Scoping Paper for

Horizon 2020 work programme 2018-2020

European Research Infrastructures incl. e-infrastructures

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1. Context

The objectives and activities of Research Infrastructures (RI) Part of Horizon 2020 contribute to several EU priorities, including the three O's strategy: Open Science, Open Innovation and Open to the world.

The development of a coherent landscape of leading edge RI in Europe will help to strengthen innovation further, develop new activities and boost the productivity and competitiveness of our economy. While the majority of RI enable curiosity-driven research and push knowledge frontiers in their respective fields, they have a direct socio-economic impact especially in relation to their links with industry and contribute towards the objective of **Jobs and Growth**.

E-infrastructures developments for the establishment by 2020 of a single and open European space for online research, including ubiquitous and reliable services for networking and computing, and seamless and open access to e-Science environments and global data resources, will help to free the potential of Big Data for the benefit of researchers, innovators and business, and to advance research and innovation, therefore contributing to the objectives of the Priority 2 of the Juncker Commission: **A Connected Digital Single Market**.

The recent Communication on the **European Cloud initiative** includes actions relevant to future developments in RI and e-infrastructures. As of 2016, the Horizon 2020 work programme will provide support to explore appropriate governance and funding for the cloud, to integrate and consolidate e-infrastructure platforms, to federate existing RI and scientific clouds and to develop cloud-based services for **Open Science**. Future actions include the connectivity of the priority European RI to the European Open Science Cloud (EOSC) and the development of a European Data Infrastructures (EDI).

The **international cooperation on global RI**, currently addressed in various fora (e.g. the Group of Senior Officials on global RI and the Global Science Forum of the OECD), is often the best way forward when pooling of resources is necessary due to the scale of investments needed for construction and operation as well as to the global dimension of the scientific challenge addressed. Its potential for supporting or complementing the EU external policies and being a tool for **Science Diplomacy** and the **Open to the World** strategy, has been demonstrated in the case of SESAME.

Other relevant European and Commission political initiatives to which this H2020 Part contributes are: the implementation of the **ESFRI Roadmap**[1], through the support to the preparatory phase of the RI projects identified in the Roadmap as well as targeted support to their implementation and operation; the application of the **ERIC regulation**[2], building an EU identity around flagship scientific facilities and providing the international counterparts with a single legal entity with whom interacting and cooperating; and the wide adoption of the

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[1] The **ESFRI Roadmap** published in 2016 introduced a new category, the ESFRI Landmarks, which are former ESFRI projects that have reached the implementation phase. The ESFRI Landmarks will require substantial support in the next years to reach full operational capacity and to ensure their long-term sustainability (estimated investment volume of EUR 12.4 billion with an operational budget of EUR 1.4 billion/ year). Furthermore, new updates of the ESFRI Roadmap should be published in 2018 and 2020.

[2] Since the adoption of the **ERIC Regulation** in 2009, 12 ERICs have been awarded so far. This number should increase to 15 by the end of 2016. 3 further projects in the 2016 Roadmap are preparing an ERIC application.

Charter of access to Research Infrastructures[3] and its promotion as an EU contribution of best practices to wider international fora such as the OECD Global Science Forum and the G7 Group of Senior Officials on global RI.

The **Advisory Group (AG) for Research Infrastructures** was renewed at the end of 2015 and the group in its new configuration met twice in the first half of 2016. The AG report highlighted and called for actions on the following issues:

- Life-cycle approach;
- Global leadership;
- Overcoming cultural, technical and organisational challenges for the EOSC;
- Lead in innovation related with RI;
- Education and Training, in particular training of managers of RI;

The AG report also asked to continue to address the widening of access to RI; the enabling and leveraging of a blend of multiple funding sources for building and operate RI; and the development of an Open Market Place for research services, via a user-driven registry or distributed catalogue of services offered by research service providers;

The drafting of the Work programme will also take into account available reports and **stakeholder consultations**. In particular:

- A consultation on European e-infrastructures, which helped identifying the future challenges, also in view of the European Cloud Initiative. The consultation in particular highlighted the surging demand in Europe for a world-class High Performance Computing (HPC) infrastructure, the need to overcome fragmentation and lack of interoperability between e-infrastructure to address grand societal challenges and promote data sharing and re-use, the shortage of ICT skills and competences in Europe, how bridging science and innovation is a key challenge for the European data-economy, and the importance of e-infrastructures long-term sustainability and reliability to ensure "innovation continuity".
- A horizontal consultation on Mathematics in Horizon 2020, launched to identify new areas where mathematics in Europe could make a real difference. The results also underlined the importance of mathematical contributions for quantum computing.
- Various contributions from major stakeholders e.g. ESFRI, e-IRG, EIROFORUM, ERICs, representatives from member states and associated countries.
- The consultation on the long term sustainability of RI. Its results confirmed that scientific excellence was ranked as the most relevant precondition for sustainability. It also highlighted the need for strengthening the interaction between RI and industry, encouraging new sources of funding, improving data management, raising the visibility of RI and their related services as a way to ensure scientific excellence, increasing the attractiveness for users including from industry and secure funding for the construction and operation phase.

The **gap analysis** performed on the RI part of Horizon 2020 for the work programmes 2014-2015 and 2016-2017 did not identify full gaps as all activities specified in the Specific Programme were, at least partially, covered already. It highlighted however areas requiring continued attention in the next work programme such as:

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[3] The **Charter of access to Research Infrastructures**, developed in close coordination with the ERA Stakeholders, was presented during the ESFRI Roadmap 2016 launch event and is available on-line on the Europa website. Based on a set of access principles and guidelines, the Charter enables the harmonisation of access policies throughout the EU setting the conditions, to obtain access to the best RI available.

- preparatory phases of the ESFRI projects from the 2018 and 2020 ESFRI roadmap updates;
- clusters of ESFRI projects to address the connectivity to the European Open Science Cloud;
- networking and access to national RI so as to fulfil the objectives of supporting 100 networks and 20000 transnational access;
- stepping-up activities to foster the innovation potential of RI.

2. Strategic orientations for 2018-2020 and translation into calls

In line with the general frame of actions foreseen in the Specific Programme and taking into account the policy context, the input from the AG and the H2020 Group, and the outcome of stakeholder consultations, the RI part of the Horizon 2020 work programme for 2018-2020 will then focus on the following priorities.

Addressing the long term sustainability of pan European Research Infrastructures through a life cycle approach:

RIs are faced to a wide range of different challenges throughout all their life cycle. The continued request by scientific communities of always more advanced facilities to produce excellence science put a strong pressure on research budgets at national and European levels. As most of the efforts are usually focused on the design, preparation and implementation phases, problems related to their operational sustainability risks to be underestimated. Another problem is the ongoing concentration of excellent infrastructures in limited regions that is contributing to increase the innovation divide within the European Research Area (ERA).

There is a need for flexible and targeted support to pan-European RI in different phases of their life cycle, covering early stage operation too, and this support could target specific issues such as ensuring the stewardship of the produced or collected data, promoting access and involvement of scientific communities, and addressing the geographic divide in the RI landscape through harmonisation of procedures between pan-European and Regional Partner Facilities.

This effort will contribute to the setting up of a coherent ecosystem of leading edge pan European RI open to researchers, industry, and other interested groups such as policy makers and the public. Such a landscape will impact on the acceleration of scientific discovery as well as on innovation, competitiveness and attractiveness of the European Research Area and it is crucial to help Europe to respond to grand challenges in science, industry and society

The main call linked to this priority is INFRADEV. This call will facilitate the preparation and implementation of the RIs identified by ESFRI and of other world-class RI of a clear European interest and dimension. Support will be provided to the preparatory phases of the projects which will enter in the 2018 (and possibly 2020) update of the ESFRI roadmap. Particular emphasis will be put on the financial and management aspects of these new RI and the involvement of national authorities at a very early stage so as to ensure long-term sustainability. Targeted ESFRI projects and other world class RI will receive specific support for their implementation and early stage operation as well as for the widening of the participation to the RI landscape via in particular the integration of Regional Partner Facilities (RPF). Under the same call, support to design studies with bottom-up approach will be maintained to allow new ideas/concepts of pan European RI to emerge.

In addition a specific action to disseminate best practises to countries which have not yet developed the appropriate procedures for strategic planning and evaluation processes, and to provide assistance via partnership processes, could be envisaged under the INFRASUPP call.

Supporting Interoperability and the European Open Science Cloud:

The European Cloud Initiative Communication stresses the importance of being able to find, access, move, share and re-use data seamlessly across global markets and borders, and among institutions and research disciplines. Europe must overcome the remaining barriers. Achieving the ambitious vision of a European Open Science Cloud (EOSC) underpinned by a European Data Infrastructure will require a significant initiative with a suitable and solid funding model centred on data at national, regional and global levels. Actions are needed along three different dimensions:

- *Cultural dimension*, a cultural change is required to truly achieve Open Science. There is a need to raise awareness and change incentive structures for academics, industry and public services to make data publicly available while at the same time respecting concerns in relation to privacy and ethics (e.g. for medical data), safety, security and commercial interests.
- *Technical dimension*, there is a need to identify and develop specifications, standards and protocols for making data available, for interoperability and data sharing across disciplines and infrastructures and to further develop cloud based services for open science, as well as software focused on e-research, and horizontal data services, e.g. access security, authorisation and authentication, etc. This would encompass the identification of a set of EOSC service providers and the creation of a catalogue of basic horizontal data services as well as more thematic data and e-tool services.
- *Organisational dimension*, there is a need to create a governance structure to federate the existing thematic data infrastructures as well as national data infrastructures and overcome fragmentation. Action is also needed to engage and enlarge the scientific user base to researchers and innovators from all disciplines and all regions.

The support to the European Open Science Cloud will improve availability and sharing of scientific data by research communities and optimise the use of IT resources. It will enable an Open Science ensuring that the intellectual capital of Europe is preserved and is available to researchers, business and citizens to generate economic and scientific advances.

The main calls linked to this priority are INFRADEV and EINFRA. INFRADEV will support Cluster of ESFRI and other world class RI in specific thematic areas to ensure harmonisation, integration and interoperability of data in those domains, interoperability with other relevant domains and full connection or integration to the EOSC.

EINFRA will support: research and education networking initiatives in the framework of GEANT; the further deployment of a pan-European interoperable data infrastructure for discoverability, open access, preservation and reuse through the integration and consolidation of e-infrastructure and the federation of existing research infrastructures and scientific clouds for Open Science; the European high performance computing (HPC) strategy towards exascale capacity in technology and services, widening the user base through HPC centres of excellence and HPC innovation hubs.

Structuring the European landscape by integrating and opening Research Infrastructures of European interest:

As highlighted by the GAP analysis and underlined in the EAG report, the support to coordination and service integration of existing key RIs of European interest, including data infrastructures, and their provision of access to scientific communities need to be continued under the 2018-2020 work programme through integrating activities (INFRAIA call) with a strengthened focus on long lasting impact in term of harmonisation and structuring of the services to users at European level. Proposals applying to this call will be requested to ensure a proper handling of and access to the data generated or collected, to widen the user base through outreach and training of potential users and to encourage participation of relevant RI

from third countries in order to facilitate access by EU researchers and ensure global interoperability. Particular care should be put in increasing visibility of the access opportunities offered under H2020, in particular by developing catalogues of services.

In order to harmonise access procedures and ensure high quality services, the projects funded under this call will be invited to implement the guidelines developed in the Charter of access to RI.

This effort will provide researchers with a wider, simplified, and more efficient access to the best research infrastructures they require to conduct their research, irrespective of location and will foster the emergence of a new generation of researchers which are educated and ready to optimally exploit all the essential tools for their research. Improved and harmonised services will be set up at EU level, leading to an improved use of resources across Europe.

Demonstrating the role of RI in the translation of Open Science into Open Innovation:

RIs can act as incubators for innovation. Demonstrating the fundamental role of RIs in this translation can be proven through the execution of **Innovation pilot projects** to integrate RIs with industry in a co-development/co-creation effort. These pilots could allow testing the combinatorial power of Open Innovation and the multiplication effect of the investment made on RIs in the creation of economical and societal value. The pilots would be selected on the basis of their strategic potential to connect science, industrial leadership and societal challenges.

The main call linked to this priority is INFRAINNOV. This call would build on the experience of the co-innovation platform for detection and imaging technologies supported under the previous work programme. The support to the development of customised services to increase participation of industry and, in particular of SMEs as users of research infrastructures will be continued throughout most of the different large action foreseen in this Work Programme. The work programme will also support technology transfer and joint development of high-tech components and solutions in the integrating activities and in the activities supporting the implementation and operation of ESFRI projects and e-infrastructures.

The expected impacts are an increased involvement of industry (including SMEs) in the development of research infrastructures, which will raise their technological level and competitiveness, and will increase the capacity to generate, absorb and use new technologies in Europe. In addition industry will be better aware of opportunities offered by research infrastructure to improve their products, e.g. as experimental test facilities, innovation hubs, knowledge-based centres.

Developing the RI manager skills:

There is a need to build the RI human resources capacity, including an improved gender balance, especially in areas that suffer from shortages in supply or where new skills and professions need to emerge, e.g. in 'data science'. The INFRASUPP call would address this challenge while training and exchange of staff would be supported as a horizontal dimension throughout the other actions.

Supporting Europe as a global leader in Research Infrastructures:

International cooperation can be increased with a better understanding of the international landscape of RI and by analysing more deeply the challenges of international RI in terms of governance, management, funding, legal aspects including issues like know how and data protection, public security, corporate and tax law. The INFRASUPP call could include specific studies for that purpose while the international outreach of pan European RI such as the ESFRI projects and ERICs will be supported under the INFRADEV and INFRAIA activities.

Call working title	Brief description of the scope of the call including information if it is cPPP.	Possible contribution from and to other WP parts
INFRADEV	This call focuses on facilitating and supporting the implementation and long-term sustainability of the RI identified by ESFRI as well as of other world-class RI. The next generation of RI can be identified through design studies. Special attention will be given to the connectivity and integration of these RI to the EOSC.	
INFRAIA	This call focuses on opening up key national and regional RI to all European researchers from both academia and industry as well as ensuring their optimal use and joint development.	
EINFRA	This call supports the European Cloud Initiative Communication focusing on the development of the research and education network, of a pan-European interoperable data infrastructure for Open Science, and of the European high performance computing exascale capacity in technology and services.	
INFRAINNOV	This call focuses on fostering the innovation potential of RI	
INFRASUPP	This call focuses on developing the human resources of RI. It will also aim at reinforcing European RI policy and international cooperation.	