

The logo consists of a solid blue square with the text "ESFRI" in white, bold, sans-serif capital letters centered within it.

ESFRI

MAKING SCIENCE HAPPEN

A new ambition for Research Infrastructures in the European Research Area

ESFRI WHITE PAPER
2020



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EXECUTIVE SUMMARY AND MAIN POLICY MESSAGES

The European Strategy Forum on Research Infrastructures (ESFRI) was established in 2002 with the purpose of developing a European approach to Research Infrastructure policy as a key element of the emerging European Research Area (ERA). Its work has radically transformed the availability of state-of-the-art facilities for researchers by making common investments easier at regional, national and European levels, reinforcing Europe's global leadership in this field. Europe has now at its disposal a rich landscape of Research Infrastructures (RIs) covering all scientific domains, with over 50 European Research Infrastructures mobilising close to € 20 billion worth of common investments.

Europe's Research Infrastructures are decisive for our capacity to deliver scientific breakthroughs and to foster innovation. At the same time, given the broad agreement on the need to rapidly address the societal challenges facing Europe and the world, science has an important mission to lead and prepare the necessary economic, social and environmental transitions. The renewal of the European Research Area will be key to this mission and ESFRI has therefore reflected on how to foster the further development of a European

Research Infrastructure system capable of effectively supporting the enabling role of research and innovation for achieving Europe's wider policy goals.

This document represents the outcomes of the reflection process over the last 15 months, engaging national authorities of EU Member States (MS) and Associated Countries (AC), the European Commission (EC) and the scientific community. It has clearly shown that we have been

ESFRI was established in 2002 with the purpose of developing a European approach to Research Infrastructure policy as a key element of the emerging European Research Area

very successful in achieving the initial objectives of the European Research Area in the field of Research Infrastructures. While further adjustments may still be needed, Europe now has effective mechanisms to identify potential new investment priorities and to develop any

new facilities, which have already materialised in a comprehensive Research Infrastructures landscape.

Nonetheless, the landscape needs optimisation to address the overall objectives of the new European Research Area. To this end, ESFRI aims to optimise the organisation of the Research Infrastructure landscape:

- to facilitate the cross disciplinary research and the exploitation of data interoperability to produce new science to tackle new societal challenges and contribute to the Sustainable Development Goals (SDGs),
- to create more efficient synergies and direction between various European and national sources of funding,
- to enable the stronger integration of Research Infrastructures into their host societies,
- to continually modernise their services in support of European priorities, and
- to strengthen the European leadership in the construction of global endeavours.

The **key messages** in our report are directed at the relevant authorities in the Member States and Associated Countries, to the European Commission, to individual Research Infrastructures and their associations, and finally to ESFRI itself. There are many challenges facing us and to overcome them will require a collective effort. ESFRI is willing to act as the driver and coordinating body for this work.

MAIN MESSAGES

ESFRI considers that the following are needed for a stronger Europe:

Reinforce the position of Research Infrastructures as an essential pillar of the European Research Area, forming a healthy, sustainable and integrated Research Infrastructure ecosystem that strives for scientific excellence with impact, and provides transnational services, supporting education and skills development.

Enhance the role of Research Infrastructures as truly strategic investments across borders of sectoral domains, contributing to European strategic agendas and enabling European research and innovation to address pressing and complex societal challenges.

Develop and exploit the potential of European Research Infrastructures as knowledge and innovation hubs, integrated into local communities, forming the basis of European competitiveness, with regional impact and global outreach.

Further strengthen the coherence between European, national and regional priorities and policies for Research Infrastructure development and funding.

Exploit the potential of Research Infrastructures as major promoters of Open Science providing FAIR (data which meet principles of findability, accessibility, interoperability, and reusability) and quality certified Open Data, supporting their contribution to the success and impact of the European Open Science Cloud and so strengthening their capacity to serve their users.

Better use the potential of the ESFRI to contribute to the development of coherent Research Infrastructure policy and investment in Europe, ensuring its appropriate capacity to that end.

INTRODUCTION AND SCOPE

European Research Infrastructures play a crucial role in Europe's ability to produce new knowledge and innovation to help understand and tackle the environmental, societal and economic challenges that we face. Over the past 18 years, the European Strategy Forum on Research Infrastructures has helped shape the research landscape in Europe through the identification, development, connectivity and support of new and existing RIs as well as enabling facilities across Europe to cooperate to provide first-class resources for Europe's researchers to carry out their work.

As an intergovernmental forum, ESFRI acts as the European knowledge hub on RI providing advice to governments on national, European and international investments in scientific facilities. To date, the ESFRI Roadmap has enabled the design and development of 55 strategic RIs, mobilising almost € 20 billion of investments across the EU. To this end, Europe now has one of the most advanced and integrated Research Infrastructure systems in the world, which is a cornerstone in the development of the European Research Area.

***ESFRI fully acknowledges
the importance of
Research and Innovation
as a driver for Europe's
future and underlines
the value that Research
Infrastructures can offer***

Looking to the future, Europe's citizens are demanding that their investments in science help to bring solutions to the global challenges of the 21st century: the impact of climate change, the harnessing of industrial change and the digital transition, the threat of social inequality and its impact on our democracies – all of which require a new approach and present the opportunity for scientific disciplines to join forces in helping address them. To meet these challenges in an effective manner, the ERA requires clearer prioritisation and better coordination combined with

a more cohesive engagement with global opportunities. And so ESFRI welcomes the six priorities of the new European Commission¹ which target similar overarching objectives as the European Council's *A New Strategic Agenda for 2019-2024*². ESFRI fully acknowledges the importance of Research and Innovation as a driver for Europe's future and underlines the value that RIs can offer, including for issues such as the Green Deal and other societal challenges.

This White Paper is ESFRI's response to the new challenges lying ahead for Europe. It is ESFRI's contribution to the ongoing debate on a renewed ERA and extends on the ERA narrative³ proposed by the European Research Area and Innovation Committee (ERAC). In its opinion, ERAC highlights four main priority areas under the headings of directionality, inclusiveness, connectivity and visibility. This White Paper shows how Research Infrastructures contribute to each of these priorities, underlining the pivotal role of RIs for the advancement of European excellence in science. It anchors RIs as pillars of competitive development of the European economy, and not least in addressing global challenges, such as the Sustainable Development Goals. It is a document in which ESFRI reflects on almost twenty years of successful existence and sets out its future development.

1. A Union that strives for more – My agenda for Europe. Political guidelines for the next European commission 2019-2024

https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

2. A New Strategic Agenda for 2019-2024

<https://www.consilium.europa.eu/media/39914/a-new-strategic-agenda-2019-2024.pdf>

3. ERAC Opinion on the future of the ERA, 23 January 2020

https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

ESFRI VISION AND MISSION

ESFRI VISION

Equipping Europe
with infrastructures for
ground-breaking research

ESFRI MISSION

ESFRI is a strategy forum of funders and policy makers with expertise in the field of Research Infrastructures. Its mandate is defined by the Council of the European Union (EU) and it acts as an informal body advising the Competitiveness Council. It consists of representatives of national authorities responsible for political decision-making and funding of Research Infrastructures. Its main role is to provide a shared, long-term strategic vision for an effective, efficient and sustainable RI ecosystem in Europe, maximising the impact of national and European investments. In doing so, it facilitates multilateral initiatives and agreements on common investments leading to the better use, development and impact of RIs across their lifecycle, at EU and international level.

ESFRI also implements *ad hoc* Council mandates by providing evidence-based input to the implementation of the strategic vision for research and

innovation in Europe. ESFRI's goal is to strengthen European research, providing the tools needed to address the scientific and societal challenges of the future. ESFRI contributes to enhancing well-being, economic growth and sustainability in Europe, thus increasing Europe's long-term capacity to meet Societal Challenges and tackle the Sustainable Development Goals.

To implement this mandate, ESFRI analyses the European landscape of Research Infrastructures, and develops and updates a Roadmap for the implementation and monitoring of a strong infrastructure base, so contributing to the implementation of the ERA Roadmap⁴.

ESFRI and its infrastructure Roadmap has worked on the basis of cross-border cooperation and dialogue. This, in alignment with the new ERA paradigm,

should be reinforced in the next period through joint coordinated actions at regional, national and European levels. This collaboration model has already resulted in the establishment of good practices and exchange of experiences in the implementation and management of Research Infrastructures across Europe. Further strengthening of these synergies will be needed to meet the new levels of ambition for European research and innovation.

ESFRI implements its mission through a comprehensive set of activities⁵ fostering the development, operational capacity, and sustainability of the entire Research Infrastructure ecosystem as a strategic goal. Through a coherent and strategy-led approach to policy-making for European Research Infrastructure⁶, ESFRI:

- Integrates and strengthens the European Research Area, empowering researchers to develop coordinated and strategic responses to rapidly evolving scientific frontiers enabling development of solutions to the pressing societal challenges and advancing and extending the use of knowledge and knowledge-based technologies.

- Facilitates the best possible conditions for advanced research in Europe through infrastructures on the ESFRI Roadmap.

- Through its Landscape Analysis and Roadmaps, facilitates multilateral initiatives for a more efficient development of European RIs and the development of globally competitive centres of excellence.

- Develops and facilitates the implementation of RIs into hubs of competence in Europe, where science, education and innovation meet to advance new collaborative models and provide solution-oriented advances based on Open Science principles.

- Facilitates international research cooperation and strengthens European research in a global perspective.

- Contributes to a more competitive, cohesive and sustainable Europe through joint efforts of European Member States and Associated Countries.

4. Conclusions of the Council of the European Union on The review of the European Research Area advisory structure, 1 December 2015

<http://data.consilium.europa.eu/doc/document/ST-14458-2015-INIT/en/pdf>

5. ESFRI Procedural Guidelines

https://www.esfri.eu/sites/default/files/ESFRI_Procedural_Guidelines_Revision_2019_Adopted.pdf

6. ESFRI: research infrastructures for Europe

https://ec.europa.eu/commission/presscorner/detail/en/MEMO_12_772

7. Variable geometry is a principle in regional integration whereby some community members can move faster than others on some matters. ESFRI has developed it to a key principle in its mandate and procedural guidelines since its creation in 2002 to allow groups of EU Member States and Associated Countries to independently pursue common RI initiatives of their interest.

ESFRI VALUES

In implementing its mission, ESFRI is conscious of the need to respect its core values. Given that ESFRI's primary function is to maximise the impact of Europe's scientific investments, it bases its decisions on the priorities associated with the creation and development of Europe's Research Infrastructures on both scientific need and excellence in research. ESFRI, through integrating the views of all Member States and Associated Countries, respects the cultural and geographical diversity of Europe allowing for solutions based on variable geometry⁷ while meeting pan-European needs. ESFRI engages in active dialogue with the scientific community, without whom the design and implementation of ESFRI's decisions would not be possible, and is committed to maximising the impact of Europe's Research Infrastructures in addressing the social, economic and environmental challenges facing Europe and the world.

This allows ESFRI to move forward based on a strong and shared consensus among all partners.

ESFRI is committed to the transparency of its processes and procedures. Official documents of the Forum, its Membership, Procedural Guidelines and Terms of References of its bodies, as well as outputs of ESFRI work and activity reports are available in the public domain. ESFRI Roadmap evaluation and monitoring processes rest on rigorous scientific and technical peer review based on independent expertise with strict conflict of interest rules following international best practices. ESFRI respects the values of equality, diversity and inclusiveness in all aspects of its business.

1

STRATEGIC ORIENTATIONS FOR THE RENEWED EUROPEAN RESEARCH AREA

Europe's commitment to jobs, sustainable growth and improving the living and working conditions of its people has been embodied in the *European Semester and the Annual Sustainable Growth Strategy*⁸. This has been a vital framework enabling Member States to learn from each other across a range of policy areas, including those related to research and innovation. The inclusion of the target of 3% of GDP being invested in Research & Development (R&D) has set a clear direction for all Member States⁹ and has facilitated the intervention of the European Structural and Investment Funds in this field. ESFRI believes that future frameworks should continue this model within the current strategic priorities of the EU.

In a similar way, the ERA is improving the efficiency and effectiveness of the overall European research and innovation ecosystem. A renewed ERA is expected to exploit the significant contribution that R&I plays in achieving Europe's wider policy objectives and to make ERA more responsive to society. Sustained political ownership and continuous commitment at all levels is needed for progress towards a fully functioning ERA. While stressing the need for coherence between European

and national levels in R&I priorities and objectives, this also presupposes acknowledging and taking advantage of the value of diversity among MS/AC as demonstrated successfully by ESFRI in the field of RIs.

The outreach of RIs to other European agendas and policies is therefore decisive. RIs, whether pan-European, national or regional are crucial for European research and are pivotal for the sustainable development of the ERA. Investment in Research Infrastructures is directed by the needs of science and shared policy priorities, but at the same time, advanced infrastructures create the basis for the development of science itself. Investment in RIs is therefore always a cornerstone of research strategies. Furthermore, the existence of unique cutting-edge scientific facilities is an important element in attracting the best researchers from all over the world to do their research in Europe, and helps to anchor European science in global research efforts; thus incentivising countries to become associated to the Research and Innovation Framework Programmes.

RI investments are a strategic investment in enriching Europe's capacity to

8. 2020 European Semester: Annual Sustainable Growth Strategy, December 2019
https://ec.europa.eu/info/publications/2020-european-semester-annual-sustainable-growth-strategy_en

9. Presidency conclusions of the Brussels European Council, 22 and 23 March 2005
https://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf

support innovation, technological advances and global competitiveness to achieve long-term sustainability of European quality of life and create solutions to global challenges.

The European RI ecosystem is facing new challenges that need to be reflected in revised strategic orientations. The demands for Research Infrastructure are increasing rapidly within most research fields. Technical progress and ever more complex scientific questions are simultaneously driving this development forward. This applies not least within environment and climate research, humanities, social sciences and major parts of medical research. Advancing fundamental knowledge about our universe, the characterisation of materials, the function of cells and characteristics of matter demand ever more sophisticated instrumentation. Complex

questions also require data and observations from several sources to be combined and a common feature in all areas of scientific research is the growing need to store, transfer and analyse large amounts of data. In many cases, this evolution means that barriers between research disciplines are breaking down and that the need for international collaboration is increasing – perhaps best reflected in the objectives of the European Open Science Cloud (EOSC).

To meet this development and enable RIs to be real actors of policy change, Europe needs clearer prioritisation, better coordination, and more efficient use of European Research Infrastructures. As such, structural investment in RIs is required to meet both new scientific needs and to contribute to the global challenges that we face.

KEY MESSAGES

ESFRI will support the European Commission and Member States in developing and implementing a strategic framework, which recognises the importance of investment into research and innovation, and which is appropriate to meet the new challenges. ESFRI and its members will support RIs in their capacity to align and coordinate European and national investments in R&I with a focus on shared policy priorities and challenges.

ESFRI invites the EC and the MS/AC to strengthen the interplay and synergies between the European, national and regional funding to RIs, to further integrate RIs in the diverse national research and innovation systems and to realize a well-functioning ERA.

The RIs are invited to include outreach to wider policy objectives as part of their strategic approach and to exploit their potential for international cooperation. Sectoral research agendas should be considered for formulating RI missions and objectives, e.g. in relation to the UN SDGs.

RESEARCH INFRASTRUCTURES AS KNOWLEDGE HUBS AND PILLARS OF COMPETITIVENESS

Two-thirds of the EU's economic growth derives from research and innovation, accounting for 15% of all productivity gains in Europe¹⁰. European Research Infrastructures are an essential pillar of this development. They play a key role in the advancement of knowledge and technologies. They improve the efficiency and effectiveness of research and contribute to the overall advancement of the European innovation ecosystem. However, breakthroughs in basic research are almost always unexpected and often consist of combining previously known knowledge in a new and innovative way, often across disciplines. The relationship between research and innovation – and therefore with Research Infrastructures – is diverse and often complex; there simply is no one-size-fits-all model. The time between a breakthrough in basic research and application varies and is very difficult to predict. Efforts must nevertheless be made to shorten the gap between scientific advances and their application in practice.

RIs must be viewed not as stand-alone installations, but as part of the broader system contributing to the longer-term development of research and innovation. This system is not only capable of integrating RIs in and across scientific domains but must increasingly create knowledge and innovation hubs around state-of-the-art RIs, attracting high-level expertise and creativity and providing space for sharing knowledge and ideas. Continued support towards the development of a European Research Infrastructure system is a strategic asset, fostering both breakthrough discoveries and incremental innovation.

Research Infrastructures also constitute a powerful resource for industry – often a prerequisite for collaboration between industry and academia. Participation in infrastructure projects also provides opportunities for European researchers and European industry to drive cutting-edge technology development. The potential for developing spin-offs from the technological advances is also significant and can be supported in future by better links with the European Innovation Council.

10. The economic rationale for public RDI funding and its impact, Brussels 2017

https://ri-links2ua.eu/object/document/326/attach/KI0117050ENN_002.pdf

*Research Infrastructures
constitute a powerful resource
for industry, a prerequisite
for collaboration between
industry and academia*

*Research Infrastructures provide
unique training opportunities
and play an important
role in the education and
upskilling of new generations
of scientists, engineers
and data professionals*

In addition, RIs provide unique training opportunities and play an important role in the education and upskilling of new generations of scientists, engineers and data professionals. Scientists visiting RIs receive technical support and training, acquiring new skills in the use of advanced technologies, data analysis and quality control.

KEY MESSAGES

The EC and the MS/AC are invited to promote and support the role of RIs as centres of excellence and as natural meeting points for research, education and innovation catalysing the exploitation of new forms of knowledge production, dissemination and use.

To implement the European Research Area, the EC, MS/AC and the ESFRI community are invited to support RIs central role to a functioning research and education system to foster innovative products and services to the benefit of economy and society and to increase their visibility and impact.

RESEARCH INFRASTRUCTURES AS STRATEGIC INVESTMENTS

Research Infrastructures are strategic investments in a broader European strategy for sustainable economic, social and environmental development. ESFRI and its members will encourage an accord across the RI landscape which will aim to foster the development of new partnerships and services which are necessary to address socio-economic challenges, the sharing of good practices and a rapid adaptation to users' needs. For example, new technologies, sustainable solutions and disruptive innovation – criteria requiring RI access – are critical elements required to achieve the objectives of the European Green Deal.

There are still large geographical variations in the allocation of the two major EU funding instruments for research and innovation, i.e. Horizon 2020 and the ESI (European Structural and Investment) Funds. However, additional complementary sources of funding for RI investments can be found in the major European strategic agendas including the Green Deal, Digital Europe, ERA and others.

HORIZON EUROPE

Horizon Europe (HE) is a key part of this broader European strategy, and it is important that Research Infrastructures exploit the full potential of the new programme to support the various efforts to tackle global challenges. To this end, HE should actively encourage the involvement of RIs in topics across all three pillars. Links between the RIs and the HE Missions, the European Partnerships and the activities in the field of widening participation and spreading excellence could be made more explicit in the work programmes.

HE will provide an opportunity to maximise the impact of Europe's RIs. The greater use of a challenge-driven approach, for example the Missions initiative, will promote the integration of the RI ecosystem whereby different RIs will cluster for a specific mission and develop joint services targeting complex research questions.

ESFRI's Landscape Analysis is currently the most advanced account of Europe's existing RI-landscape in pointing out the gaps and needs required to create a coherent European RI landscape capable of addressing future challenges. The dialogue with the RI community should be continued and strengthened to support the Landscape Analysis.

*Horizon Europe will
provide an opportunity
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of Europe's Research
Infrastructures.*

*The Mission initiative will
promote the integration
of the Research
Infrastructure ecosystem
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mission and develop joint
services targeting complex
research questions*

KEY MESSAGES

The EC and the MS/AC are invited to contribute to the further structuring, integration and long-term sustainability of the RI system in Europe and introduce actions to increase the outreach and impact of RIs to industry and society.

The ESFRI Research Infrastructure Landscape Analysis and Roadmap should be further strengthened as a strategic tool for European decisions to identify the RI gaps, needs and opportunities, and be a guide for the design of the broader Horizon Europe programme.

COHESION, SMART SPECIALIZATION AND ESIF

Research and RIs have the potential to promote greater cohesion in Europe through their capacity for facilitating excellent science. A Europe-wide distribution of RIs would help to reduce the "excellence gap" caused by lagging capacities in parts of the EU. Furthermore, developing the concept of Smart Specialisation Strategies, by including the scheme of regionally anchored RIs and ensuring that the EU state aid rules are more RDI friendly, would sizably contribute to closing the research and innovation gap. This would help to realise the full research potential from all EU regions while equally respecting at the same time the excellence criterion as the major guiding principle. Effective complementarity and practical synergies between all EU funded programs should therefore be assured.

Research and RIs play a key role also in the creation of effective innovation systems especially through the strategic identification of regional research priorities by the development of Smart Specialization Strategies (S3). RIs are

strongly rooted in the regions and critically influence regional development. The outreach of RIs extends from scientific output to the impact on educational systems, from regional development to overall market effects and general societal benefits. Therefore, Europe should continue to develop a medium- to long-term vision for the development of a coherent RI ecosystem, where cooperation between RIs within and across scientific disciplines and, where appropriate, integration between existing and planned RIs is encouraged. ESFRI identifies investment into RIs as a method for increasing regional competitiveness and thus cohesion between the different European countries

***Research Infrastructures
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and regions. The full potential of RIs has not yet been realised by many regional authorities and as a consequence RIs are not sufficiently included in the planning, design and implementation of the Regional Smart Specialisation Strategies. The role of Joint Research Centre of the European Commission in sharing knowledge on possibilities to better coordinate regional RI investment plans between the regions and cross-nationally could be utilised.

KEY MESSAGES

The EC and the MS/AC are invited to maximise synergies between regional funds (incl. S3 and structural funds), national funds and others European programmes, by interplay between the national and regional research and innovation systems, complemented by measures at the European level. The EC and the MS/AC are invited to increase alignment and synchronisation between national roadmaps and funding decisions at regional level where structural funds are distributed.

The EC and the MS/AC are invited to explore possibilities to more firmly anchor RIs in the Smart Specialisation Strategies, and to develop knowledge innovation hubs in which RIs are embedded in regional education, research and development, closely interacting with local businesses and industry, and introduce measures to maximise the impact of RIs on society. This will in many cases require stronger coordination of regional strategies, and alignment with the priorities of sectoral ministries.

The EC, with support from ESFRI, is invited to further remove barriers preventing the use of ESIF for building and running RI facilities.

IMPACT ORIENTED RI STRATEGIES AND RI OUTREACH TO SOCIETY

RIs contribute to key scientific and technology discoveries and can often have a considerable impact on other elements. The impact of research and RIs on industry, for example, needs to be better understood and further strengthened. However, the impact of RIs on non-economic societal aspects should not be overlooked. Social cohesion, inducing cultural changes, understanding social values and behaviouristic patterns, citizens' well-being, contribution to environmental protection and improved health, among others are some examples where RIs can play an important role¹¹. New methods need to be developed to evaluate these impacts, particularly in relation to global challenges.

These benefits of research and RIs should be the subject of comprehensive assessment and should be effectively communicated to citizens. Furthermore, to strengthen the trust in science, good practices should be exemplified and participatory approaches or continuous training linked with RIs should be fostered.

11. The Committee of regions advises in its Communication the Member States work closely together with local and regional administrations to collect information on RIs and related issues including mapping of activities and outputs, in order to assess the impact of RIs for the regional, national and European economy.

<https://cor.europa.eu/en/engage/studies/Documents/EPRS-Briefing-637939-ERA-Regional-cross-border-perspectives-FINAL.pdf>

KEY MESSAGES

The MS/AC are invited, with support from ESFRI and Horizon Europe, to incentivise RIs to monitor their societal and economic value and impact; and follow their objectives, missions, and contribution to societal challenges and Sustainable Development Goals and ultimately to Europe's competitiveness.

The MS/AC are invited, with support from ESFRI and Horizon Europe, to develop participatory approaches, continuous training schemes and dissemination of good practices to strengthen the link between science and citizens.

2

IMPLEMENTING A HEALTHY RI ECOSYSTEM IN EUROPE

A healthy integral ecosystem of RIs in Europe is a prerequisite for competitive development of European research and innovation, and thus, for the competitiveness and sustainability of the European economy. Roadmapping is an important tool for strategic development of RIs on the national and European levels¹². Despite the progress made in the last decade at the level of pan-European RIs and the success of ESFRI in triggering national processes, the diversity of national research and innovation systems leads to a variety of approaches to the roadmapping and funding of RIs.

Notwithstanding this diversity, it is worth considering the development of certain common features¹³ which make the overall Research Infrastructure policy more effective:

- regular updates of inventories of existing RIs and an identification of needs and gaps,
- a transparent prioritisation of national needs that take into account the European perspectives,
- better coordination of RI roadmapping processes into the national research and innovation eco systems, taking outreach to other relevant national policies (education, health, etc.) into account,
- prioritisation of new and existing RIs in view of the available funding for RIs,
- the setup of coordination structures for RIs at ministry level,
- and supporting coherence between national and European RI processes.

12. ERA Progress Report 2018 – Data gathering and information for the 2018 ERA monitoring – Technical Report, February 2019

https://ec.europa.eu/info/sites/info/files/research_and_innovation/era/era_progress_report_2018-technical.pdf

13. InRoad final report - Main findings and recommendations, December 2018

https://www.inroad.eu/wp-content/uploads/2018/12/InRoad_finalreport.pdf

GOVERNANCE AND COORDINATION AT NATIONAL AND EUROPEAN LEVELS

Sustained political ownership and commitment at all levels is needed for progress towards a functioning RI ecosystem. ESFRI fosters and implements this idea of ownership, taking full account of the principle of variable geometry¹⁴. Through the ESFRI roadmap process, national RI policy priorities are systematically considered at the European level. ESFRI thus provides long-term orientations for large investment decisions at national and European levels, while fully acknowledging that national RI systems have their own rules and priorities. In that sense, ESFRI represents a role model for lean governance, which has been proven efficient, effective, impactful and successful in its implementation. ESFRI RI roadmaps, including the ESFRI Landscape Analysis, have become important reference points for European and national decision-making processes. They clearly demonstrate that early communication between decision makers of the European countries on emerging RIs is crucial in order to reach the common European objectives consistently with national interests. It is particularly important for distributed infrastructures, strongly dependent on national roadmapping and financial commitments. ESFRI's evaluation methodology has become an exemplar of good practice, inspiring many national procedures in and beyond Europe. As a next step, ESFRI has developed a Monitoring Approach, which will support the internal governance of the RIs, help create a philosophy of self-assessment and help define their role in the European research landscape. This methodology is fully in line with the EU Council conclusions of May 2018¹⁵ encouraging Member States to develop a common approach to monitoring RI performance.

An early communication between decision makers of the European countries on emerging Research Infrastructures is crucial to reach the common European objectives consistently with national interests

KEY MESSAGES

ESFRI invites the MS/AC, respecting the diversity of the national research systems, to take account of the benefits of greater coherence between the national and ESFRI roadmaps (both timing and contents), and to strengthen national roadmapping procedures, exploring options based on the ESFRI model, existing good practices and recommendations.

ESFRI will further work on developing appropriate communication mechanisms in order to foster effective exchange of information, e.g. by setting a common portal on the national roadmapping procedures, timelines and good practices.

14. Variable geometry is a principle in regional integration whereby some community members can move faster than others on some matters. ESFRI has developed it to a key principle in its mandate and procedural guidelines since its creation in 2002 to allow groups of EU Member States and Associated Countries to independently pursue common RI initiatives of their interest.

15. Conclusions of the Council of the European Union of 29 May 2018 on Accelerating knowledge circulation in the EU. Doc 9507/18

<http://data.consilium.europa.eu/doc/document/ST-9507-2018-INIT/en/pdf>

LONG-TERM SUSTAINABILITY OF RIs

A robust long-term vision is the essential prerequisite in order to successfully and sustainably operate a Research Infrastructure. The challenge of ensuring long-term sustainability (LTS) of RIs is very complex in nature. Recommendations listed in the ESFRI Scripta 2 on *Long-Term Sustainability of RIs*¹⁶ and actions identified in the EC Staff Working Document on *Sustainable European Research Infrastructures – a call for action*¹⁷ remain very relevant elements of RI policy. In addition to scientific excellence as an indisputable key element, LTS requires an adequate legal and financial framework, and must be embedded in a supportive, policy-driven environment to be successful. Sufficient funding including adequate and sustainable funding models, required across the whole RI lifecycle to address the diversity of needs and the funding gaps, is indispensable for successful RI strategy. A joint effort combining European, national or other funding sources is vital for the healthy development of the pan-European RI ecosystem. For RIs to remain relevant throughout the entire RI lifecycle, scientific excellence is the condition *sine qua non*, which becomes, together with adequate human resources, crucial when it comes to long-term persistence in the operational phase. Effective governance and sustainable long-term funding (public and private) are other key elements for ensuring long-term sustainability of RIs at every stage in their lifecycle. All these LTS elements, though present and also referred to throughout the entire document, form a unique set, which should be considered and implemented as a general strategic guidance, and not only for ESFRI initiated RIs.

Moreover, Research Infrastructures should also contribute to their sustainability by moving towards their own carbon neutrality.

16. Long-Term Sustainability of Research Infrastructures. ESFRI Scripta Vol.2, October 2017

https://www.esfri.eu/sites/default/files/ESFRI_SCRIPTA_SINGLE_PAGE_19102017_0.pdf

17. Sustainable European Research Infrastructures – a call for action. EC Staff Working Document, October 2017

https://ec.europa.eu/info/sites/info/files/research_and_innovation/research_by_area/documents/swd-infrastructures_323-2017.pdf

KEY MESSAGES

When establishing a new infrastructure, its funders should plan from the start for the financing of the different phases of the RI lifecycle; taking account also of human resources needs (staff salaries, recruitment, retention and training) and data-management costs.

ESFRI will continue to support initiatives facilitating the combination of national and European funds and synergies between Horizon 2020/Horizon Europe, the Structural and Investment Funds and other European funding for RIs as an element of effective RI implementation and sustainability.

ACCESS TO RIs INCLUDING TRANS-NATIONAL ACCESS

A long-time objective of Europe has been to open up and increase trans-national access (TNA) to national Research Infrastructures (of European interest) and to European Research Infrastructures, such as those prioritised by ESFRI. Nevertheless, this has not been as successful as originally envisioned. Some of the possible reasons may be related to lack of availability, e.g. when competing with national users for funding, e.g. when no specific funding of [additional] costs by home or host organisations are available. Horizon Europe and other EU-level programmes have been especially critical to funding transnational access when national rules pose limitations to funding RI access abroad. Furthermore, issues related to personal data, security or intellectual property often become more sensitive in a trans-national context. The bottlenecks however do vary depending on the scientific domain, the modality of access for a class of infrastructures, or the nature of costs and funding mechanism utilised.

A key element for defining the principles of RI access policy has been the European Charter for Access to Research Infrastructures. The Charter promotes the harmonisation of access procedures as well as the enhanced transparency of access policies adopted by Research Infrastructures with the final purpose of enabling users to access the

best Research Infrastructure to perform their work, wherever it might be located. Assessment of the implementation of the Charter, and its potential review, would further reinforce the accessibility of Research Infrastructure services for European scientists and innovators.

One fundamental observation is that access models for centralised and distributed RIs can be different but the real key difference that dwarfs all others is that between physical¹⁸, remote¹⁹ and virtual²⁰ access to RIs. For both physical access (e.g. using coastal vessels or telescopes on site) and remote access (e.g. using high performance computers), due to the limited and non-time-shareable resources of the corresponding RIs, it is typical to adopt models that partition access time into three components: standard access to members according to their proportion on some key parameter, e.g. financial contribution; competitive access to members based on excellence; and possibly a (usually small) fraction of competitive access open to non-members and/or fee-based access to the market. There is a natural competition/tension between the three components, members vs non-members, scientific excellence vs quotas/geographical return, so identifying the right proportion according to the priorities of an RI is a significant challenge.

18. Physical access is "hands-on" access when Users physically visit an infrastructure, /facility/ or equipment. The available services or resources are not unlimited and a competitive process is required following a defined procedure and criteria for selection of Users.

19. Remote access is access to resources and services offered by the RI without Users physically visiting the infrastructure/facility. Similar to Physical access, the services or resources are not unlimited and a competitive selection is required.

20. Virtual access means free access to Users provided through communication networks; the available services or resources can be simultaneously used by an unlimited number of Users and the Users are not selected. Virtual access typically concerns access to data and digital tools.

KEY MESSAGES

RIs based on physical or remote access should continue to offer services on an excellence basis in line with European Charter for Access to Research Infrastructures (e.g. access should be granted according to the quality of proposals submitted by the relevant research community and evaluated following a process of peer review). For each RI, a proper balance must be found between RI member and non-member access as well as priority, excellence-based, and fee-based access. RIs based on virtual access should offer services on an open and FAIR basis.

With the support of ESFRI, the MS/AC are invited to promote the convergence of national policies and frameworks on RI access and funding models; to reduce the overhead of establishing and operating (especially distributed) RIs and thereby facilitating transnational access. Furthermore, the EC and MS/AC are invited to consider additional, sustainable funding models, complementing the existing funding model, which approaches (transnational) access (TNA) as an element of EC projects.

The EC and MS/AC are invited to make RI access costs eligible for an expanded set of funding sources, including national funds, European structural and investment funds, and appropriate EC framework funds (e.g. all Pillar 1 and Pillar 2 instruments in Horizon Europe).

MOBILITY AND TRAINING OF RESEARCHERS AND RI STAFF

RIs provide unique training opportunities and play an important role in the education and upskilling of new generations of scientists, engineers and data professionals. Scientists visiting RIs receive technical support and training, acquiring new skills in the use of advanced technologies, data analysis and quality control. Human resources (HR) are a critical component of RIs. HR policy and the quality of management defines the quality of the RI to the same extent as its technical and technological readiness. Therefore, appropriate training and skills development for RI staff at the various levels, from top management to technicians and supportive personnel is crucial. It is important to secure the right people at the right place at the right moment following the principles of equality, diversity and inclusiveness, and connect this with proper career path and mobility of managers and engineers.

Fostering the training of RI managers, operators and users plays an important role in RI success and facilitates its optimal use.

The development of a formal curriculum for RI managers and its implementation in a dedicated master's program has been an important milestone towards establishing a formal career path in RI management and fostering the general attractiveness of careers in the RI domain. These elements could now be further modularized to enable easier delivery to existing staff.

One of the obstacles to effective researchers' mobility in Europe, including Research Infrastructure managers and operators, is the fragmentation of the pension systems and limited transferability of pension rights across countries. To address this obstacle, the European Commission established a European pension fund for research organisations and their employees called RESAVER²¹. RESAVER facilitates mobility across the EU providing an attractive solution to securing transferability and accumulation of pension rights across countries and employers. It is an interesting scheme that could be considered by the European RIs.

21. e.g. RESAVER, a multi-employer occupational pension solution for research organisations in Europe and their employees. It enables employees to stay with the same pension plan when moving between different countries or employers

KEY MESSAGES

The MS/AC are invited to incentivise and support the role of RIs in education and training of students, researchers, technicians and engineers, as well as in promoting science and scientific careers to young people by stronger structured collaborations between RIs and universities leading to greater mobility and exchange programmes between these sectors.

The MS/AC and the RIs are invited to take measures and design incentives to have sufficient quality and quantity of staff that can be recruited by RIs to ensure their proper implementation, operation and impact. They are invited to support training, mobility and exchange of experience actions for RI research and technical staff, drawing inspiration from actions like Marie Skłodowska Curie and Erasmus+.

The MS/AC and the RIs should maintain clear and effective equal opportunities policies, to ensure that the best people are recruited in the right jobs, taking account of the specific characteristics of positions for management, technical and administrative staff, the requirements for career development (on management, scientist & administrator tracks), including lifelong learning and skills development.

MS/AC together with RIs are invited to establish a clear formal career path in RI management, fostering the general attractiveness of careers in the RI domain, also by properly accounting for gender issues. ESFRI will contribute to the European framework on career evaluation / progression announced in the ERAC opinion on ERA.

The EC, the MS/AC and the RIs are invited to support measures to foster the long-term mobility of managers and technical staff within the RI eco-system along the RI lifecycle. The use of transferable pension schemes should be part of these considerations.

HIGH-QUALITY OPEN RESEARCH DATA AND ROLE OF ESFRI IN EOSC

European RIs foster the definition, implementation and further development of advanced solutions for the effective provisioning and use of high-quality scientific data, with effective metadata descriptors, ease of access, interoperability and reusability, fully implementing the FAIR (Findable, Accessible, Interoperable, and Reusable) principles. ESFRI Landmarks and other internationally open RIs, not only produce scientific data that are used by highly competitive international research communities, but also assure a robust quality control of the produced data sets. In addition, the ability of RIs to develop interoperability concepts becomes critical not only for effective data sharing, but also more generally, it will direct the capability of RIs to address the multidisciplinary character of the societal challenges and SDGs. These efforts must be recognized, properly analysed and utilised to contribute to

RIs, including the various alternatives for governance models and fully reflecting the engagement and responsibility of RIs in and for Open Science, should be utilised to the maximum extent in the EOSC implementation²⁴.

EOSC should have a clear extra value for its end users. These include primary scientific advantages, such as enhanced data and service connections, a better ability to address interdisciplinary and societal challenges, and improved e-infrastructure services and tools for RIs and their data consumers. On top of that political, social and cultural advantages, for example improved political decision-making capabilities, increased societal awareness and leading a change in culture towards Open Science. Further, qualifying factors such as transparency, high data quality, research acknowledgement/credit, and training are important.

22. Conclusions of the Council of the European Union of 18 May 2018 on the European Open Science Cloud (EOSC). Doc. 9029/18

<http://data.consilium.europa.eu/doc/document/ST-9029-2018-INIT/en/pdf>

23. Keynote speech by President von der Leyen at the World Economic Forum:

https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_20_102

24. Implementation Roadmap for the European Open Science. EC Staff Working Document Cloud, April 2018

https://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf

The experience gathered by ESFRI should be utilised in the EOSC implementation

shaping the European Open Science Cloud²² system. EOSC provides a chance to increase data sharing beyond RIs, since it will provide European researchers with seamless access to a wealth of data²³ and a wide range of value-added services from different national and regional backgrounds. The experience gathered by ESFRI and ESFRI-initiated

EOSC requires a long-term and sustained funding to ensure relevance, uptake and its continued existence. This funding should also reflect the evolving needs of the supported communities, with necessary periodic updates and related development initiatives.

The EOSC cluster projects play an important and multi-faceted role for both EOSC and RIs, being on one side providers of data and services of all kinds (e.g. data services, research products services) and on the other side as users of services provided by EOSC. The relationship between direct funding for RIs and EOSC-derived funding for the horizontal

services and resources provided for the RIs need to be considered, with the precise specification for each facility.

EOSC is working on a change of culture towards open research data according to the FAIR data principles. Such a cultural change can be achieved through targeted education and training, incentives and reward mechanisms. On top of this, the extra value of EOSC should be clearly visible for its end users, including the many benefits of Open Science, and the 'added value' for RIs. Further, an understanding of the costs associated with Open Science is needed. Business models, legal entity concepts as well as access models are being defined by EOSC. The RI community should act as a key player in these efforts, leading the change of culture, driving data quality and more open access to data. Together with the scientific community of users, the RIs have a key role to help the EOSC to start with a robust high-quality data sets and working commons.

KEY MESSAGES

ESFRI will continue to support the development of a European Open Science Cloud and the close connection of RIs to EOSC with increased FAIR and open data sharing and availability to stimulate inter-disciplinary and transdisciplinary research to achieve the societal goals. Horizon Europe should continue to support such developments.

The EC, the MS/AC and EOSC are invited to take full advantage of the well performing best practices in data management, storage and curation implemented at RIs at the ESFRI Roadmap that already implement FAIR and Reproducibility criteria for data, which operate them through open access portals and which can contribute to achieving the EOSC's long-term goal of research data interoperability.

The EC, the MS/AC and the RIs are invited to take account of the vital need for data professionals in their education and innovation activities and to consider supportive measures at an appropriate scale.

3

FUTURE ESFRI ACTIVITIES AND ORGANISATION

ESFRI, in line with its mandate defined by the Council of the European Union²⁵, is committed to developing its contribution to meet the twin priorities of strengthening Europe's capacities to carry out cutting-edge science and of providing the conditions in which science can help to solve the major socio-economic and environmental challenges facing the world. As the maturity of the European Landscape of Research Infrastructures is growing, it is vital for its further development to maximise the scientific, economic and societal impact, which may require some changes to the way ESFRI operates.

ESFRI and infrastructures at the ESFRI Roadmap have worked based on cross-fertilisation and dialogue, which should be reinforced in the next period, in alignment with the new ERA paradigm, by joint coordinated actions at national (including regional) and European levels. Further strengthening of these synergies will be needed to meet the new levels of ambition for European research and innovation.

ESFRI implements its mission through a comprehensive set of activities²⁶ fostering the development and sustainability of the entire Research Infrastructure ecosystem as a strategic goal.

25. ESFRI was established in 2002 with the initial goal to support a coherent and strategy-led approach to policy making on Research Infrastructures in Europe and to facilitate multilateral initiatives, acting as an incubator for pan-European and global Research Infrastructures. This mandate was extended in 2004 to include the development of a Roadmap. As the ESFRI Research Infrastructures included in the first three Roadmaps (2006, 2008, and 2010) were becoming more mature, ESFRI was also asked to follow-up their implementation and the mandate has recently been enriched in the areas of data-driven RIs and EOSC as well as long-term sustainability. ESFRI has also played an active role in the implementation of the ERA Roadmap. See Conclusions of the Competitiveness Council of 2004, 2012, 2015 and 2018.

26. ESFRI Procedural Guidelines
https://www.esfri.eu/sites/default/files/ESFRI_Procedural_Guidelines_Revision_2019_Adopted.pdf

KEY MESSAGES

ESFRI will contribute, in its areas of responsibility, to realising the renewed vision for the European Research Area as part of the renewed ERA governance after 2020.

LANDSCAPE ANALYSIS OF EUROPEAN RESEARCH INFRASTRUCTURES

ESFRI performs a regular Landscape Analysis of the Research Infrastructures accessible to European science and industry, with the aim of identifying their strengths, potential and weaknesses in all fields of research. The Landscape Analysis identifies the main RIs operating open access in Europe as well as major new or ongoing projects. This includes national, regional and international facilities as well as consortia that offer integrated services and transnational access to state-of-the-art resources for research. ESFRI's analysis is currently the most advanced attempt to describe Europe's existing RI-landscape and pointing out gaps and further needs to fill in order to create a coherent European RI-ecosystem capable of addressing future challenges.

One of the key elements of an effective RI ecosystem is that the services, data and products offered by RIs are generally accessible based on the excellence-driven access principles, increasingly cross-disciplinarily interlinked, meet the needs of

their scientific communities, and keep up to date with scientific progress. As more and more RIs on the ESFRI Roadmap become fully operational, the importance of ensuring that they follow these principles is growing. Various RI communities, from the same scientific areas and across disciplines, have in recent years started several integration activities of various, more or less formalised characters.

Landscape Analysis is a very important component of ESFRI work, but it is vital that it goes beyond a description of existing facilities and involves a more user-driven analysis focused on service offer and considering impact related to the broader political agendas. This would also allow promoting the use of European Research Infrastructures more broadly to researchers and industry at large. The interplay between regional (smart specialisation), national and European strategies should be more explicitly reflected in the Landscape Analysis.

KEY MESSAGES

ESFRI will develop the Landscape Analysis of European RIs to become a more strategic tool, considering a user-driven and impact-oriented perspective in relation, for example, to the Sustainable Development Goals and Missions, also promoting the use of Landmark infrastructures to researchers, industry and society.

ESFRI's Landscape Analysis will become more comprehensive, going beyond the description of existing large-scale Research Infrastructures, considering relevant initiatives also at national level.

ESFRI will support the self-organisation and consolidation of RIs within the same domain and across domains, in order to better address users' needs in replying to societal challenges and to promote sharing of good practices on the different RI related agendas.

ESFRI ROADMAP

ESFRI's main task is and will remain the identification of strategic priorities for investments in Research Infrastructures of pan-European interest that meet the long-term needs of European research communities and serve European society at large. The ESFRI Roadmap is a key instrument through which the Forum establishes a long-term European strategic planning for the development of RIs.

ESFRI applies the lifecycle approach to the development and implementation of Research Infrastructures, which has proved effective in ensuring the consistency of the ESFRI Roadmap methodology. The lifecycle concept describes the different milestones in the development, implementation and operation of a Research Infrastructure over time, specifying minimal key requirements that must be met at each stage. Application of this concept allows for a coherent assessment of the scientific and organisational maturity of Research Infrastructures across all fields of science²⁷.

ESFRI Roadmap 2021 will conclude the second cycle of these strategic documents. In the first cycle (2006, 2008, 2010) ESFRI focused primarily on identification of new priorities. In the second cycle (2016, 2018, 2021) ESFRI implemented the lifecycle approach and a comprehensive evaluation methodology, identifying additional new priorities, but also following up on the progress of existing ESFRI Projects and identifying the implemented infrastructures as ESFRI Landmarks. The cyclical nature of the Roadmap, combined with a ten-year limit for Projects to stay on the Roadmap before implementation, has proved effective in mobilising the scientific community and the national authorities to build up the institutional capacity for starting operations.

As the European Research Infrastructure landscape becomes more comprehensive, the approach to the ESFRI Roadmap needs to evolve as well, with periodicity spread more evenly throughout the 10-year cycle allowing for an even more strategic selection of new priorities. The long-term vision of the ESFRI roadmap also needs to consider the EOSC development.

27. ESFRI Public Roadmap 2021 Guide

https://www.esfri.eu/sites/default/files/ESFRI_Roadmap2021_Public_Guide_Public.pdf

KEY MESSAGES

ESFRI will refine the lifecycle approach to the development of Research Infrastructures and will reinforce its application to the selection of new initiatives and the follow-up of ESFRI Projects and Landmarks.

ESFRI will adapt the scope and structure of the Roadmap in the context of the renewed ERA policy framework and will present the following update (after the 2021 edition) in 2025.

ESFRI will strengthen the links of the Roadmap to the research and innovation agenda at national and European levels, and it will continue to develop international standards in strategic priority setting for RIs, supporting the development of the global RI ecosystem.

MONITORING OF EUROPEAN RESEARCH INFRASTRUCTURES

ESFRI, following the invitation by the Competitiveness Council of 29 May 2018²⁸, has developed a common approach across RIs to monitor their performance based on Key Performance Indicators (KPIs)²⁹. A key feature of this approach is its flexibility to adapt the KPIs according to the specific needs and objectives of each individual RI. ESFRI shall further discuss the implementation of this Monitoring Approach and possibilities to promote the uptake by the RIs.

The Monitoring Approach will support the internal management of the RIs. It will also provide a meaningful and feasible tool for assessments, evaluations and reviews along the ESFRI Roadmap process and throughout the lifetime of a RI. Results from this approach could support the regular assessments and reviews of Projects and Landmarks.

The ESFRI Monitoring Approach is a tool for assessment of the individual RI performance and progress towards the individually set targets. Through regular reviews, it allows not only adequately the identified challenges of an individual RI to be addressed, but also indicates the health of the entire RI ecosystem, and thus supports RI sustainability.

The ESFRI Monitoring Approach aims to contribute to establishing pan-European standards for monitoring of RIs.

28. Conclusions of the Council of the European Union of 29 May 2018 on Accelerating knowledge circulation in the EU. Doc 9507/18

<http://data.consilium.europa.eu/doc/document/ST-9507-2018-INIT/en/pdf>

29. Report of ESFRI Working Group on Monitoring of Research Infrastructure Performance

https://www.esfri.eu/sites/default/files/ESFRI_WG_Monitoring_Report.pdf

ESFRI will promote the voluntary uptake of a Monitoring Approach by all Research Infrastructures, aiming at establishing pan-European standards

KEY MESSAGES

ESFRI will promote the implementation of the Monitoring Approach by the RIs on a voluntary basis.

ESFRI will explore options to utilise the process for its own evaluation procedures. This implies the involvement of the Strategy Working Groups and the Implementation Group. Options for external support may be evaluated.

ESFRI will further develop this approach when necessary, in close cooperation with all stakeholders taking into account overarching goals like Open Science.

STRATEGIC ADVICE AND DEVELOPMENT OF RI-RELATED EXPERTISE

ESFRI has developed into a unique knowledge hub on Research Infrastructure policy and its implementation. ESFRI's advisory capacity is built up on the involvement of high-level experts, from all relevant fields, across all activities and tasks of the Forum. In addition to identifying investment priorities and following RI implementation, this expertise has been extensively used by the Council of the EU and the European Commission to address specific RI-related challenges, such as strengthening the innovation potential of RIs, developing a long-term sustainability framework and consolidating Open Science policies.

Key elements of a robust RI governance, access to RI and RI produced data, as well as RI impact in broader terms, must be better understood and incorporated into ESFRI's knowledge base. This will allow ESFRI to strengthen its activities in mentoring and sharing implementation experience with and among RIs.

To support these activities, there is a clear need to communicate more effectively about the role, contribution and impact of Research Infrastructures and of ESFRI itself. The responsibility for this falls to European, national and regional authorities, and to the RIs themselves.

KEY MESSAGES

ESFRI will continue to provide strategic advice either on MS/AC demand or based on its own initiative on specific RI related matters. It will actively contribute to the policy discussions on the future of ERA and particularly on the role of RIs in implementing the Open Science concept.

ESFRI will continue the strong dialogue and the exchange of knowledge, experience and good practice between ESFRI and European Research Infrastructures at all levels. It will investigate the possibility of organising a platform for regular discussion among the different European RI stakeholders, e.g. an ESFRI Stakeholder Forum.

The EC and the MS/AC, with support from ESFRI, are invited to exploit and promote the proven added-value of ESFRI in the design and implementation of the new ERA, in particular in its capacity to contribute to the horizontal, cross-sectoral approach and to the achievement of the SDGs.

The EC, the MS/AC and ESFRI are invited to support RIs in communicating to stakeholders, including citizens, about their contribution to Europe's competitiveness, to finding answers to the global challenges and to tackling the SDGs.

ESFRI ORGANISATION AND CAPACITY

The organisation and form of the ESFRI Forum is fit for purpose in fulfilling its objectives and providing an effective platform for both the RI policy discussions and the preparation and implementation of the methodology for RI evaluation and monitoring. Nevertheless, as the processes linked to the ESFRI Roadmap have been to a large extent carried out internally, they put significant pressure on ESFRI's capacity.

ESFRI's unique capacity to contribute to the coordination and development of European RIs rests heavily on the work conducted by the six Strategy Working Groups (SWGs) and the Implementation Group (IG). These groups consist of high-level dedicated experts from ESFRI Member States. It is because of the vast competence in these groups that ESFRI can carry out the evaluations necessary for ESFRI's Landscape Analysis, Roadmap, and monitoring. The SWGs bring much of the scientific competence of ESFRI and are also engaged in a range of *ad hoc* activities.

In the implementation of its mandate as well as the related tasks and activities, ESFRI benefits from a substantial support structure which has in general proved effective. The support to ESFRI's activities is threefold: a) the ESFRI Executive Secretariat, provided in-kind by the EC, b) the ESFRI Chair secretariat and secretariats of Executive Board Members and Working Group Chairs offered by the corresponding MS/AC, and c) the EU Framework Programme project-based support (CoPoRI, StR-ESFRI,

StR-ESFRI 2). The current setting in general serves the purpose and the participation of EC at appropriate levels across all ESFRI activities is very important.

However, as the European RI landscape has become richer and more mature, ESFRI's mandate has been substantially expanded. The growing number of activities has resulted in substantial pressure on the resources available as each of the four components of the ESFRI support structure assumed more tasks and responsibilities. Moreover, ESFRI's operations are critically dependent on all the four components working in close synergy, but as none of these components has assured sustainability in the long term, this creates a significant risk.

For ESFRI to effectively respond to the new ambition for European science and European Research Infrastructures, ESFRI needs to revisit its organisation and support structures. This requires a more sustainable structure around the Forum with increased operational capacity, providing ESFRI and its Secretariat with additional means to further delegate the implementation of operational tasks. Ideally, the reinforced support structure should be independent from the cycles of ESFRI Chair elections and project cycles of the EU Framework Programme. ESFRI also continually needs to consider the workload put on the SWGs and IG, securing that ESFRI can continue to benefit in a sustainable manner from input from the European research community.

KEY MESSAGES

ESFRI will maintain its general purpose, structure and the way of working based on its values and uniqueness, including the ESFRI Forum, Executive Board and Working Groups, but ESFRI will consider transferring a greater number of operational tasks to its support structure.

ESFRI will consider options to increase its operational capacity and to maintain its strategic role in developing an effective and sustainable RI ecosystem in Europe.

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