ESFRI

WORKING GROUP REPORT

Monitoring of Research Infrastructures Performance

December 2019

Report of the ESFRI WORKING GROUP ON MONITORING OF RESEARCH INFRASTRUCTURES PERFORMANCE (WG MONITORING)

Contents

Executive Summary

Following the invitation by the Competitiveness Council of 29 May 2018, the European Strategy Forum on Research Infrastructures (ESFRI) established a Working Group (WG) to develop a common approach across Research Infrastructures (RIs) to monitor their performance based on Key Performance Indicators (KPIs). The proposed KPIs should provide a comprehensive framework ranging from input to outcome indicators. They will be used in the periodic review of ESFRI Landmarks and moreover, they should be useful and may be adopted by a wider range of RIs, funding authorities and stakeholders.

The KPIs were developed to address the most commonly held objectives of pan-European RIs, to ensure that they are likely to be relevant and adopted by the widest range of RIs, and they were tested against the RACER criteria, i.e. they had to be Relevant, Accepted, Credible, Easy to monitor, Robust. The WG is aware that novel methods, such as those based on altmetrics are likely to significantly modify the approach to monitoring in the future. However, currently, they do not meet the RACER criteria and were not considered in the development of the system.

Further details of each KPI are given in accompanying reference sheets. The suitability of the KPIs to facilitate the monitoring of performance was tested through surveys and a stakeholder workshop. The results of this consultation indicate, that given the diversity of types and missions of RIs, the KPIs can be implemented effectively if they are adapted to the specific character and context of individual RIs. While the WG proposes that this is achieved through a dialogue between the relevant parties for all of the RIs, it is of particular importance for RIs under construction, which require customized KPIs according to their phase of development.

The WG notes that although KPIs are the most often used method to monitor progress towards objectives, they are often poor proxies of progress towards objectives. A move towards enhanced inclusion of narratives, such as theory of change and storytelling has been observed lately, not only in the case of evaluations, but also monitoring. The proposed methodology therefore requests that the RIs accompany the agreed KPIs with a context and develop also their own narratives.

This diversity also means that not all KPIs, or even all objectives, will be equally relevant to all RIs. Indeed, some RIs are not yet able to gather the data needed to track all KPIs and may need specific tools to be developed for this purpose.

An approach to use the KPIs to monitor performance is outlined and it is recommended that a Monitoring Implementation Group be established by ESFRI to support the implementation and monitor the adoption and use of the KPIs, to refine them through the experience gained through this process and to help establish best practice across European RIs and their stakeholders. This Group should also follow the development of novel indicators and approaches, as well as the need for inclusion of new indicators, e.g. when the EOSC user policy will be adopted. Furthermore, the monitoring approach proposes that the KPIs for each RI are established in 2020, in a dialogue between the RIs, their boards/funders/ministries, the Strategic Working Groups (SWGs) of ESFRI addressing a specific domain, and the Monitoring Implementation Group. The Group may also play the role of facilitator for the use of the KPIs at the time when the RI evaluation/assessment is carried out, either by ESFRI or by external agencies.

The proposed set of KPIs, reference sheets, and the monitoring approach are presented here along with the following **key recommendations** of the WG.

1. **All KPIs should be aligned with the objectives of RIs and fulfil RACER criteria: Relevant, Accepted, Credible, Easy to monitor, Robust. Each KPI should be accompanied by a reference sheet that provides a definition, data source(s), method of calculation, and other information concerning calculation or applicability.**

2. **Given the diversity of RIs, their objectives and state of development and the varying relevance of specific KPIs for each RI, the KPIs are not suitable for a comparison of the performance of RIs.**

3. **While the proposed objectives are relevant for most RIs, many of the suggested KPIs cannot currently be used by all of them. The WG acknowledges that some adaptation may be needed in order for a certain KPI to be applicable for a RI. RIs should also provide a short narrative for each of the quantitative KPIs, putting it in its specific context.**

4. **Specific methods or tools to gather the data will need to be developed or agreed by RIs to be able to reliably report on some of the proposed indicators. The WG recommends that ESFRI facilitates such a development.**

5. **It is recommended that ESFRI establishes a Group for the implementation of KPIs and monitoring of pan-European RIs (Monitoring Implementation Group) to help establish best practice in developing and implementing KPIs, and to ensure that such experience is shared widely across European RIs and their stakeholders.**

6. **It is proposed that the KPIs to be used by each RI are determined in a dialogue between the RI and – ESFRI (Strategic Working Groups, Implementation Group, the Monitoring Implementation Group), involving other relevant parties, e.g. funders of the RIs or ministries. RIs should then collect data, and calculate the KPIs periodically, in a manner that can be presented to the evaluators during the periodic evaluation by ESFRI. We recommend that the data be made available for future consultation.**

7. **We recommend to the RIs and their stakeholders to consider applying the proposed objectives and KPIs for their own monitoring purposes.**

1. Objectives and deliverables of the Monitoring Working Group

In the meeting of 29 May 2018, the Competitiveness Council adopted conclusions on *Accelerating knowledge circulation in the EU* which: *"…; INVITES Member States and the Commission within the framework of ESFRI to develop a common approach for monitoring of their (RIs) performance and INVITES the Pan-European Research Infrastructures, on a voluntary basis, to include it in their governance and explore options to support this through the use of Key Performance Indicators".*

ESFRI was asked to implement this mandate and set up an *ad hoc* WG whose Terms of Reference (ToR) set the following objective: *"…to consolidate the existing knowledge on monitoring of RI performance, propose a common approach at European level and explore options to support this through the use of Key Performance Indicators (KPIs). Such KPIs must be easy to use, shall be adjustable to different systems and types of RIs (new as well as existing) and yet robust to ensure high level of confidence. They could serve as one element of the monitoring carried out by RIs and their governance bodies to monitor their performance."*

The ToR specified the composition of the WG, with a membership to include ESFRI delegates, experts representing funding and decision-making bodies, RI managers and practitioners, and representatives of the European Commission: Annex 1 lists the WG members. The ToR also outlined the deliverables, as follows:

- A concept of a common approach for the monitoring of RI performance, including the periodic review of ESFRI Landmarks;

- A matrix with a core set of KPIs that could be applied across the different RIs;

- Rationale for the development and optimization of KPIs for specific RIs;

- Recommendations aimed to facilitate the inclusion of the monitoring of RI performance, also by using adapted KPIs, in the governance of RIs.

The WG was tasked with producing a report which should include:

- A proposal on the methodology to be adopted for the ESFRI Landmark periodic update;

- A proposal on common elements of monitoring methodologies and options for KPIs to be applied on a voluntary basis, by RIs and funding authorities.

- The Group should also propose a methodology for the periodic update of the state of play of the ESFRI Landmarks, taking into account the results of the pilot review exercise of 2017. This would include the monitoring of landmarks which are not operational.

The WG activities are outlined in Annex 2 and include both the meetings of the group as well as various consultations and workshops to involve national funding bodies and RIs in the process.

2. KPIs – definitions and considerations

A number of recent studies have aimed to establish a set of parameters to describe or quantify the *performance*, and in some cases also the *impact* of RIs[1-4] It is important to establish from the outset that KPIs concern the former and provide a means of monitoring the performance of a RI with regard to progress towards its stated objectives from inputs, through activities and outputs to outcomes. Indicators may be defined for various points in this chain for the different objectives of the RI. When monitored on a regular basis (typically annually), such KPIs provide valuable information both for the operators of RIs and for their stakeholders to optimise progress towards the objectives through changes in inputs and activities. Evaluation of the *impact* of a RI in various areas generally requires an in-depth evaluation, usually by external experts after an appropriate time lag during which such impacts may become more clearly apparent. The European Commission co-funded RI-PATHS project is developing a framework for socio-economic impact of RIs.[5]

The development of KPIs that may be applied effectively to the many, diverse RIs across Europe is not straightforward. One set of KPIs will not be equally applicable to all RIs, with their various levels of maturity, the breadth of domains of science they serve, their different characters as providers of advanced instrumentation (e.g. a facility such as a telescope or a synchrotron) or resources (e.g. language resources, databanks or collections of samples in a biobank), or whether they are single-sited or distributed RIs[6].

Given the definition of KPIs in relation to objectives, the identification of the most common KPIs across pan-European RIs began by establishing their most commonly held objectives. In a second step, the relevant factors that help RIs to achieve these objectives can be identified and then quantified or qualified in the form of indicators. KPIs produced in this way should be tested against the RACER criteria[7], meaning that they should be:

- **Relevant** – *i.e.* closely linked to the objectives of the RI over a particular period of time.

- **Accepted** by the RIs (at all levels) and stakeholders otherwise there will be limited implementation.

- **Credible** for non-experts, unambiguous and easy to interpret.

- **Easy** to monitor – e.g. data collection should be possible at low cost.

- **Robust** – e.g. against manipulation.

The extent to which the KPIs are relevant to each RI, as well as some of the details of the KPI and issues concerning their applicability, will vary from RI to RI and should be determined either by the RI itself, together with an advisory or governing body when the KPI is used for self-monitoring or, where there is an external (e.g. funding agency) body overseeing the monitoring process, with that body too. This requires each KPI to be accompanied by a file or reference sheet that sets it in the context of the particular RI being monitored.

The WG makes the following general recommendations about the development of KPIs:

1. **The WG recommends that all KPIs should be aligned with the objectives of RIs and fulfil RACER criteria: Relevant, Accepted, Credible, Easy to monitor, Robust. Each KPI should be accompanied by a reference sheet that provides a definition, data source(s), method of calculation, and other information concerning calculation or applicability.**

2. **Given the diversity of RIs, their objectives and state of development and the varying relevance of specific KPIs for each RI, the KPIs are not suitable for a comparison of the performance of RIs**

3. The working framework to develop KPIs: common objectives of RIs

The working framework within which a long-list of KPIs was first determined was the set of the most commonly held objectives across European RIs, bearing in mind that they can vary considerably with, *inter alia*, the level of maturity of the RI, the scientific domains it serves, whether it is at a single site or distributed, and whether it is a facility or a RI that provides access to resources such as a databank. The WG reviewed the outcomes of a number of surveys of the objectives of RIs, as well as studies to develop KPIs or impact indicators which also reviewed or proposed RIs' objectives[1,2,8,9,10].

Many of the objectives presented in these reports are also key to the Long-Term Sustainability (LTS) of RIs[11], the issue that inspired this particular study, and the subject of the recent European Commission Working Document on LTS of RIs[12]. Based on the key areas of recommendations of this report, together with sets of objectives derived from the five surveys or studies mentioned above, summarised in Annex 3, the WG identified the following nine objectives of greatest relevance for RIs in general:

- **Enabling scientific excellence**

- **Delivery of education and training**

- **Enhancing transnational collaboration in Europe**

- **Facilitating economic activity**

- **Outreach to the public**

- **Optimising data use**

- **Provision of scientific advice**

- **Facilitating International co-operation**

- **Optimising management**

The WG took note that while each of the objectives was shared by at least 40% of ERICs[10], only the objective of enabling scientific excellence was shared by all of them (Annex 3).

This approach was tested through a survey in February 2019 of ESFRI RIs and ERICs regarding which of these objectives they shared, and what KPIs they had in relation to each objective. The RIs were also given the opportunity to state other objectives and KPIs they might have that were not included among those presented in the questionnaire.

The outcome of the survey was reviewed to identify the most commonly occurring KPIs among the RIs which were then tested against the RACER criteria, and in some cases modified to produce a set of 21 KPIs, each accompanied by a reference sheet to provide more detailed information. The survey also revealed a number of indicators that did not satisfy the RACER criteria but which were regarded as valuable complements to KPIs in indicating progress towards objectives. These took the form of narratives. It should be noted too that the surveys revealed a number of RIs which had either developed little or no KPIs[3], or put forward KPIs that did not satisfy the RACER criteria**.**

The proposed KPIs were submitted to the pan-European RIs in a second questionnaire, asking how relevant they are for each RI. Further input was provided by a workshop, which brought together representatives from RIs, from ministries and from national funding bodies, including many ESFRI delegates. Feedback from both

processes, including written and oral comments, also proved valuable in refining the KPIs and the reference sheets.

A conclusion drawn from both the workshop and the questionnaire is that at present there is not a single KPI that is regarded as workable by all RIs. Several reasons for this were given: (i) not all RIs regard the nine most generally relevant objectives that we identified as relevant to them; (ii) not all KPIs for an objective held by the RI were regarded as appropriate in their current form and would need to be modified further to match their needs; (iii) some RIs stated that they are unable to gather the data they need to determine the KPI. An example of the last case concerns RIs that provide access to data collections through open access routes which are not necessarily monitored so there may be little or no trace of who has accessed the data and how it was used without setting up extensive data mining tools. To this end, several of the RIs mentioned that the development or mutual exchange of the methods or tools would be most efficient and effective if it is co-ordinated across RIs and may require supporting activity where individual RIs lack appropriate expertise or resource.

Considering the feedback, the WG recommends the following:

3. **While the proposed objectives are relevant for most RIs, many of the suggested KPIs cannot currently be used by all of them. The WG acknowledges that some adaptation may be needed in order for a certain KPI to be applicable for a RI. RIs should also provide a short narrative for each of the quantitative KPIs, putting it in its specific context.**

4. **Specific methods or tools to gather the data will need to be developed or agreed by RIs to be able to reliably report on some of the proposed indicators. The WG recommends that ESFRI facilitates such a development.**

The final set of KPIs is presented in **Table 1**. KPIs are accompanied by reference sheets detailing their use (Annex 5).

In addition to the quantitative indicators, the WG proposes that a number of qualitative indicators are used by the RIs in order to present their progress towards their objectives to the evaluators. While the RIs are invited to develop these indicators, some examples are provided in in **Annex 4.**

Objective	KPIs
Enabling scientific excellence	1. Number of user requests for access 2. Number of users served 3. Number of publications 4. Percentage of top (10%) cited publications
Delivery of education and training	5. Number of master and PhD students using the RI 6. Training of people who are not RI staff
Enhancing collaboration in Europe	7. Number of members of the RI from ESFRI countries 8. Share of users and publications per ESFRI member country
Facilitating economic activities	9. Share of users associated with industry and publications with industry 10. Income from commercial activities and the number of entities paying for service
Outreach to the public	11. Engagement achieved by direct contact 12. Outreach through media 13. Outreach via the RI's own web and social media
Optimising data use	14. Number of publicly available data sets used externally
Provision of scientific advice	15. Participation by RIs in policy related activities 16. Citations in policy related publications
Facilitating international co-operation	17. Share of users and publications per non-ESFRI member country 18. International trainees 19. Number of members of the RI from non-ESFRI countries
Optimising management	20. Revenues 21. Extent of resources made available

Table 1. Numerical KPIs per objective. Further details of each KPI are provided in reference sheets (**Annex 5**).

4. A proposal on the methodology to be adopted for the ESFRI Landmark periodic update

The mandate of the WG is to propose a common approach for the monitoring of RI performance, including the periodic review of ESFRI Landmarks. The proposed monitoring approach was developed in discussion with ESFRI and the stakeholders, through a workshop and a public consultation.

As indicated in the previous chapter, indicators cannot be applied across all the RIs, due to their different objectives, differences in type (e.g. enabling access to facilities or resources, such as data) or operations and the fact that some tools, which would enable them to collect the data, have yet to be developed. It is therefore acknowledged that the RIs should use the KPIs that are suitable for them, having assessed their relevance (Recommendation 3) and ensured that they conform to the RACER criteria, and that some adaptations of the reference sheets will be needed (Recommendation 3).

The WG recognises the need for co-design of the KPIs and the monitoring system to assure the quality and acceptance by the community. To this end the RIs were involved in the process through various consultations and workshops throughout their development. Discussions with the stakeholders and a cluster and discriminant analysis of the replies of the RIs to the questionnaire about the relevance of the KPIs [13] confirmed that are significant differences in the relevance of certain indicators, depending on the ESFRI domain of the RI. It is therefore proposed that the ESFRI SWGs , which address specific domains, are involved in the tailored development of the monitoring of pan-European RIs. Furthermore, the WG is also aware that several of the RIs already report a different set of prescribed KPIs to their boards, funders or ministries. In order to minimize the reporting burden on the RIs, and facilitate the adoption of the KPIs, the proposed set of indicators should be discussed also with these stakeholders.

The quantitative and qualitative KPIs for each of the ESFRI landmarks, either operational or not operational, are thus to be agreed in discussion with the RIs in question and their boards/funders/ministries, and the appropriate SWGs. It would be strongly recommended that each RI defines an official contact person for monitoring issues. Given the already high workload of the SWGs and the IG, ESFRI should consider to form a Monitoring Implementation Group which would also be involved in the discussions in order to assure coherence of the approach across the domains and drive the future process related to the implementation and modification of the indicators and the monitoring system. The Monitoring Implementation Group shall also promote the uptake of the approach through informing, discussing and maintaining contacts with Landmarks, Projects, non-ESFRI RIs and other stakeholders. It should work until ESFRI has finally decided how to adapt its internal structures and how to organize the future monitoring processes.

The review of Landmarks shall not be solely based on KPIs, but accompanied also by context and the narratives, prepared by the RIs. These provide essential information for the reviewers, but any evaluation or review has to reflect a broader information basis. Thus questionnaires, hearings, and reference to other evaluations of the RI shall add to this process.

In general, the review of Landmarks shall take place at certain agreed intervals (e.g. every five years). The schedule shall reflect the capacities of ESFRI (not all Landmarks in a given year, but spread over a five-year period) and the internal schedules of the RIs, in order to avoid conflicts with other reviews and to give the RIs the chance to implement possible recommendations and to feed them into their processes.

After agreeing on the KPIs and the objectives in the dialogue process, the RIs will be requested to collect the necessary data in order to be able to provide them to ESFRI during their periodic review. Periodic meetings of the RIs and the Monitoring Implementation Group will allow for fine tuning of the KPIs and the exchange of best practices.

The KPIs are mainly designed to address operational RIs. For the monitoring of RIs in earlier phases, adaption will be necessary and shall be done as outlined below.

For Projects, the KPIs shall be fed into a monitoring at the end of their ten years on the roadmap to assess a potential Landmark status, in line with the analysis of how they fulfil the minimal key requirements for the implementation phase. After being on the roadmap for a reasonable time (e.g. five years), a similar monitoring shall be applied to Projects with the aim to assess the progress made by the RI and to identify critical issues. This would give the RIs the chance to address these issues in order to achieve progress towards implementation.

The KPIs to be used for monitoring of Projects shall be agreed in the dialogue process during the preparatory phase, reflecting the RI's development timeline towards implementation. As in the case of Landmarks, this monitoring will not be based solely on KPIs, but take into account questionnaires, hearings, and results from other evaluations, as described above. In doing so, later conflicts are avoided and the RI has sufficient time to prepare for the later monitoring and start collecting data.

The Working Group advises that before starting the collection of KPI data from the RIs, general rules on storage, use and distribution of data shall be endorsed and communicated. These rules are likely to be influenced by Open Science policy principles, in line with EOSC deployment.

The approach was designed to monitor individual Projects against their own objectives. Nevertheless, the ESFRI monitoring and review processes may identify some problems common to several RIs. In such a case ESFRI should see if the underlying challenges should be addressed in the Landscape Analysis and/or politically through other appropriate channels.

Considering the various feedbacks, the working group recommends the following:

5. *It is recommended that ESFRI establishes a Group for the implementation of KPIs and monitoring of pan-European RIs (Monitoring Implementation Group) to help establish best practice in developing and implementing KPIs, and to ensure that such experience is shared widely across European RIs and their stakeholders.*

5. *It is proposed that the KPIs to be used by each RI are determined in a dialogue between the RI and – ESFRI (Strategic Working Groups, Implementation Group, the Monitoring Implementation Group), involving other relevant parties, e.g. funders of the RIs or ministries. RIs should then collect data, and calculate the KPIs periodically, in a manner that can be presented to the evaluators during the periodic evaluation by ESFRI. We recommend that the data be made available for future consultation.*

5. Potential application to other non-ESFRI RIs

The proposed monitoring approach is designed in such a way that it can be applied to other RIs or to evaluations of RIs outside the ESFRI context. The WG recommends such RIs and their stakeholders to consider adopting the approach for their own purposes. It should be particularly useful for those RIs who have not yet developed KPIs or who have little experience of doing so. It is also suggested that the recommendations, as provided throughout this document are followed.

7. **We recommend to the RIs and their stakeholders to consider applying the proposed objectives and KPIs for their own monitoring purposes.**

6. Timescale for implementation

By the end of 2019, the general framework of KPIs, and a monitoring approach are to be adopted by ESFRI. The WG recommend that a small group of a few experts from the WG is set up shortly afterwards in order to drive the implementation of the system.

We recommend that the proposed KPI set up is tested on a limited number of selected RIs prior to roll out on a broad scale, preferably during the first half of 2020.

When ESFRI concludes that there is a functional set up for implementing KPI on a broader scale, the SWGs, the Monitoring Implementation Group, RIs and their stakeholders should, in a dialogue, reach an agreement on the KPIs to be used by the RIs by the end of 2020 and the RIs should start collecting the data for the agreed KPIs in 2021.

Annex 1: Members of the Working Group

Name	Role
Peter Wenzel-Constabel (Chair)	National Expert - Germany
Andrew Harrison (vice-Chair)	National Expert – UK
Lucia Banci	National Expert – Italy
Sofie Björling	National Expert – Sweden
Isabelle Diaz	National Expert - France
Domenico Giardini	National Expert – Switzerland
Bjørn Henrichsen	National Expert – Norway
Ana Ramos	National Expert – Portugal
Marek Stankiewicz	National Expert – Poland
Jana Kolar	External Expert
Giancarlo Panaccione	External Expert
Alasdair Reid	External Expert
Dany Vandromme	External Expert
Margarida Ribeiro / Dominik Sobczak	EC Representative

Acknowledgment: Magnus Friberg (Sweden) and Christoph Peschke (Germany) also made significant contributions to the WG

Annex 2. Activities of the Working Group

The WG (composition see Annex 1) held 9 meetings as well as working in sub-groups, and remotely by e-mail and telephone conferences:

- 20 November 2018 –after the Workshop with ESFRI Landmarks on 19-20 November 2018 (Milan)
- 16 January 2019 (Brussels)
- 12 March 2019 (Brussels)
- 21 May 2019 (Brussels)
- 2 June 2019 (Brussels)
- 2 July 2019 (Brussels)
- 28 August 2019 (Brussels).

A preliminary report was presented to the ESFRI Forum in Liblice on 27-28 March 2019.

The WG was aware of the importance to receive input and feedback from the stakeholders (especially ESFRI Research Infrastructures and Landmarks). For this reason, the WG asked in two rounds of questionnaires specifically on the stakeholders' opinions on the objectives and on the relevance of the proposed KPIs. In addition, the WG had a meeting with representatives of the ERIC Forum on 5 April 2019.

On 3 July 2019, the WG organised a Stakeholder Workshop in Brussels with support from the StR-ESFRI Project. This workshop was attended by nearly 80 participants, representing ESFRI RIs, RI-related organizations and ESFRI delegates. The participants made comments on the relevance, contents, applicability of the KPIs proposed as well as on the general monitoring approach. All ESFRI RIs, ERICS and members of ERF AISBL were also surveyed through a questionnaire for their views on the relevance of each proposed KPI to their RI; this elicited a response from 38 RIs.

Members of the WG met with SWG Chairs on 24 September 2019.

The monitoring approach was discussed with stakeholders at the ESFRI Workshop in La Palma, 6-8 November 2019.

Annex 3. Sets of objectives produced or revealed in various recent surveys

This annex collates sets of objectives produced or revealed in various recent surveys organised under common themes using the CERIC survey as the reference point on the left-hand side and the recommendations of recent surveys on LTS on the right-hand side. The percentages for the objectives from the CERIC survey indicate the percentage of ERICs who have a certain objective in their statutes.

2018 CERIC Survey of Statutes of ERICs and ESFRI Roadmap RIs (estimated % take-up)[9]	2019 OECD Strategic objectives[2]	2016 ESFRI Landmarks Pilot Review[8]	2013 - ESFRI WG 2013 Indicators (ex-post)[1]	Monitoring of 2008 and 2010 Projects (replies to questionnaires)[8]	2017 EC and ESFRI - key factors for LTS[11,12]
Be a national or world scientific leading RI and/or an enabling facility to support science (100%)	Be a national or world scientific leading RI and an enabling facility to support science	Scientific excellence User strategy and access policy	Excellence Usage	Scientific performance User Access	Ensuring scientific excellence
Be an enabling facility to support innovation, knowledge transfer (70%)	Be an enabling facility to support innovation	Socio-economic impact	Knowledge transfer		Unlocking the innovation potential of RIs
Become integrated in a regional cluster/in regional strategies/be a hub to facilitate collaborations (70%)	Become integrated in a regional cluster/in regional strategies/be a hub to facilitate collaborations	Pan European relevance Stakeholder commitment (national / regional involvement)	'Background information' contains elements of European role, character Networking Membership	Pan-European relevance	Support transnational access to RIs; European synchronization of national roadmaps
Promote education (50%), and outreach (70%)	Promote education, outreach and knowledge transfer	User strategy and access policy (training, expansion/development of user community)	Networking (e.g. interdisciplinary links) Knowledge transfer	Public outreach	Attracting and training the managers, operators and users of tomorrow Socio-economic impact
Provide scientific support to public policies and standards (60%)	Provide scientific support to public policies	Socio-economic impact			

2018 CERIC Survey of Statutes of ERICs and ESFRI Roadmap RIs (estimated % take-up)[9]	2019 OECD Strategic objectives[2]	2016 ESFRI Landmarks Pilot Review[8]	2013 - ESFRI WG 2013 Indicators (ex-post)[1]	Monitoring of 2008 and 2010 Projects (replies to questionnaires)[8]	2017 EC and ESFRI - key factors for LTS[11,12]
Data policy, production and use (60%)	Data policy, production and use	e-needs		Data	Exploiting better the data generated by the RIs
International co-operation (45%)					Structuring the international outreach of RIs.
Governance, management, optimum use of resources (40%)		Governance & management, preparatory work, planning, finances, risks Human resources policy		Organisation quality/safety Human resources	Effective governance and sustainable long-term funding
Others	Assume social responsibility towards society				

Annex 4. Examples of qualitative indicators per objective

Objective	Rational (what to measure)	Proposed Indicators*	Type
Enabling scientific excellence	Attractiveness of RI	5-year trend in number of proposals /user requests/registered users	Narrative
	Added value to science	Impact studies	Narrative
Enhancing collaboration in Europe (Sub-objective) Integration of distributed facilities	Policies related to integration of distributed RIs	A single access point to RI's data, services and/or facilities, as a prevailing more of access	Y/N
	Policies related to integration of distributed RIs	A single access point to resources of multiple partners of a distributed RI by industry	Y/N
	Policies related to integration of distributed RIs	Centralised evaluation and selection, based on excellence	Y/N
	Policies related to integration of distributed RIs	A common strategy and policy for intellectual property and know-how protection and exploitation adopted	Y/N
	Policies related to integration of distributed RIs	A central communication strategy adopted by the GA A joint research infrastructure roadmap	Y/N
	Policies related to integration of distributed RIs	A research infrastructure roadmap of the RI	Y/N
Facilitating economic activities	Partnerships with industry	Existence of an Industry Engagement Plan and Dedicated Resources	Y/N Narrative
	Technology transfer	Existence of a TT-Office and dedicated resources to support its activities	Y/N Narrative
Outreach to the public	Extent of outreach and engagement achieved by direct contact (events, visitors, guided tours)	Events organised satisfaction - % satisfaction rates of attendees	Narrative
		Visitor satisfaction – average % satisfaction rates of visitors	Narrative
Optimising data use	Basic requirement for any project, RI or even RPO	Existence of a Data Management Plan	Y/N
	Check of the adherence to open data guidelines	Compliance to FAIR: Measure of interoperability, by number of cross-collaborations between communities or projects, benefiting of the RI data uses	Y/N Narrative
	Check whether the data warehouses are in-house or on external clouds Decision includes guarantee for sustainability and	Maintenance and sustainability of data : public or commercial storage vs in-house storage *to be related possibliy to EOSC connectivity and usage	Narrative

Objective	Rational (what to measure)	Proposed Indicators*	Type
	Adhesion to EOSC project (and overall EU strategy for scientific data). Involvement in EOSC development	EOSC connectivity (in place or planned). Participation (Y/N) to one of the EOSC integrating projects	Y/N Narrative
	Check of the entry point to the data	Centralised entry gateway to RI data	Y/N
	Qualify the way data can be accessed and made or considered as interoperable. Potential relationship with the RDA	Existence of on-line metadata description and indexing of data	Y/N
	Potential limit to export and sharing Do the RI have an ethical chart or policy in place for its data	Ethical measures (Y/N)	Y/N
Provision of scientific advice	Standardisation / regulatory impact	Impact cases illustrating contribution of RI to standardisation or regulatory development	Narrative
Facilitating international co-operation	Internationalisation strategy	Y/ N Narrative	Y/N Narrative
Optimising management	High standard of 'social responsibility'	Corporate Social Responsibility system, Diversity policy; gender balance, corporate ethics charter	Narrative
		Compliance with EU charter of access	Y/N
	Effective safety and risk management	Risk management plan and procedures adopted and updated periodically	Y/N Narrative
		Environmental management system adopted (e.g. ISO14001, EMAS)	Y/N Narrative
	Sound financial management and accountability	Budget and milestones in plan/deviations	Y/N Narrative

Annex 5. Data Sheets for KPIs

Draft – 1 September 2019

Data sheets for each of the proposed 21 KPIs are organised in relation to the 9 objectives, A-I. While the proposed objectives are relevant for most RIs, many of the proposed KPIs cannot currently be used by all of them. Some adaptation may be needed in order for a certain KPI to be applicable for a RI. RIs should also provide a short narrative for each KPI, putting it in its specific context.

A. ENABLING SCIENTIFIC EXCELLENCE

1. Number of user requests for access

Objective	Enabling Scientific Excellence
Indicator	Number of user requests for access
Definition(s)	For access to facilities: number of user proposals for access For resource RIs: number of users of resources, such as collections, data, services
Rationale	Indicator of the attractiveness of the RI.
Assumptions	The size of the community depends on a number of factors. Young, relatively unknown RIs will start with a small community which will increase with their visibility, quality and extent of offer. In the case of the requests for access to the research facilities, the success rate may affect the number of applications. Once it reaches a very low level, the number of applications is likely to level off. In some RIs, metrics on usage requests is maintained at the level of individual resources, as researchers don't make central requests for access. In the case of resource RIs, the number of users is also affected by the terms of access: Some RIs require no registration, while others demand registration processes of varying complexity. Also, in the case of monitoring of access though IP address it needs to be considered that in some cases, hundreds of users may use the resources though one IP address.
Data/information needs and resources	A tracking/recording system should be set up by the RI.
Who is providing this information	Provided by the RI.

Detailed methodology for indicator calculation	Record and report the number of applications for access/registered users. For RIs which do not require registration, number of unique users/visits/logins is reported.
	For RIs providing more than one type of service (e.g. data, services, access to the facility, platform and event-based access), values for each category are reported.
	Subgroups may be reported, as per
	   - Share of users per ESFRI country (KPI 8);
	   - International users (KPI 18);
	   - Academic users;
	   - Non-proprietary Industrial users (KPI 9).

Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used.
Estimated cost of data collection (including access to external databases)	Generally low. May be high for RIs offering fully open and free access to resources.
Level of reporting burden	Generally low. May be high for RIs offering fully open and free access to resources.
Additional issues or Observations	International: non-ESFRI member countries. Some RIs may not distinguish between KPI 1 and 2 and will report either of the two. In such a case, the assumptions described here may apply to KPI 2. Technical solutions may improve the quality and ease of reporting.

2. Number of users served

Objective	Enabling Scientific Excellence
Indicator	Number of users served
Definition(s)	For access to facilities: number of granted proposals/accepted users For resource RIs: number of downloads/studies or provisions of service.
Rationale	Indicator to measure the size of the community served.
Assumptions	This depends on many factors. Young, relatively unknown institutions will start with a small community which will increase with their visibility, quality and extent of offer. However, once established it is likely that the RI will become oversubscribed and in the case of physical facilities, the number of users served will then depends on the experimental time available. This indicator can also provide a measure of the efficiency of operations, provided that the quality of service is not diminished (for example, if the time allocated per user is reduced too far without any compensating improvement in performance per unit time, the output may be affected negatively).
Data/information needs and resources	A tracking/recording system should be set up by the RI
Who is providing this information	Provided by the RI

Detailed methodology for indicator calculation	The number of granted proposals/ accepted users/ number of downloads/ number of studies or services provided is recorded and reported.
	For RIs providing more than one type of service (e.g. data, services, access to the facility, platform and event-based access, key science and PI projects), values for each category are reported.
	For some data RIs it might not be suitable to report both, Number of user requests for access and Number of users served.
	Subgroups may be reported, as per
	   - Share of users per ESFRI country (KPI 8);
	   - International users (KPI 17);
	   - Academic users;
	   - Non-proprietary Industrial users (KPI 9).

Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used
Estimated cost of data collection (including access to external databases)	Low for most RIs
Level of reporting burden	Low for most RIs
Additional issues or Observations	International: non-ESFRI member countries. Some of the RIs may not distinguish between KPI 1 and 2 and will report either of the two. In such a case, the assumptions described in KPI 1 may apply. Technical solutions may improve the quality and ease of reporting.

3. Number of publications

Objective	Enabling Scientific Excellence
Indicator	Number of publications
Definition(s)	Number of publications based on the research performed using facilities/resources of the RI. The publication is shared by the countries of the home institutions of all authors, the sum of the shares being one.
Rationale	Related primarily to the *quantity* of science enabled and in a secondary fashion to the *quality* of the science enabled.
Assumptions	The number of publications based on research performed using facilities/resources of the RI provides a measure of the extent of those services, the size of the user community and the combined performance of the two in transforming the experimental results or data into publishable material.
Data/information needs and resources	Much of the published output will be captured using commercial databases such as WoS and Scopus which contain mainly articles published in peer-reviewed journals. However, the scope of the survey has to be wider in some scientific fields and may require the RI to gather the information directly from the users, including proceedings papers, book chapters, books and technical reports, or use of e-tools such as web crawlers in order to identify the publications. It should be noted that not all publications based on work conducted using RIs cite the RI and not all users are forthcoming in providing such data. Subgroups may be reported, as per - Share of publications per each of the ESFRI countries (KPI 8). - Share of publications per each of the non-ESFRI countries (KPI 17)
Who is providing this information	Provided by the RI.
Detailed methodology for indicator calculation	1. Collect the publications based on the research performed using facilities/resources of the RI resorting to the variety of means outlined above. 2. Count.
Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used.
Estimated cost of data collection (including access to external databases)	Subscription to database. Manual cleaning of database.
Level of reporting burden	Low to high
Additional issues or Observations	The relevance of different types of publications varies significantly from discipline to discipline. RIs can report here a wide variety of publication types (in addition to journal articles). Some data based RIs and e-infrastructures might currently not be able to report values on this indicator. Technical solutions may enable/improve the quality and ease of reporting.

4. Percentage of top cited publications

Objective	Enabling Scientific Excellence
Indicator	Percentage of top (10%) cited publications
Definition(s)	Percentage of publications based on research performed using facilities/resources of the RI that, compared with the publications in the same field and in the same year, belong to the top 10% most frequently cited.
Rationale	Indicator of the quality/impact of science enabled.
Assumptions	High quality articles usually have an impact on scientific community, as exhibited through citations. Exceptionally, an article may get citations for other reasons, such as the exposure of fake data. The indicator is not suitable for very young RIs. A period of 4 to 5 years after publication is needed to have enough citation data.
Data/information needs and resources	Access to commercial citation databases WoS or Scopus
Who is providing this information	Service provider
Detailed methodology for indicator calculation	1. Define the publication dates and determine the number of papers published and included in WoS or Scopus. 2. Define the citation window and retrieve the number of citations. 3. Determine the WoS or Scopus subject category. 4. Retrieve the normalization factors. 6. Calculate the field/year/type of publication normalized citation score. 7. Calculate (or retrieve) the top 10% boundaries. 8. Calculate the percentage of publications in the top10%
Unit of measure	Percentage.
Frequency of measurement	Biannually, with rolling publication dates. E.g. In 2020, the publications 2015-2018 In 2022, the publications 2017-2019
Assessment of indicator quality and comparability	Commonly used. Accepted indicator for quality / impact.
Estimated cost of data collection (including access to external databases)	Medium
Level of reporting burden	Low
Additional issues or Observations	The Top10% indicator is calculated on a paper basis: each paper is assigned to scientific field(s) and the number of citations it received is compared to the number of citations received by articles in the same field(s) and in the same year. If the indicator is used by, e.g. ESFRI, to obtain data for all RIs, the database (WoS or Scopus) should be chosen, as well as the service provider for its calculation, in order to obtain coherent results. Results will depend on the database used. This indicator is suitable only for scientific fields where the most common publication channel is the journal article. Some data based RIs and e-infrastructures might currently not be able to report values on this indicator, since they cannot reliably collect the data for KPI 3. Technical solutions may enable/improve the quality and ease of reporting.

B. DELIVERY OF EDUCATION AND TRAINING

5. Number of master and PhD students using the RI

Objective	DELIVERY OF EDUCATION AND TRAINING
Indicator	Number of master and PhD students using the RI
Definition(s)	Number of master and PhD students who have performed some of their studies at or using the services of the RI in a particular year regardless of whether they are funded/hosted by the RI or access it as a user.
Rationale	Indicator of the extent of the education and training of the external academic community, comprising both experienced and potential users
Assumptions	Each student is given the same weight regardless of importance of RI with regard to training opportunities
Data/information needs and resources	RI database created by logging those accessing the RI as a facility or its data and checking whether they are PhD or master students. A suitable logging system should be able to check whether a single person is given access multiple times.
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	Identify the users accessing the RI as a facility or its data who declare themselves to be PhD or master students and correct for multiple accesses in any one year to determine the unique number of people in this category in any one year.
Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	
Estimated cost of data collection (including access to external databases)	Low for most RIs
Level of reporting burden	Low
Additional issues or Observations	Some data RIs might currently not be able to report values on this indicator. Data collection methodology might need to be refined. Not all RIs share this objective.

6. Training of people who are not RI staff

Objective	DELIVERY OF EDUCATION AND TRAINING
Indicator	Training of people who are not RI staff
Definition(s)	The total number of person hours for which people external to the RI have made use of training opportunities provided by the RI, through both real (e.g. face to face) events and on-line services
Rationale	Education and training of the external academic community, comprising both experienced and potential users
Assumptions	Assumes that there is a 'simple' correspondence between the hours provided in face-to-face or on-line training and the extent of that training (i.e. all hours regarded as equally valuable or effective) and that this can be captured effectively
Data/information needs and resources	RI database
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	For face-to-face sessions it is any time spent in such sessions apart from registration and breaks; for on-line sessions the time logged in. A subgroup may be reported, as per - International trainees (KPI 18)
Unit of measure	Person hours
Frequency of measurement	Annually
Assessment of indicator quality and comparability	
Estimated cost of data collection (including access to external databases)	Depending on what has already been put in place, this may require setting up a system/software to collect the data and the time and effort taken to enter the data
Level of reporting burden	Low to medium once suitable system/software in place
Additional issues or Observations	Not all RIs share this objective. Some data RIs might currently not be able to report values on this indicator.

C. ENHANCING TRANSNATIONAL COLLABORATION IN EUROPE

7. Number of Members of the RI from ESFRI countries

Objective	ENHANCING TRANSNATIONAL COLLABORATION IN EUROPE
Indicator	Number of Members of the RI from ESFRI countries
Definition(s)	Number of organisations/countries with a formal engagement (e.g. members, associated members or observers, bound by legal agreement or MoU), who are based in an ESFRI member country.
Rationale	Indicator provides a measure of the extent to which the RI may play a role to: help coordinate and facilitate integration at European level; to promote common standards, tools and practice; to expand the catalogue of activities available at RIs to new beneficiaries/members or partner countries.
Assumptions	Assumes that a broad involvement of organizations/countries demonstrate Europe-wide relevance.
Data/information needs and resources	Collected by the RI
Who is providing this information	Provided by the RI

Detailed methodology for indicator calculation	Count number of Members according to each type of formal engagement, including the country hosting the RI.
	The nature of the engagement should be classified by type (if relevant):
	   - Members
	   - Associated members
	   - Observers
	   - Number of participating countries
	Subgroups may be reported, as per
	   - Number of international (non-ESFRI) members (KPI 19)

Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used
Estimated cost of data collection (including access to external databases)	Low for most RIs
Level of reporting burden	Low
Additional issues or Observations	RIs have to define rules for engagement. For several RIs, this indicator will level-off. Not all RIs share this objective.

8. Share of users and publications per ESFRI member country

Objective	ENHANCING TRANSNATIONAL COLLABORATION IN EUROPE
Indicator	Share of users and publications per ESFRI member country
Definition(s)	As defined in KPI 2, KPI 3
Rationale	The indicator provides a measure of the extent to which the RI may play a role to: facilitate and optimise the use of pan-European facilities and to develop a Pan-European user community; increase the number of new users (experiments/projects).
Assumptions	As defined in KPI 2, KPI 3
Data/information needs and resources	As defined in KPI 2, KPI 3
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	As defined in KPI 2, KPI 3 In both cases the country of the host institution of the user/author is considered. If the author gives more than one affiliation then this is shared out among the host countries (e.g. 2 affiliations is treated as 0.5 for each).
Unit of measure	Number and %
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used.
Estimated cost of data collection	As defined in KPI 2, KPI 3
Level of reporting burden	Low-high
Additional issues or Observations	As defined in KPI 2, KPI 3 Some RIs may not distinguish between KPI 1 and 2 and may use either of the two. Not all RIs share this objective.

D. FACILITATING ECONOMIC ACTIVITIES

9. Share of users associated with industry and publications with industry

Objective	FACILITATING ECONOMIC ACTIVITIES
Indicator	Share of users associated with industry and publications with industry
Definition(s)	As defined in KPI 2, KPI 3
Rationale	Indicator of the extent to which scientists from industry, the RI and possibly also one or more universities collaborate and exchange knowledge.
Assumptions	As defined in KPI 2, KPI 3
Data/information needs and resources	As defined in KPI 2, KPI 3
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	As defined in KPI 2, KPI 3
Unit of measure	% and number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used
Estimated cost of data collection	As defined in KPI 2, KPI 3
Level of reporting burden	Low-high
Additional issues or Observations	As defined in KPI 2, KPI 3 Some RIs may not distinguish between KPI 1 and 2 and may use either of the two. Several RIs might not be able to report on the share of non-proprietary industrial users. Not all RIs share this objective.

10. Income from commercial activities

Objective	FACILITATING ECONOMIC ACTIVITIES
Indicator	Income from commercial activities and the number of entities paying for service
Definition(s)	Share of revenue from the RI's economic activities (sale of services and goods, access provision) reported in the in the annual accounts
Rationale	Indicator for the level of commercial activity in relation to the overall level of operation of the RI
Assumptions	
Data/information needs and resources	The accounting data
Who is providing this information	The accounting department of the RI
Detailed methodology for indicator calculation	Sum of the revenues from RI economic activities (sale of services and goods; access provision from users, which are not funded by a public funder), and the number of entities
Unit of measure	Unit of the currency; the number of entities
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Regarding the quality, measuring the revenues is a good tool to indicate the actual technology transfer that has successfully taken place. Regarding comparability, this indicator is not equally relevant for all types of RIs.
Estimated cost of data collection (including access to external databases)	Generally low. It is medium for entities, where operation of the RI is only a part of the activities and thus assigning revenues to the RI is not always straightforward.
Level of reporting burden	Low.
Additional issues or Observations	Not all RIs share this objective. Some RIs might not be able to undertake commercial activities.

E. OUTREACH TO THE PUBLIC

11. Extent of outreach and engagement achieved by direct contact

Objective	OUTREACH TO THE PUBLIC
Indicator	Engagement achieved by direct contact (events, visitors, guided tours)
Definition(s)	Outreach by public relations/direct contact with specific target groups: organisation of (e.g. summer schools, events for industry, government sector etc.) or participation at events organised by third parties; and visitors to the RI
Rationale	Provides a measure of the impact of the RI in terms of raising public awareness and understanding of research in the fields in which the RI operates
Assumptions	The RI has in place a tracking system for visitors, attendees at events organised by the RI and participation of staff at external events, etc.
Data/information needs and resources	The data is gathered internally by event managers and visitor services. The basic requirement requires gathering (respecting GDPR rules) data on type of visitor/participant, age, sex, origin, etc. as well as standard visitor/participant satisfaction statistics. Subgroups may be reported, as per - School children - General public - Policy makers
Who is providing this information	The information should be gathered by the media/public relations and communications staff of the RI.
Detailed methodology for indicator calculation	The indicators tracked include - number of visitors, - participants of the events and - events organised, number and hours (reported to a minimum 0.25 days)
Unit of measure	Number of visitors/participants, number and hours of events
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used.
Estimated cost of data collection (including access to external databases)	Low
Level of reporting burden	Low
Additional issues or Observations	The indicator applies to physical (notably single-sited) RI and less so to data infrastructures. This objective might not be relevant to all RIs.

12. Outreach through printed, broadcast and web-based media

Objective	OUTREACH TO THE PUBLIC
Indicator	Outreach through printed, broadcast and web-based media
Definition(s)	Impact of press and communication actions in raising awareness of RI mission, activities and societal relevance of results
Rationale	Measurement of result of the RI activity in terms of awareness and understanding within the general public and policy circles.
Assumptions	It is assumed that the RI has in place a public relations/media strategy and at least one member of staff working in this field to ensure reporting and monitoring occurs.
Data/information needs and resources	The information required concerns compiling a record of mentions of the RI in different media (press, TV, radio, etc.) – this may include interviews of RI management or researchers, articles/reporting based on press releases, etc.
Who is providing this information	The information should be gathered by the media/public relations and communications staff of the RI.
Detailed methodology for indicator calculation	Number of times the RI is mentioned in press articles, radio or TV broadcasts or web-based media not-related to RI. Multiple mentions within one media report is counted as one.
Unit of measure	Printed (digital) media tracking enables to measure the number of articles mentioning the RI or research results generated at the RI, etc.
Frequency of measurement	The date is generally reported on annual basis
Assessment of indicator quality and comparability	Commonly used. The indicator can be used by all types of RIs.
Estimated cost of data collection (including access to external databases)	Media tracking can be done internally at the RI or can be outsourced to various commercial providers. Cost will vary depending on the method used.
Level of reporting burden	Low
Additional issues or Observations	Negative reporting in the media may significantly contribute to the value of this KPI. This objective might not be relevant to all RIs.

13. Outreach via the RI's own web and social media activities

Objective	OUTREACH TO THE PUBLIC
Indicator	Outreach via the RI's own web and social media activities
Definition(s)	Website popularity and level of social media engagement: Web (e.g. Google analytics) analytics and social media analytic tools (Twitter, Linkedin, Youtube, Flickr, Facebook, etc.)
Rationale	RI presence and engagement via web and social media activities
Assumptions	It is assumed that the RI has in place a social media strategy and at least one member of staff is assigned responsibility for managing social media and analysing impact.
Data/information needs and resources	Three indicators are reported: - Engagement rate in social media - Tracking downloads via website - Monitoring interactions with newsletters via tools like MailChimp (click rates, etc.)
Who is providing this information	The information should be gathered by the media/public relations and communications staff of the RI.
Detailed methodology for indicator calculation	Ideally, data on followers, etc. of social media accounts should be downloaded periodically and analysed to identify posts which have generated 'peaks' in interactions, etc. The analytical methods are not particularly sophisticated and require only basic statistical know-how. Training in social media analytics may be useful. Data is reported as per social media (Twitter, Linkedin, Youtube, Flickr, Facebook, etc.)
Unit of measure	For web sites standard indicators include: Users, New Users, Page views, Unique page views, Avg. session duration, etc. For social media, standard indicators include profile visits, total number and number of new followers (per period), mentions and interactions, etc. Annual although analytic tools (Google Analytics, Twitter analytics), enable more frequent tracking if required. The indicator can be used by all types of RIs.
Frequency of measurement	Annual although analytic tools (Google Analytics, Twitter analytics,), enable more frequent tracking if required
Assessment of indicator quality and comparability	Commonly used
Estimated cost of data collection (including access to external databases)	The cost is relatively low as it mainly involves staff time in collating and analysing data from social media accounts.
Level of reporting burden	Low
Additional issues or Observations	This objective might not be relevant to all RIs.

F. OPTMISING DATA USE

14. Number of publicly available data sets used externally

Objective	OPTMISING DATA USE
Indicator	Number of publicly available data sets used externally
Definition(s)	Number of data sets produced as a consequence of access to the RI that are subsequently accessed by other users
Rationale	Indicator of the extent to which the data that the RI produces/makes available is regarded as useful by people who could be in the same scientific domain, in other scientific domains or even by the general public. It thus provides some indicator of the wider significance of the data.
Assumptions	The 'rationale' for this indicator assumes that external access to the data provides some added value and this can only be checked by tracking its subsequent use.
Data/information needs and resources	Monitoring system for access to RI's database(s), linking specific datasets to specific requests for access
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	1. Identify 2. Count
Unit of measure	Number of data users (individuals or/ institutions).
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Indicator is not commonly used and may need refinement after a period of test usage.
Estimated cost of data collection (including access to external databases)	Cost of setting up systems to provide monitored access to RI database, including administrative overhead (e.g. sorting out legal issues).
Level of reporting burden	Low. Medium in the case of multiple databases.
Additional issues or Observations	The amount of data in a data set may vary considerably, even within the same RI. Additional details, asked for at login, may lower user friendliness and result in fewer users.

G. PROVISION OF SCIENTIFIC ADVICE

15. Participation by RIs in policy related activities

Objective	PROVISION OF SCIENTIFIC ADVICE
Indicator	Participation by RIs in policy related activities
Definition(s)	Number of participations, reimbursed by the organisers, in policy related working groups, committees & advisory boards. In the case of working groups, etc, organised by intergovernmental organisations, the invitation suffices.
Rationale	Indicator of the extent to which the RI is deemed as relevant by policy makers. Both for science policy and for addressing societal challenges.
Assumptions	RIs may enable scientific developments within a particular challenge and may contribute to developments of policies such as those contributing to development of ERA, ESFRI, etc. Invitations of the staff linked to the RI, with the affiliation of the RI acknowledged, to participate in working groups, committees and advisory boards (contributing to the SDG or other societal challenges as well as to the European Research Area or dedicated to industry), reflect the policy relevance of a certain RI. Working groups, committees and advisory boards should be external to the RI and should have an international composition, or advise an international or national body (e.g. UN entities, ministries, agencies). In the case of multiple meetings linked to one e.g. advisory group, every attendance counts as a participation.
Data/information needs and resources	The information is collected by the RI.
Who is providing this information	Provided by the RI.
Detailed methodology for indicator calculation	1. Collate information on participation to and contributions by RI staff to policy events, relevant working groups, etc. 2. Presentations, working papers, reports etc. to which the RI has contributed can be collated and shared via dedicated space on the RI website or via ResearchGate, etc. 3. Analyse contributions broken down by level (Global, European, national, etc.) or by theme.
Unit of measure	Number of invitations/contributions (working notes, joint reports, etc.) per annum.
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Indicator is not commonly used and may need refinement after a period of test usage.
Estimated cost of data collection (including access to external databases)	Low
Level of reporting burden	Low
Additional issues or Observations (for instance, what is "international", etc..)	Not all RIs share this objective.

16. Citations in policy related publications

Objective	PROVISION OF SCIENTIFIC ADVICE
Indicator	Citations in policy related publications
Definition(s)	Number of times the RI or its projects are cited in policy related publications
Rationale	Indicator of the extent to which the RI and the research that results from it is involved in influencing policy.
Assumptions	Particularly RIs operating in a domain of a societal challenge of Sustainable Development Goals may contribute to the policy development of the domain.
Data/information needs and resources	The information is collected by the RI, it requires assigning responsibility for tracking citations to a dedicated member of staff, this could be the strategy director or similar function.
Who is providing this information	Collected by the RI based on monitoring European and national policy developments in their field of science, etc
Detailed methodology for indicator calculation	1. Collect the citations – this can be done using (social) media monitoring (see the related KPI on outreach) or by a dedicated monitoring of key government departments/agencies with which the RI works or interacts. Policy publications are publications dedicated to policy makers (governments, agencies, etc). Scientific publications and publications for the general public do not count in this category. 2. Several citations related to the same achievement in one document count as one citation. 3. Aggregate and present visualisations of the data (trend over time, etc).
Unit of measure	Number of citations
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Indicator is not commonly used and may need refinement after a period of test usage.
Estimated cost of data collection (including access to external databases)	Low
Level of reporting burden	Low
Additional issues or Observations	A uniform approach to data collection would be advisable. Not all RIs share this objective.

H. FACILITATING INTERNATIONAL COOPERATION

17. Share of users and publications per non-ESFRI member country

Objective	FACILITATING INTERNATIONAL COOPERATION
Indicator	Share of users and publications per non-ESFRI member country
Definition(s)	As defined in KPI 2, KPI 3
Rationale	Indicator of the relevance/attractiveness of the RI internationally.
Assumptions	As defined in KPI 2, KPI 3
Data/information needs and resources	As defined in KPI 2, KPI 3
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	As defined in KPI 2, KPI 3
Unit of measure	Number and %
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used.
Estimated cost of data collection	As defined in KPI 2, KPI 3
Level of reporting burden	Low-high
Additional issues or Observations	As defined in KPI 2, KPI 3 In both cases country of the host institution of the user/author is considered. If the author gives more than one affiliation then this is shared out among the host countries (e.g. 2 affiliations is treated as 0.5 for each) Some RIs may not distinguish between KPI 1 and 2. They are referred to KPI 1 Reference sheet for the definitions and methodology. Not all RIs share this objective.

18. International trainees

Objective	FACILITATING INTERNATIONAL COOPERATION
Indicator	International trainees
Definition(s)	As defined in KPI 6
Rationale	Indicator of the relevance/attractiveness of the RI internationally
Assumptions	As defined in KPI 6 The global relevance of the RI can be assessed by the interest that it raises among international users. It is a demonstration of the central role of European RIs to address complex scientific problems and their contribution to solve societal challenges. The RI role in developing scientific communities in parts of the world where they are underdeveloped may also contribute to (scientific) integration within and between the countries involved.
Data/information needs and resources	As defined in KPI 6
Who is providing this information	As defined in KPI 6
Detailed methodology for indicator calculation	As defined in KPI 6
Unit of measure	Person-hours
Frequency of measurement	Annually
Assessment of indicator quality and comparability	
Estimated cost of data collection (including access to external databases)	This may require setting up a system to collect the data
Level of reporting burden	Low
Additional issues or Observations	International countries are non-ESFRI member countries. Not all RIs share this objective.

19. Number of members of the RI from non-ESFRI countries

Objective	FACILITATING INTERNATIONAL COOPERATION
Indicator	Number of members of the RI from non-ESFRI countries
Definition(s)	As defined in KPI 7
Rationale	Indicator provides a measure of the extent to which the RI may play a role in international environment to: help coordinate and facilitate integration of activities; to promote common standards, tools and practice; to expand the catalogue of activities available at RIs to new beneficiaries/members or partner countries.
Assumptions	
Data/information needs and resources	As defined in KPI 7
Who is providing this information	As defined in KPI 7
Detailed methodology for indicator calculation	As defined in KPI 7
Unit of measure	Number
Frequency of measurement	Annually
Assessment of indicator quality and comparability	As defined in KPI 7
Estimated cost of data collection (including access to external databases)	Low
Level of reporting burden	Low
Additional issues or Observations	RIs have to define rules for engagement. Not all RIs share this objective.

I. OPTIMISING MANAGEMENT

20. Extent of resources made available to users

Objective	OPTIMISING MANAGEMENT
Indicator	Extent of resources made available to users
Definition(s)	Experimental time available or size of resources database made available to users to facilitate research.
Rationale	Indicator related to the primary service provided by a RI to users, noting that other services may also be important e.g. extent to which RI staff provide support in analysing results.
Assumptions	
Data/information needs and resources	Collected by the RI
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	The total available time allocated to users or number of data entries/ data sets/ items/ respondents/ services. For RIs collecting data from various sites, each site can be considered a data set. Facilities report allocated time for experiments, including internal research. For RIs offering more than one type of resources (e.g. data & services) values for each category are reported.
Unit of measure	Hours (facility RI) or number of data entries/ data sets/ items/ services (resource RI).
Frequency of measurement	Annually
Assessment of indicator quality and comparability	Commonly used
Estimated cost of data collection (including access to external databases)	None
Level of reporting burden	Low
Additional issues or Observations	In the case of some RIs the rate of the increase of the database might not change over time. Also, the rate will level-off in the case of some facilities. Some RIs might not be able to measure the available capacity accurately enough for a KPI. Not all RIs might share this objective.

21. Revenues

Objective	OPTIMISING MANAGEMENT
Indicator	Revenues
Definition(s)	Sources of revenue and their respective contributions to investments and operational costs
Rationale	Indicator demonstrating the funding available for various activities, Changes over the years indicate the development of an institution with regard to construction, upgrades and decommissioning – depending on the point in the lifecycle of the RI - and the level of operations, which in turn provides an indication of the sustainability of the RI
Assumptions	There is reliable information on the revenues (of investments, operations costs), as well as on funding needs
Data/information needs and resources	List of sources of revenue and their contributions to (a) investment and (b) operational costs
Who is providing this information	Provided by the RI
Detailed methodology for indicator calculation	The indicator is calculated by adding the following revenue categories - Financial and in-kind contributions received from the members of the institution - Financial and in-kind contributions received by third parties - Financial and in-kind contributions related to project externally funded - Commercial revenues - Other revenues All these items are accounted according to the accounting standards adopted by the institution (accrual criteria vs financial criteria)
Unit of measure	Amount in national currency; nature of the revenue
Frequency of measurement	Annually.
Assessment of indicator quality and comparability	Commonly used. This is an essential indicator of high quality and visibility.
Estimated cost of data collection (including access to external databases)	None beyond the standard operating costs of a correctly run RI
Level of reporting burden	Low.
Additional issues or Observations	A true assessment seems to require information on target and actual values, as well as reflections on alternative solutions (if there are funding deficits). Some distributed RIs do not have the contributions of their nodes or representing entities audited. Such contributions are not included in the annual accounts of the RI, resulting in a low value of the indicator.

Glossary

AC	Associated Countries
CERIC	Central European Research Infrastructure Consortium
DMP	Data Management Plan
EC	European Commission
EMAS	Eco-Management and Audit Scheme
EOSC	European Open Science Cloud
ERA	European Research Area
ESIF	European Structural and Investment Funds
e-IRG	e-Infrastructure Reflection Group
ERA	European Research Area
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
FAIR	Findable, Accessible, Interoperable, and Re-usable
KPI	Key Performance Indicator
LTS	Long-Term Sustainability
MS	Member State
MoU	Memorandum of Understanding
OECD	Organization for Economic Cooperation and Development
RACER	Relevant, Acceptable, Creditable, Easy to monitor, Robust
RDA	Research Data Alliance
RI	Research Infrastructure
RI-PATHS	Research Infrastructure Impact Assessment Pathways (Project in Horizon 2020)
RIS3	National/Regional Research and Innovation Strategies for Smart Specialisation
SDG	Social Development Goal
SWG	Strategic Working Group
ToR	Terms of Reference
UN	United Nations
WoS	Web of Science (Commercial citation database)
WG	Working Group

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