

The European landscape of e-Infrastructures is as diverse as its cultures and ethnicities. One cannot opt for a single scenario for all countries, or enforce an "apply in all cases" solution when it comes to the existing, or future, organisation scheme of all Member States and related Associated Countries.

There exist a number of countries, which have more than one, or even few, national provisioning organisations. We distinguish between four types of e-Infrastructures:

1. Networking,
2. Computing,
3. Data, and
4. Other Services.

In most of the 28 countries that supplied related information, there exists a provisioning organisation that offers two or more types of e-Infrastructure (for example networking and computing, or networking and services) and one (or more) additional one(s) offering data, computing or other services e-Infrastructures. In some cases, this organisation of the first case (with two or more types of e-Infrastructure) is the major one in the country, while others specialise in a specific type, or part of it.

In order to analyse the European landscape, we divide countries into generic categories with similar characteristics. More specifically, and concerning only the number of provisioning organisations that exist, we classify them into three categories:

Category A has only one provisioning organisation that provides all types of e-Infrastructures in the country.

Category B has two or three such organisations, with or without an overlap.

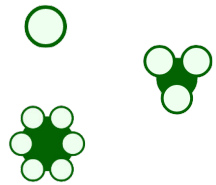
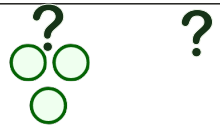
Category C has four or more organisations, and in many cases with an overlap between them. The resulting table on page 31 (left) and infographic on page 32 show how Europe looks like, with regard to the number of national e-Infrastructure providers.

Countries of category A obviously need only to internally coordinate their own e-Infrastructures. However, this classification does not stop the countries of categories B and C from having a well-defined and established coordinating structure and a clear division of duties between these organisations. For this purpose, in the case where multiple national organisations exist in a country, we requested the coordination of the activities between them to be described. Based on these replies, most European countries show some level of coordination with specific rules between e-Infrastructure provisioning organisations, and fewer report that there is no direct coordination structure, or loose coordination rules between such organisations. See the table on page 31 (right) and infographic on page 32.

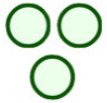
It is worth noting that some countries show steps of significant improvement as far as coordination is concerned in the last months, and that in several countries there are ongoing processes even now. For example, Italy has initiated a dialogue and through it, Research Infrastructures and e-Infrastructures have decided to create a National Coordination Group: the Italian Computing and Data Infrastructure (ICDI). Other examples of countries where recent steps to improve coordination were reported were Czechia and Norway.

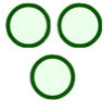
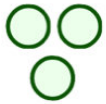
Category	Icon	Number of horizontal provisioning	Countries
A		Only one major provisioning organisation providing the major e-Infra-structure services in a country	Denmark, Hungary, Turkey
B		Two or three provisioning organisations providing the major e-Infrastructure services in a country	Bosnia & Herzegovina, Bulgaria, Croatia, Czechia, Estonia, Finland, Greece, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Serbia, Slovenia, Sweden, Switzerland
C		Four or more provisioning organisations providing the major e-Infra-structure services in a country	Austria, Belgium, France, Germany, Italy, Norway, Portugal, Spain
		Reply requiring further specifications or no reply	UK

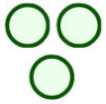
Number of horizontal provisioning organisations at national level (question 2a)

Icons	Coordination level	Countries
	Well-defined coordination structure with specific rules between provisioning organisations reported, or single major organisation in the country.	Bulgaria, Czechia, Denmark, Estonia, Finland, France, Hungary, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Portugal, Slovenia, Sweden, Switzerland, Turkey
	Not well-established coordination structure reported, or loose coordination rules.	Austria, Belgium, Bosnia & Herzegovina, Croatia, Germany, Greece, Latvia, Serbia, Spain
	Reply requiring further clarifications to classify or no reply	Poland, UK

Coordination at national level (question 2a)

Country	Organisations
Austria	
Belgium	
Bosnia & Herzegovina	
Bulgaria	
Croatia	
Czechia	
Denmark	
Estonia	
Finland	
France	

Country	Organisations
Germany	
Greece	
Hungary	
Italy	
Latvia	
Lithuania	
Luxembourg	
Norway	
Poland	

Country	Organisations
Portugal	
Serbia	
Slovenia	
Spain	
Sweden	
Switzerland	
the Netherlands	
Turkey	
United Kingdom	?

Answers to Question 2b

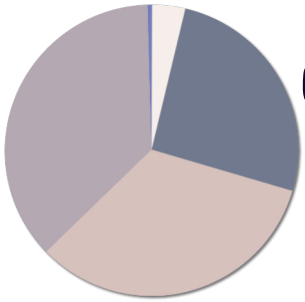
Question 2b: Describe the governance of this organisation/these organisations (such as: legal entity, composition of board or council, representation of stake-holders, such as universities, research infrastructures, funding agencies, etc.).

Analysis

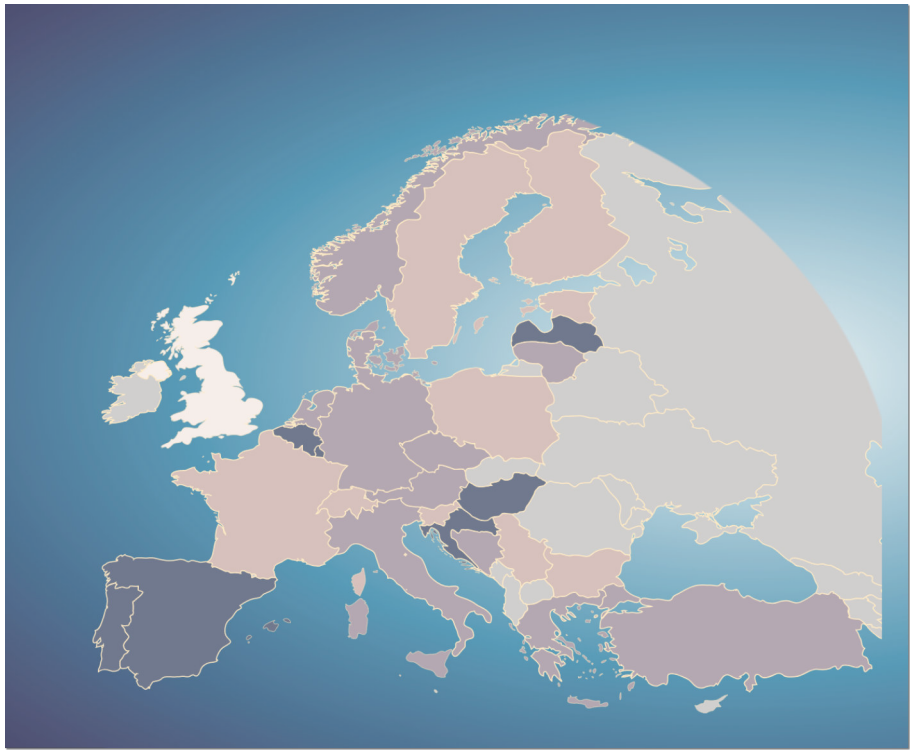
In order to analyse the governance of the e-Infrastructures in a country, the specifics of each country must be well understood. A strong example of this is the fact that in many countries there is a ministry which owns part of or the entire e-Infrastructure provisioning organisation. However, the same ministry may delegate the strategic governance to a board that is entirely (or in its larger part) composed of members of the Academic and the Research Institutions of that country.

It is obviously of great importance for the governance of any European level e-Infrastructure to be fully aware of how its national building blocks are governed. It is actually important to know what kind of organisation is the one taking decisions concerning the strategy to be followed.

The same conclusion holds for all individual types of e-Infrastructure (Networking, HPC, Data, Other Services). The results for each individual country are presented per e-Infrastructure type, respectively, in pages 34 – 37.

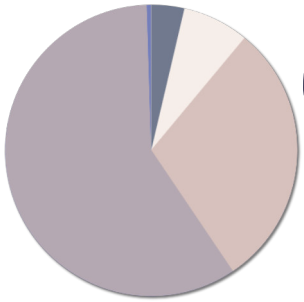


Governance of Networking e-Infrastructure

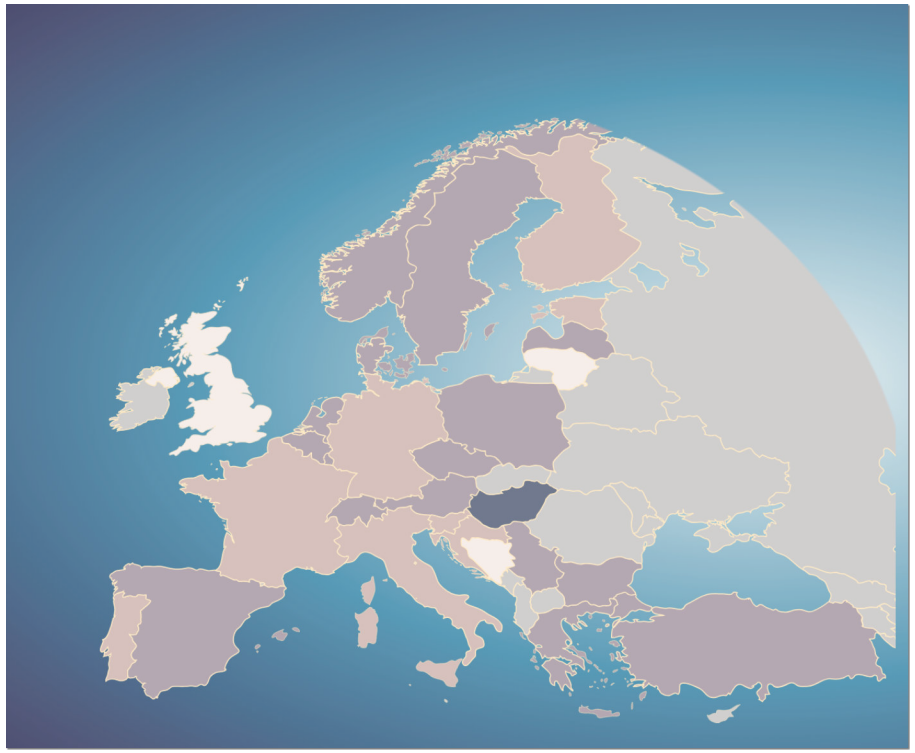


	Organisation type	Countries		
26%	Ministry or Research Council	Belgium Croatia Hungary	Latvia Luxembourg Portugal	Spain
37%	Research Institutions or Universities	Austria Bosnia & Herzegovina Czechia	Denmark Germany Greece Italy	Lithuania Norway the Netherlands Turkey
33%	Mixed case (strategic management of e-Infrastructure though collaboration of both previous kinds)	Bulgaria Estonia Finland	France Poland Serbia	Slovenia Sweden Switzerland
4%	Further specification needed	UK		

question 2b-networking

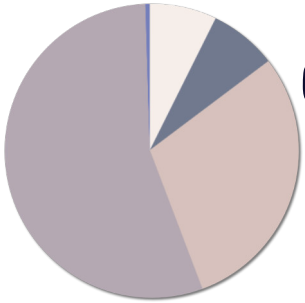


Governance of Computing e-Infrastructure



	Organisation type	Countries		
4%	Ministry or Research Council	Hungary		
59%	Research Institutions or Universities	Austria Belgium Bulgaria Czechia Denmark Greece	Latvia Luxembourg Norway Poland Serbia	Spain Sweden Switzerland the Netherlands Turkey
30%	Mixed case (strategic management of e-Infrastructure though collaboration of both previous kinds)	Croatia Estonia	Finland France Germany	Italy Portugal Slovenia
7%	Further specification needed	Bosnia & Herzegovina	Lithuania	UK

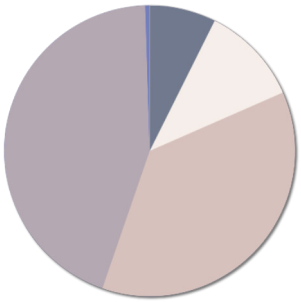
question 2b-computing



Governance of Data e-Infrastructure

	Organisation type	Countries		
7%	Ministry or Research Council	Hungary		
56%	Research Institutions or Universities	Austria Bulgaria Czechia Denmark Greece	Latvia Lithuania Luxembourg Norway Poland	Slovenia Spain Switzerland the Netherlands Turkey
30%	Mixed case (strategic management of e-Infrastructure though collaboration of both previous kinds)	Belgium Croatia Estonia	Finland France Germany	Portugal Sweden
7%	Further specification needed	Bosnia & Herzegovina	Serbia	UK

question 2b-data



Governance of "Other Services" e-Infrastructure

	Organisation type	Countries		
7%	Ministry or Research Council	Hungary	Italy	
44%	Research Institutions or Universities	Austria Bulgaria Czechia Denmark	Greece Norway Poland Spain	Sweden Switzerland the Netherlands Turkey
37%	Mixed case (strategic management of e-Infrastructure though collaboration of both previous kinds)	Belgium Croatia Estonia Finland	France Germany Latvia	Portugal Serbia Slovenia
11%	Further specification needed	Bosnia & Herzegovina	Lithuania Luxembourg	UK

question 2b-Other services

Answers to Question 2c

Question 2c: Describe how this organisation/these organisations are funded (main funding streams, such as ministries, research councils, grants, subsidies, third parties (industrial, other), membership contributions, user contributions, etc.).

Analysis — Networking

Nearly all countries (with the exception of Bosnia and Herzegovina) have established an NREN providing networking services for research. The majority of these NRENs is funded by the corresponding ministries or research councils. Funding from the Research Council is taken from the Research Council's operational budget and not subject to competition. Additionally, in some cases membership fees or stakeholder (universities and research institutions) and user contributions provide a major funding stream. Furthermore, in some countries users provided services fees (pay-per-use). In few countries (Germany, Italy, Portugal and Switzerland) the NREN is financed entirely, or for its most part, by the stakeholders or user communities. Most countries reported that (additional) project-based funding is received from the Commission through participation in GÉANT or other European projects. Two countries (Greece, Portugal) report European Structural Funds used to fund the NREN.

Table: Funding of networking e-Infrastructure (question 2c-networking)

Country	Financing body					
	Ministry	Research Council	Membership fees / Stakeholder contribution	User contribution	EU Funding (apart from GÉANT funding)	Other
Austria			■			
Belgium	■			■		■
Bosnia & Herzegovina						
Bulgaria	■					
Croatia	■				■	■
Czechia	■		■	■	■	■
Denmark			■			
Estonia		■				
Finland	■	■	■		■	■
France	■					
Germany			■			
Greece	■				■	■
Hungary	■		■	■	■	■
Italy			■	■		
Latvia	■					■
Lithuania	■					
Luxembourg	■			■	■	
the Netherlands	■		■	■	■	
Norway	■			■		
Poland	■		■		■	■
Portugal	■		■		■	■
Serbia	■					
Slovenia	■				■	
Spain	■		■			
Sweden		■	■			
Switzerland				■	■	
Turkey	■					
UK		■				

Analysis — Computing

The category computing comprises all kinds of computing ranging from Grids and cluster computing to high-performance computing.

In most countries computing is at least partially funded through national ministries and research councils. Several of them list this type of funding as their main source. Many countries mention that their only (Austria), or significant additional funding comes from stakeholders and user communities. Some mention EU Structural Funds use for financing compute resources, or report about subsidies from the EU for computing activities.

Country	Financing body					
	Ministry	Research Council	Membership fees / Stakeholder contribution	User contribution	EU Funding (apart from GÉANT funding)	Other
Austria			■			
Belgium	■			■		
Bosnia & Herzegovina	■			■		
Bulgaria	■					■
Croatia	■				■	■
Czechia	■		■	■	■	■
Denmark	■			■		
Estonia		■				
Finland	■	■			■	
France	■					
Germany	■					
Greece	■				■	■
Hungary	■		■	■		■
Italy	■		■			
Latvia	■			■		■
Lithuania						
Luxembourg	■			■		
the Netherlands	■		■		■	
Norway		■	■	■	■	
Poland	■					
Portugal		■	■	■		
Serbia	■					
Slovenia	■					
Spain	■	■			■	
Sweden		■	■			
Switzerland	■					
Turkey	■					
UK		■				

Table: Funding of computing e-Infrastructure (question 2c-computing)

Analysis — National Data Infrastructure

(National Data Service / Data Management / Repositories)

Many countries receive funding for their data repositories by the ministry of education and research. In some countries the research council is funding the data repositories or providing project-based funding (Germany) for data repositories. Several countries mention membership fees or user contribution for data repositories. EU funding is also noted by some countries. Only funding streams for data repositories have been considered.

Country	Financing body					
	Ministry	Research Council	Membership fees / Stakeholder contribution	User contribution	EU Funding (apart from GÉANT funding)	Other
Austria			■			
Belgium						
Bosnia & Herzegovina						
Bulgaria						
Croatia	■					
Czechia	■		■	■	■	■
Denmark	■		■	■	■	■
Estonia						
Finland	■	■	■		■	
France	■		■			
Germany		■	■			
Greece	■				■	
Hungary	■		■	■		■
Italy						
Latvia				■		■
Lithuania			■			
Luxembourg						
the Netherlands		■				
Norway	■	■	■	■	■	
Poland						
Portugal						
Serbia						
Slovenia						
Spain		■			■	
Sweden						
Switzerland						
Turkey	■					
UK						

Table: Funding of national data e-Infrastructure (question 2c-data)

Answers to Question 2d

Question 2d - Describe the access policies of this organisation/these organisations, including any legal restrictions in using the e-Infrastructure.

Analysis

From the access policies of e-Infrastructures point of view, one clearly sees that in most of them access is strictly at a national level, especially for computing services.

There are cases where service-portfolios may allow regional access (Nordic and Iberian countries) and countries such as Estonia or Germany in the area of HPC, which allow access to some resources for international users.

In most countries the access of country-wide service-portfolios is free of charge for the user.

In some countries there are policies in place to allow for the use of the national resources (mainly computing related, but services too) based on a peer-review process (mainly in the HPC field), while few provide access on an annual contribution basis or a pay-per-use model.

In addition to that, there are also several countries that have already set up access policies to allow for (partial) industrial use of the national e-Infrastructures (mostly for innovation), mainly in the area of computing. Some countries follow a regulated model to do this, while most have a pay-per-use one.

One horizontal (country-wide) data storage service is still missing in most countries.

Table: e-Infrastructure access policies

Country	International / Regional access	Restrictions in access
Austria		Hospitals and Public administration allowed; Industry allowed in some e-Infrastructure on pay basis
Belgium		HPC/HTC Tier-2: Only one Flemish university requires payment by the users. HPC level Tier-1: free, access is on a peer-reviewed model. Industry allowed, but has to pay except if within funded project with a university
Bosnia & Herzegovina		
Bulgaria		
Croatia		University hospitals and some bodies of Public and Gov administration allowed to connect to NREN; computing and digital repositories only to Academia & Research
Czechia	International (some of the e-Infra-structure)	Industry allowed for R&D activities only, peer review in some e-Infrastructures
Denmark		Private companies with a significant research element are allowed in the network. Companies can pay for access to compute resources, if any are vacant
Estonia	International (some of the e-Infra-structure)	
Finland		

Country	International / Regional access	Restrictions in access
France		Peer review in some e-Infrastructures
Germany		Industry allowed in network, peer review in computing
Greece	International and regional (Balkan region) access (limited to some cloud/storage services)	Peer review in some e-Infrastructures
Hungary		Public collections (museums, libraries, etc.), some high level public administration, selected industrial R &D allowed
Italy		Very limited industry participation
Latvia		Very limited industry participation. Pay-per-use
Lithuania		
Luxembourg		Industry will be allowed in the future
the Netherlands		Industry use is regulated, fees for some services
Norway	International (some of the e-Infrastructure)	Industry allowed in some e-Infrastructures, annual fees in some e-Infrastructures, peer review

Country	International / Regional access	Restrictions in access
Poland		Industry allowed in some e-Infrastructures. Peer review.
Portugal	Regional (some of the e-Infrastructure)	Industry allowed in some e-Infrastructures. Peer review.
Serbia		
Slovenia		Museums and public libraries allowed; industry allowed on pay basis (rather limited)
Spain	Regional (some of the e-Infrastructure)	
Sweden	Regional (only for pre-defined specific projects)	Large HPC-projects undergo peer review.
Switzerland		Industry allowed, pay-per-use models exist
Turkey		Industry allowed in some e-Infrastructures with fee
UK		Grant or pay per use

Answers to Question 3

Question 3 - Please list national domain-specific e-Infrastructures or other domain areas of particular interest in the country (e.g. ELIXIR nodes) and include whether they use the horizontal e-Infrastructures (listed above).

Analysis

The following issues have been identified:

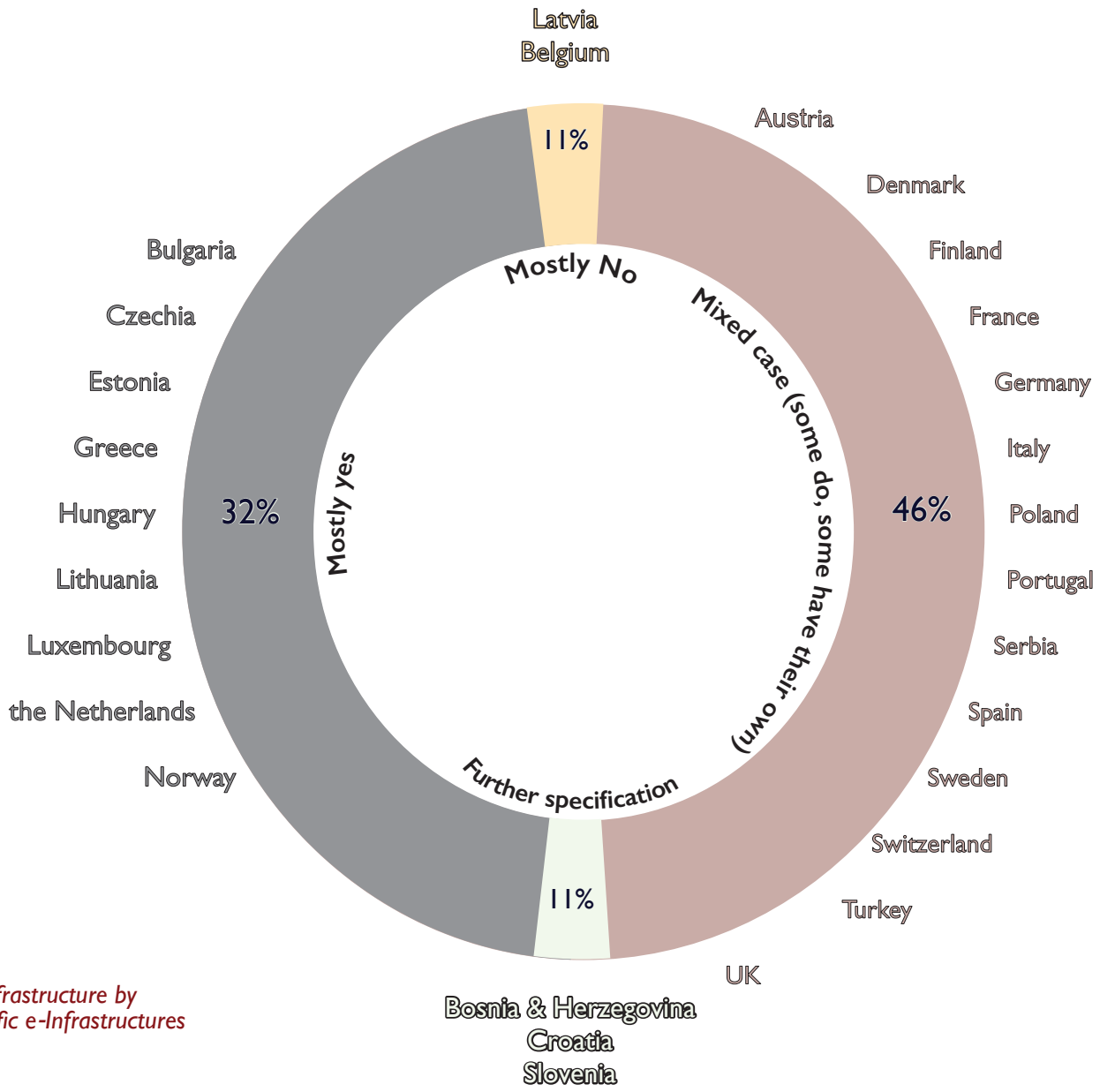
1. The list of domain specific e-Infrastructures per country covers the major ones, and in particular the ones with a regional, European or international dimension, and it is thus not complete;

2. In every country some level of use of horizontal e-Infrastructures by domain specific ones is reported, but this is triggered by the formulation of the question. This also explains why most countries mention the position of their ELIXIR-node (which was mentioned as an example in the question).

3. The network is – obviously - the most frequently used horizontal e-Infrastructure.

4. Many countries that provided information on domain-specific research infrastructures refer to their national roadmap for (large) research infrastructures.

Some countries provide interesting information on the interplay between (the funding of) these large research infrastructures and the horizontal e-Infrastructures. Two countries in particular (Norway, Netherlands) describe these mechanisms: RIs applying for funding from the national Roadmap funds are obliged to fill in an e-Infrastructure section (and corresponding budget) that they need to have discussed in advance with their national horizontal e-Infrastructure provider(s) (e-Needs). There is only very limited experience yet with such mechanisms.



Infographic:

Use of horizontal e-Infrastructure by national domain-specific e-Infrastructures

Annex 2 - National node survey template

Template for 'national node' information

In the e-IRG 2016 Roadmap two recommendations are directed at national governments and funding agencies. They should reinforce their efforts to:

1) embrace e-Infrastructure coordination at the national level and build strong national e-Infrastructure building blocks, enabling coherent and efficient participation in European efforts;

2) together analyse and evaluate their national e-Infrastructure funding and governance mechanisms, identify best practices, and provide input to the development of the European e-Infrastructure landscape.

These recommendations also appear in the Council conclusions (28/29 May 2018), which (statement 8) reads: "ENCOURAGES Member States to invite their relevant communities, such as e-Infrastructures, research infrastructures, Research Funding Organisations (RFO's) and Research Performing Organisations (RPO's), ***to get organized*** *so as to prepare them for connection to the EOSC."*

This template is directed at collecting information from each Member State/Associated Country (MS/AC) about the *current status* in order to address - in a second step of analysis - these challenges. This analysis will be the core of e-IRG's next policy document.

A first collection of short information will indicate whether a "one-size-fits-all" template/ questionnaire can accommodate all countries. If not, a more flexible approach will be needed with more open questions.

In the template the word *e-Infrastructure* is assumed to cover various 'layers' or components, in particular: **networking, computing, data and tools & services.** Whenever this is necessary to describe the country's context, *separate* information on these components should be provided.

At this stage questions 1 to 3 are considered to be most relevant. Question 4 can be addressed at a later stage.

Respondent are free if they consider it relevant - in addition to the national perspective- to insert information on regional aspects (within or between countries).

e-IRG delegates are responsible for providing the information for his/her country. Responses should be sent to secretariat@e-irg.eu ultimately Monday 11 June.

1) Please provide your country name and an email for further questions [1]

Country name	
Email address	

2) Please list information on organisations, governance, funding, access policies for e-Infrastructures (or its components) in your country. Input should list only the most relevant information (<2 A4 paper size). Use links

to documents to provide further details, if so wished.

2a) Describe which organisation or organisations have been given the responsibility on the national level for provisioning e-Infrastructure services in your country.

If the answers contain multiple organisations, describe (if applicable) how these organisations coordinate their activities amongst themselves.

2b) Describe the governance of this organisation/these organisations (such as: legal entity, composition of board or council, representation of stakeholders, such as universities, research infrastructures, funding agencies, etc.).

2c) Describe how this organisation/these organisations are funded (main funding streams, such as ministries, research councils, grants, subsidies, third parties (industrial, other), membership contributions, user contributions, etc.).

2d) Describe the access policies of this organisation/these organisations, including any legal restrictions in using the e-Infrastructure.

3) Please list **national domain-specific e-Infrastructures** or other domain areas of particular interest in the country (e.g. ELIXIR nodes) and include whether they use the horizontal e-Infrastructures (listed above).

National domain-specific e-Infrastructure (*repeat for each*)		
Use of national horizontal e-Infrastructures (if applicable); if not write short text about the domain e-Infrastructure	Network	
	Computing	
	Data services	
	Other services	
	Own/Separate e-Infrastructure	

4) Please list the main components of the e-Infrastructure (networking, computing, data and other services/tools)

Network infrastructure(s)	
Computing infrastructure(s)	
Data infrastructure(s)	
Other tools/services	

[1] This personal information will be used just for the inquiry on national nodes and consultation on this. The collected (personal) data will be destroyed after that.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