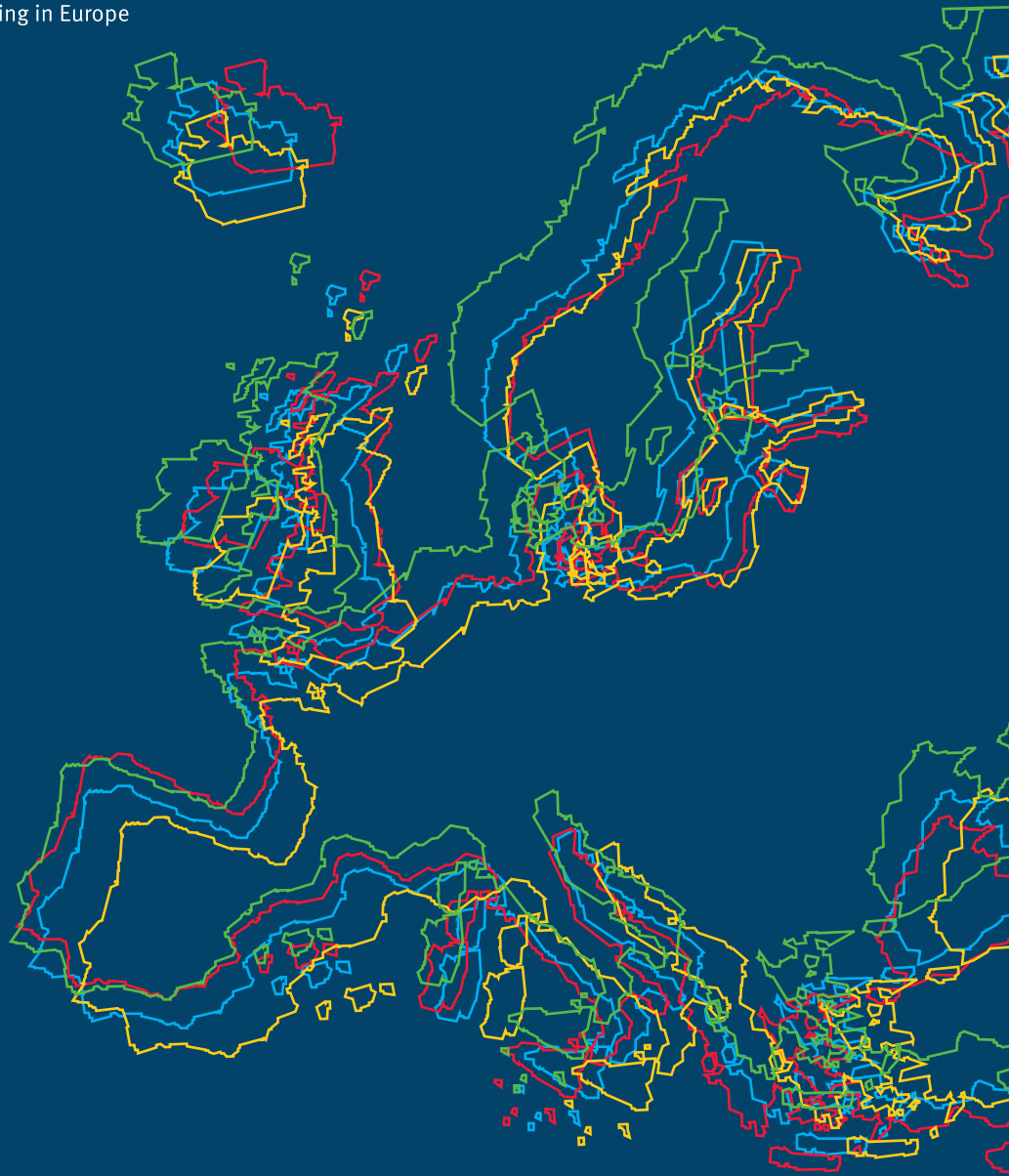




InRoad synchronising research infrastructure
roadmapping in Europe



INROAD FINAL REPORT

MAIN FINDINGS AND RECOMMENDATIONS



InRoad has been funded by the
European Union's Horizon 2020
Research and Innovation programme
under grant agreement No 730928.

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Bern, 05. December 2018

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FOREWORD

Europe benefits from a very rich and diverse Research Infrastructure (RI) landscape. This landscape is spread over the 28 Member States of the European Union and a series of countries associated to the European framework programmes for research and innovation. Investigating this landscape, from the regional to the European level, is a fascinating endeavour. The diversity of existing practices for deciding which RIs to fund, how to fund them and how to run them can of course threaten the efficiency and the sustainability of the landscape. After spending two years in the context of InRoad looking into the details of these practices, I was surprised how dynamic this environment is, with a constant evolution of practices and models, but also how little was known or shared about national processes.

Naturally, InRoad has not limited itself to looking and describing national RI funding and decision-making processes. The project has also put forward a series of recommendations and good practices to be debated in view of enhancing coordination within the RI landscape in Europe. It is now up to the broad and diverse community addressed in the following report to take those practices forward and implement them in the respective contexts.

The initial idea beyond the InRoad project came from a series of activities undertaken by the Science Europe working group on RIs between 2014 and 2016, summarised in the report [‘Strategic Priorities, Funding and Pan-European Co-operation for Research Infrastructures in Europe’](#). Since then, the political landscape has advanced significantly, due to the work done on the long-term sustainability of RI by the European Commission, the European Strategy Forum for Research Infrastructures (ESFRI), the OECD and others. All these debates have been (and still are) taking place while InRoad was conducting surveys, interviews and expert workshops on the matter. InRoad always has taken an open and proactive stance with respect to these developments and has offered a platform of exchange and shared its draft insights to stimulate the debates.

I sincerely hope that the recommendations and good practices listed in this document will further nurture the debate around RI long-term sustainability and contribute to a more efficient and integrated European Research Area.

Martin Müller, InRoad Coordinator



ACKNOWLEDGMENTS

The consortium of InRoad would like to acknowledge the work of the many contributors to this report, and thank everyone who provided information, advice and support in view of its development. First, we would like to thank the European Commission for not only funding the project, but also thoroughly supporting its activities. We would also like to thank the members of InRoad's Advisory Board for sharing their invaluable experience, playing an active role during InRoad events and providing pertinent feedback on the project's outputs. We would also like to thank all Reflection Group members who attended InRoad workshops and supported the project throughout its different phases. Last but not least, we would like to warmly thank everyone who offered their time to participate in the various stages of data collection, from the InRoad consultation to the case studies and interviews. Their involvement made it possible for InRoad to achieve its objectives, and to present this Final Report.



POLICY INSIGHTS AND RECOMMENDATIONS

HIGHER DEGREE OF COORDINATION BETWEEN NATIONAL AND EUROPEAN RI ROADMAPPING PROCESSES

- 1** InRoad recommends that national RI roadmapping processes contain at least the following minimal key elements as a prerequisite for a higher degree of coordination for RI policies at national and EU level:
 - Regular updates of inventories of existing RIs and an identification of needs and gaps (i.e. through landscape analysis);
 - Long-term strategic priorities and a transparent prioritisation of national needs that take into account the European perspectives;
 - Evaluation of RI relevance according to scientific, managerial, strategic and societal dimensions and corresponding monitoring mechanisms, which consider national strategic priorities and scientific needs as well as lifecycle stages, types and missions of the RI;
 - Prioritisation of new and existing RIs in view of the available funding for RIs.
- 2** InRoad encourages better integration of RI roadmapping processes into the national research and innovation eco-systems and across other relevant national policies (education, health, etc.).
- 3** InRoad recommends connecting national RI roadmaps to long-term funding plans.
- 4** InRoad encourages user communities to prioritise their needs with a long-term perspective in order to increase sustainable collaboration in the same and/or interdisciplinary thematic areas.

HIGHER DEGREE OF COORDINATION BETWEEN REGIONAL, NATIONAL AND EUROPEAN FUNDING FRAMEWORKS

- 5** InRoad recommends that EU Member States and Associated Countries improve financial predictability and stability across RIs' entire lifecycle and guarantee the ability to provide RI services to a broad user community.
- 6** InRoad calls for closer synergies across regional, national and European levels, both through greater coherence among priority-setting exercises within research and innovation policies and an adjustment of the regulatory frameworks of the different instruments.
- 7** InRoad calls for fostering communication, mutual learning and cooperation through the exchange of information between RIs and other stakeholders, to promote adequate and sustainable RI funding and enhance the societal value of RIs.

BEST PRACTICES AND COMMON STANDARDS FOR RI BUSINESS PLANNING

- 8** InRoad recommends all RIs to develop a business plan in order to align their strategy, resources and goals and to connect their mission with national and international strategic agendas.
- 9** InRoad recommends the use of the business plan as a management tool, in the form of a living document aimed at ensuring the long-term sustainability of the RI.
- 10** InRoad recommends early and continuous stakeholder involvement for the development, implementation and updating of a sound business plan.



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DEFINITIONS IN THE CONTEXT OF THIS REPORT

The [InRoad consultation](#) and [compendium](#) as well as the analysis of documents related to national RI roadmapping processes revealed a great variety of terms and definitions used between countries. In this section, we propose a list of common terminology used throughout InRoad final report.

Business plan	Concrete, operational and budgeted translation of the business model. Formal document which should describe the organisation's strategy and vision, how the business model will be implemented, and expectations regarding the development of the organisation's activities and finances (OECD 2017).
Business case	A documented rationale justifying the feasibility of a specific RI. It includes a description of the physical infrastructure, the plans for services and access, the legal and governance structure and the expectation of return on investment, for example, as socio-economic impact (Adapted from ISBE Project 2014).
Distributed RI	A distributed RI consists of a Central Hub and interlinked National Nodes. The essential features are: 1) a unique specific name, legal status and a governance structure with clear responsibilities and reporting lines, including international supervisory and relevant external advisory bodies; 2) legally binding attributions of coordination competences and resources to the Central Hub; 3) a unique access policy and provide for a single point of access for all users with a support structure dedicated to optimise the access for the proposed research (ESFRI 2018).
European Structural and Investment Funds (ESIF)	European Regional Development Fund (ERDF), Cohesion Fund, European Social Fund (ESF), European Agricultural Fund for Rural Development (EAFRD) and European Maritime and Fisheries Fund (EMFF) (Adapted from European Commission 2015).
Evaluation	The peer-review process of assessing RI proposals regarding scientific excellence, relevance, feasibility and impact (Adapted from ESFRI 2011).
Key Performance Indicator (KPI)	Metric that is used to track the performance, effectiveness or efficiency of a service or process. KPIs are generally important metrics that will be aligned to critical success players and important goals. KPIs are therefore a subset of all possible indicators, intended to allow for monitoring [see also indicator] (Adapted from European Commission 2017b).
Landmark	RIs that have reached an advanced Implementation Phase and are pan-European hubs of scientific excellence, generating new ideas and pushing the boundaries of science and technology (Adapted from ESFRI 2018).
Landscape Analysis	Analysis of the RI ecosystem based on the identification of the main RI operating in a given geographical area, e.g. national or European, as well as planned projects and existing gaps. This typically includes an analysis of strategic elements, e.g. strengths and weaknesses, outputs and services, and growth models. (Adapted from IAC Publishing 2017 and ESFRI 2016b)
Monitoring	The continuous process of assessing the performance of RI including the delivery of outputs and supply of services to intended beneficiaries. It is carried out during the lifecycle of RIs with the intention of correcting any deviation from operational objectives [ESFRI sometimes uses the term 'interim evaluation' instead of monitoring] (ESFRI 2011).



Operational costs	Operational costs refer to day-to-day costs of operations derived from running RI services. They include personnel costs, equipment maintenance cost, consumables, etc. (Adapted from Wikimedia Foundation 2017)
Prioritisation	Refers to the process of deciding which needs should be met and which needs cannot be met, at least not immediately (Nayak 2012).
Research Infra-structures	Facilities, resources and services that are used by the user communities to conduct research and foster innovation in their fields. They include major scientific equipment (or sets of instruments), knowledge-based resources such as collections, archives or scientific data and e-infrastructures such as data and computing systems and communication networks. Such infrastructures may be 'single-sited', 'virtual' or 'distributed' (European Commission 2010 , ESFRI 2011).
RI lifecycle	The lifecycle of a RI includes concept development, design, preparation, implementation, operation and termination (ESFRI 2016b).
RI long-term sustainability	The capacity for a research infrastructure to remain operative, effective and competitive over its expected lifetime (OECD 2017).
Roadmap	Strategic plans elaborated jointly by scientists, managers, funders and policymakers, under the aegis of the latter, with well-defined explicitly-stated contexts, goals, procedures and outcomes. (...) Typically, it involves the organisation of extensive 'bottom-up' consultations, leading to tough choices among competing projects (Adapted from OECD 2008).
Roadmapping processes	The entire process by which a roadmap is created, implemented, monitored and updated as necessary (International Energy Agency 2014).
Single-sited RI	A research infrastructure located in a unique place (European Commission 2017a).
Smart Specialisation Strategy	A place-based approach within the framework of Cohesion Policy, characterised by the identification of strategic areas for intervention based both on the analysis of the strengths and potential of the economy and on an Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement. It is outward-looking and embraces a broad view of innovation including but certainly not limited to technology-driven approaches, supported by effective monitoring mechanisms (European Commission 2018).
User	Users of RIs include individuals, teams and institutions from academia, business, industry and public services. They are engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of projects. (European Commission 2016b).



ABBREVIATIONS

AC	Associated Countries to Horizon 2020
EC	European Commission
EJP	European Joint Programmes
EMMRI	Executive Masters in Management of Research Infrastructures
ERA	European Research Area
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategic Forum for Research Infrastructures
ESIF	European Structural Investment Funds
EU	European Union
EU FP	EU Framework Programme for Research and Technological Development
FIRI-Committee	Finnish Research Infrastructures Committee
GDP	Gross Domestic Product
HPC	High-Performance Computing
IP	Intellectual Property
IPR	Intellectual Property Rights
ISCIII	Spanish National Institute of Health Carlos III
JPI	Joint Programming Initiatives
KPI	Key performance indicator
KTH	KTH Royal Institute of Technology
LEAPS	League of European Accelerator-based Photon Sources
MEYS	Czech Ministry of Youth, Education and Sports
MIUR	Italian Ministry of Education, Universities and Research
MS	Member States
NOP	Italian National Operational Programme
NWO	Netherlands Organisation for Scientific Research
OECD	Organisation for Economic Co-operation and Development
RCN	Research Council of Norway
RFI	Research Infrastructure Council of Norway
R&I	Research and innovation
RI	Research Infrastructure
RoI	Return on Investment
RIS3	Research and Innovation Smart Specialisation Strategies
RPO	Research Performing Organisation
RTW	Regional Technical Workshop
SMART	Specific, Measurable, Attainable, Relevant and Timely
SME	Small and Medium Enterprises
TFEU	Treaty on the Functioning of the European Union
TNA	EU transnational access
URFI	Swedish Universities' Reference Group for Research Infrastructures
VAT	Value Added Tax



INTRODUCTION

[InRoad](#) is a two-year Horizon 2020 project looking at ways to foster a **higher degree of coordination of priority setting, evaluation and funding mechanisms, as well as to ensure sustainable planning for Research Infrastructures (RIs) in Europe**. To achieve this, the project conducted a broad consultation of national practices related to decision-making and funding for RIs, and engaged in a series of interviews, case studies and workshops with regional and national stakeholders (national authorities, funding organisations, RI host institutions and RI managers) across Europe. The analysis of the extensive data collected during the project activities allowed the project partners to identify common trends and good practices that are summed up in this document. Other reports available on the project's website (see especially the [InRoad Consultation Report](#), the [InRoad Compendium](#) and the [report on the series of regional workshops](#)) provide comprehensive background information. A series of further publications, based on in-depth case studies, is included in the Annexes. They discuss the elements provided in this final report and detail all the necessary information about the methodology used to collect the data and identify good practices.

The needs, good practices and trends contained in this document allow InRoad to develop **policy insights for a broad range of stakeholders** such as European Union (EU) and national policymakers, as well as RI funders and managers. These insights were designed to contribute to a higher degree of coordination of RI policies in Europe. The document was elaborated based on the research and engagement activities conducted by InRoad consortium members. Therefore, please be aware that the document does not reflect the view of the beneficiaries or the European Commission (EC) but of the InRoad consortium, based on a thorough data collection process.

In total, **10 recommendations** are presented in this document. They contain clear messages highlighting the main conclusions and results of the work carried out by InRoad. The recommendations are then further developed and justified with explanatory texts containing complementary evidence and insights based on InRoad findings. The Annexes provide additional evidence to support the recommendations.

The findings and policy insights are address three main policy areas, as briefly described hereunder.

1. HIGHER DEGREE OF COORDINATION BETWEEN NATIONAL AND EUROPEAN RI ROADMAPPING PROCESSES

The [InRoad Consultation Report](#) and [InRoad Compendium](#) provide an overview of national RI roadmapping processes. The data collected revealed a great diversity of purposes and scopes of national RI roadmapping processes in Europe. These differences are the result of the specificities of each national context and Research and Innovation (R&I) system, as well as the varying intentions behind the introduction of national RI roadmapping processes. Considering the diversity of national RI roadmapping processes in Europe and the fact that they respond to the specific characteristics and needs of national R&I systems, one-size-fits-all solutions are not possible. Thus, the following report puts forward a series of **key elements to be included in national RI roadmapping processes** and recommendations to align RI policies with national strategic priorities and funding plans, in order to successfully implement the national R&I strategy, support a predictable environment for future investments and achieve a greater societal impact. This section is supported by ANNEX I: REPORT ON GOOD PRACTICES AND COMMON TRENDS OF NATIONAL RI ROADMAPPING PROCEDURE AND EVALUATION MECHANISMS.



2. HIGHER DEGREE OF COORDINATION BETWEEN REGIONAL, NATIONAL AND EUROPEAN FUNDING FRAMEWORK

The results of the [InRoad consultation](#) indicate that 93% of the responding countries link their funding decisions for RIs with the definition of strategic priorities, suggesting that this is an important aspect for the majority of the consulted countries. However, within existing regional, national, and European funding frameworks, funding is still not guaranteed for all the different RI lifecycle phases – particularly for operation and termination. A higher degree of coordination is therefore needed through **a better understanding of existing RI funding instruments and regulations across all lifecycle stages of RIs**. This is especially relevant for long-term oriented RIs where a multi-source funding based model is necessary to ensure stability throughout all lifecycle stages, through the adoption of transparent and simple processes of application for funding. This section is supported by ANNEX II: FINDINGS FROM THE CASE STUDIES ON RI FUNDING.

3. BEST PRACTICES AND COMMON STANDARDS FOR RI BUSINESS PLANNING

InRoad findings show that there is a common misconception that the use of business plans is exclusive to the private sector. However, RIs are expected to use all possible means to **reach maturity and maximise impact to ensure their long-term sustainability**. In this context, a business plan is an important tool to support internal decision-making for individual RIs and to contribute to sustainable long-term planning. Therefore, InRoad provides a set of recommendations for RI business planning in terms of their content and optimal use. This section is supported by ANNEX III: REPORT ON BEST PRACTICES FOR BUSINESS PLANS.



DETAILED ANALYSIS

HIGHER DEGREE OF COORDINATION BETWEEN NATIONAL AND EUROPEAN RI ROADMAPPING PROCESSES

The following recommendations are based on the extensive data collected during the project activities but more specifically on four in-depth case studies, which explored the entire decision-making process for one cycle of a national RI roadmapping process. The data was collected through expert interviews with different actors from each case. In order to identify good practices the case selection focused on countries with more experience with national RI roadmapping processes, according to the following criteria:

- include an assessment of the European and national research landscape;
- include a scientific and economic evaluation of new and existing projects;
- include a business plan as an eligibility criterion;
- are linked to funding commitments;
- are coordinated with roadmapping at EU level.

Based on these criteria and preconditions, the following four countries were selected: Sweden, Czech Republic, Netherlands and Finland. For more information about the development and evidence of the following section, please consult Annex I of this document.

IMPORTANT NEEDS IN VIEW OF NATIONAL RI ROADMAPPING PROCESSES

In its [report](#) on roadmapping of large RIs, the Organisation for Economic Cooperation and Development (OECD) defined RI roadmaps as “*Strategic plans elaborated jointly by scientists and policymakers, under the aegis of the latter, with well-defined explicitly-stated contexts, goals, procedures and outcomes. (...) Typically, it involves the organisation of extensive ‘bottom-up’ consultations, leading to tough choices among competing projects.*”¹ Increasingly complex and expensive RI projects require careful planning and sound funding models. In that context, the RI roadmap is a tool to manage the existing RI portfolio and to plan future developments efficiently and transparently.

The [InRoad consultation](#) revealed that the current situation in Europe is far more diverse than the scope of the OECD definition. National RI roadmaps vary in scope, purpose and content. Nevertheless, a national RI roadmap is understood as an important tool to increase the transparency and accountability of public research funding used for RIs. The design of a national RI roadmap allows to bring together needs and priorities from different actors of the national R&I system, and to take into account both scientific excellence and societal impact. As such, national RI roadmaps are not only important for individual countries’ R&I systems, but are also essential for the long-term sustainability of pan-European RIs. National RI roadmaps contribute to justifying long-term funding commitments effectively and efficiently. Finally, if a national RI roadmap has been elaborated in a transparent process, it brings legitimacy to the process and the decisions among all relevant stakeholders.

¹ OECD Global Science Forum (2008): Report on Roadmapping of Large Research Infrastructures.



TRENDS IN THE DEVELOPMENT OF NATIONAL RI ROADMAPPING PROCESSES

Since the founding of the European Strategic Forum for Research Infrastructures (ESFRI) in 2002, national RI roadmapping processes have strongly evolved. Focusing solely on the ESFRI roadmapping processes, it is possible to identify the following phases:

- The main intention of the **1st phase** can be understood as incubation of projects, incl. the first three ESFRI Roadmaps (2006, 2008 and 2010), which are mainly lists of opportunities;
- The **2nd phase**, from 2010 to 2016, was triggered by the request of the Council of the EU for more prioritisation. Since then, the ESFRI Roadmap includes an assessment of the implementation of the projects and a prioritisation of RI projects. ESFRI Roadmaps are based on integrated landscape analyses that identify not only needs and gaps in different thematic fields, but also cross-disciplinary issues. In this phase, a High-Level Expert Group was formed by the European Commission (EC) to evaluate implementation status of projects on the ESFRI Roadmap. The [AEG report](#)² resulted in the introduction of new rules, such as a maximum period of 10 years for projects to be included the ESFRI Roadmap before upgrading to a landmark status or, if requirements are not fulfilled, being removed from the roadmap;
- The **3rd phase** of the ESFRI Roadmap for RI introduced an ecosystem approach. The ESFRI Roadmap 2016 includes a landscape analysis, the assessment RI project implementation and the scientific case. The 2018 ESFRI Roadmap 2018 encompasses the entire RI portfolio and additionally includes a periodic peer-review of the scientific status of four landmarks as a case study. The new guidelines provide precise definitions of RI, lifecycle and phases of the lifecycle;
- The **4th phase**, as currently envisaged, will be characterised by the challenges lying ahead, e.g. the need to refine the methodology for monitoring RI projects and for the periodic review of landmarks. Further consolidation of the European RI landscape is needed in order to guarantee long-term sustainability of European RIs and ESFRI needs to find its role in the global context.

ESFRI has been a key driver of national RI roadmapping processes. Hence, trends towards more sophisticated and complete RI roadmap processes can also be found at the national level, where the following approaches are increasingly being taken into account:

- **Top down approach** in order to elaborate long-term strategic priorities;
- **Bottom-up approach** in order to elaborate needs of the user communities;
- **Landscape analyses** in order to assess needs, strengths, gaps and accordingly priorities for RIs within the national ecosystem and increasingly also in Europe;
- **Evaluation / Monitoring methodologies** for the selection of RI proposal for the national roadmap and assessment of quality of existing RIs.

To guarantee the long-term sustainability of the European RI ecosystem, it is important to invest the available public funding for RIs as efficiently and effectively as possible. The growing popularity of the mentioned approaches already contributes to a higher degree of coordination between regional, national and European RI roadmapping processes. While national roadmaps feed their priorities into the ESFRI process, the priorities identified within ESFRI also rely on national funding commitments.

² European Commission (2013): Assessing the projects on the ESFRI roadmap: a high-level expert group report.



Diversity is a feature of the European R&I landscape, composed of countries with individual R&I systems. However, the diversity of roadmapping cycles makes coordination among the EU Member States (EU MS) and Associated Countries to Horizon 2020 (AC) more challenging, thus threatening the sustainability of the European RI ecosystem. However, as those differences lie within national responsibility, it is neither desired nor feasible to align national RI roadmapping cycles. Thus, InRoad recommends **the development and common use of minimal elements for national RI roadmapping process and for RI monitoring and evaluation**, to allow for more effective coordination and to promote the long-term sustainability of the RI landscape.

MINIMAL ELEMENTS FOR A NATIONAL RI ROADMAPING PROCESS

1

InRoad recommends that national RI roadmapping processes contain at least the following minimal key elements as a prerequisite for a higher degree of coordination for RI policies at national and EU level:

- **Regular updates of inventories of existing RIs and an identification of needs and gaps (i.e. through landscape analysis);**
- **Long-term strategic priorities and a transparent prioritisation of national needs that take into account the European perspectives;**
- **Evaluation of RI relevance according to scientific, managerial, strategic and societal dimensions and corresponding monitoring mechanisms, which consider national strategic priorities and scientific needs as well as lifecycle stages, types and missions of the RI;**
- **Prioritisation of new and existing RIs in view of the available funding for RIs.**

Based on trends and needs listed above, the analysis of the InRoad consultation results completed by a desk review showed that there is considerable variation between countries in the way these elements are implemented within the roadmapping process. This was also confirmed by the analysis of the in-depth case studies. In general, transparent processes with well-defined steps, methodologies and goals are essential to create trust and legitimacy.

Considering the diversity of factors driving national RI roadmapping processes, the first step towards a higher degree of coordination would be the development of a common understanding of a minimal set of elements for RI roadmapping. InRoad therefore suggests identifying and sharing **minimal key features of a RI roadmapping process, which have been identified as prerequisites for a higher degree of coordination**. A shared understanding of those elements could act as a prerequisite for dialogue and exchanges of experience, thus leading to a higher degree of coordination of RI processes in Europe and a more sustainable European Research Area (ERA). On top of those minimal elements, InRoad recommends that national RI roadmaps have a clearly defined scope and purpose, i.e. in terms of political support for RIs, link to funding, as well as links to national and European policies and pro-



grammes. A clear definition of RI that is broadly understood and accepted by all actors involved in the process is also an essential prerequisite.

The following figure illustrates how these minimal elements of good practice can be implemented in a national RI roadmapping process. It shows in a dynamic way the different steps of the process and indicates when inputs from which actors are needed to support the prioritisation and evaluation of quality within the process. Furthermore, it is important to note that this is a periodic process – although the appropriate cycle depends on the context.

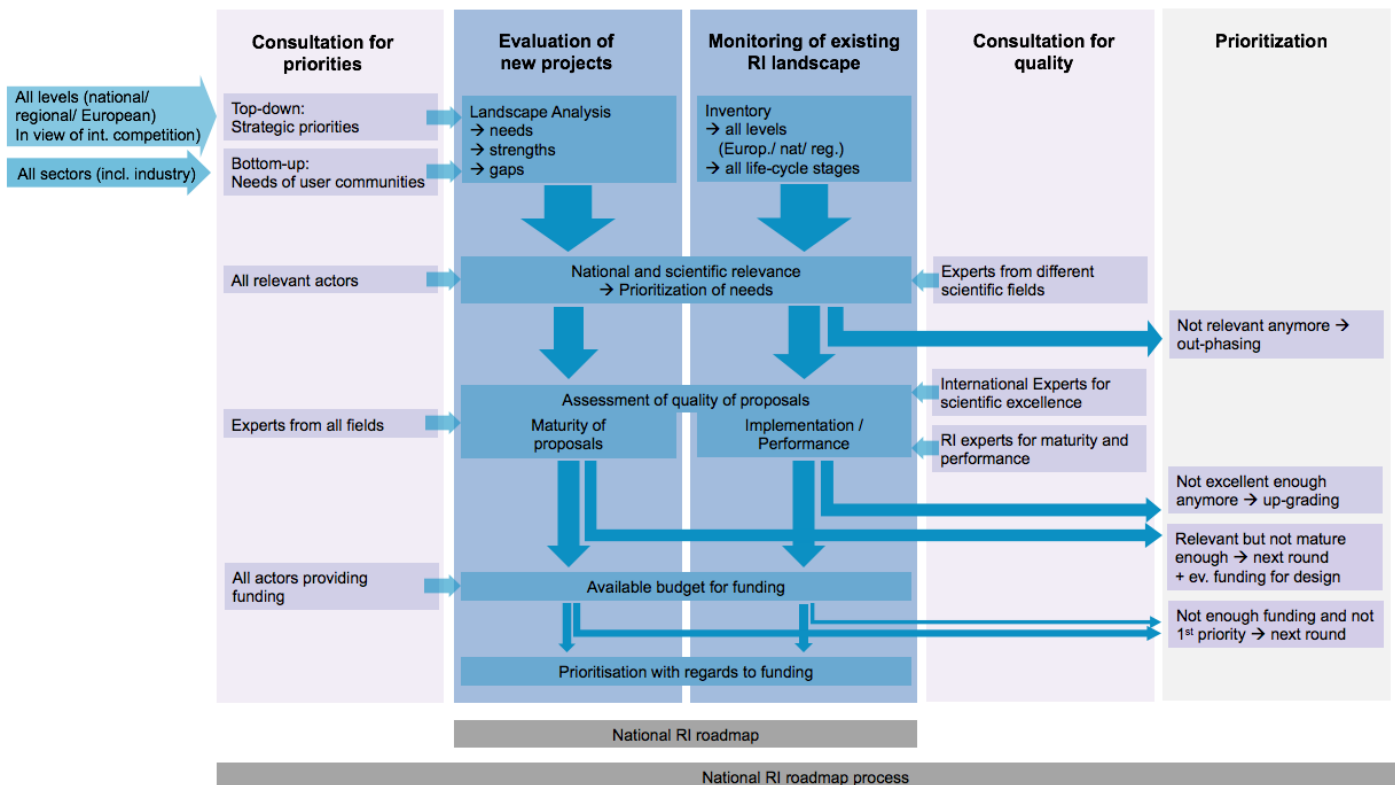


Figure 1: Minimal elements of good practice for national RI roadmapping processes.³

When deciding on the periodicity of roadmap updates, countries are advised to take into account the time and resources needed to organise prioritisation exercises, consultations, calls and evaluations (when applicable), and to consider the timeline of the ESFRI process. Updates and regular evaluations are necessary, but they can represent a burden for the actors involved in the process. Therefore, InRoad encourages careful consideration regarding their timing.

REGULAR UPDATES OF INVENTORIES OF EXISTING RIS AND AN IDENTIFICATION OF NEEDS AND GAPS (I.E. THROUGH LANDSCAPE ANALYSIS)

In order to invest available public research funding for RIs in the most effective and sustainable way, it is important to be aware of the existing institutional, national, regional and European RI landscape. One way to achieve this is to establish **inventories, including RIs at all levels**, which are updated regularly. It is also possible to use existing databases (e.g. [MERIL](#))

³ These elements of good practice of a national RI roadmapping process will be further elaborated within a PhD thesis of Isabel Bolliger on "National decision-making for prioritizing of funding of large-scale Research Infrastructures" (forthcoming).



as a source of information, to avoid duplication of work. As only 44% of the respondents to InRoad consultation see their RI roadmap process as an inventory of existing RIs, InRoad encourages an efficient use of such databases, and the development of incentives to maintain and regularly update them.

Another relevant element is a **regularly updated landscape analysis**. In the InRoad consultation, 74% of the participating countries indicated that landscape analyses should be part of roadmapping processes. In the countries analysed, they serve to identify strengths, gaps and/or needs in the national RI landscape. Their use could be strengthened with regard to highlighting the complementarity between RIs at European, national and regional levels. This helps to adequately position new and already established RIs in the landscape. Moreover, landscape analyses could be better related to national strategies and priorities, in complement to bottom-up identification of needs.

Good practice 1: Up-to-date landscape analysis. *The Czech RI roadmapping process includes a landscape analysis, carried out by expert working groups composed of national experts from each scientific field represented in the roadmap. This analysis identifies strengths and gaps in the national RI landscape, and supports the strategic vision of the Czech Ministry of Youth, Education and Sports (MEYS) and the prioritisation of RI projects.*

LONG-TERM STRATEGIC PRIORITIES AND A TRANSPARENT PRIORITISATION OF NATIONAL NEEDS THAT TAKE INTO ACCOUNT THE EUROPEAN PERSPECTIVES

The national RI roadmapping process is important to reflect on both national and European priorities, to assess the needs of the user community for RIs at all levels and to achieve a balance between funding commitments for national RIs and participation in European RIs. In most countries, it was found that there is scope for clearer priority-setting and increased transparency. Notably, linkages between strategy, roadmapping, evaluation and decision-making, e.g. funding decisions, are not always clear.

In view of prioritisation, it is important to have a **transparent, consultative process that includes all relevant actors**, including user communities, funders, RI managers and host institutions. To support such prioritisation processes, InRoad encourages the development of transparent procedures with clearly defined criteria and responsibilities (i.e. who makes the final decision to construct or fund a RI).

Good practice 2: Stakeholder engagement and institutional RI priorities. *Universities, who are important funders of RIs in Sweden, are represented in the roadmapping process by a specific group (URFI). They contribute to defining strategic areas based on the inventory of needs and reviewing proposals from the call. The Research Infrastructure Council (RFI) also encouraged universities and research performing organisations (RPOs) to prioritise their own needs and develop institutional roadmaps, which some have started to do (e.g. Chalmers University, KTH Royal Institute of Technology (KTH)). This provides a solid foundation for institutions to justify and negotiate their needs and commitments for RIs.*

Appropriate bottom-up identification of the long-term needs of the user community ensures that investments in RIs bring real added value for researchers and that RIs are used to their full extent. Conversely, top-down identification of strategic priorities of national relevance, as



well as a description of how those priorities relate to the landscape analyses, are important in view of decision-making and prioritisation.

EVALUATION OF RI RELEVANCE ACCORDING TO SCIENTIFIC, MANAGERIAL, STRATEGIC AND SOCIETAL DIMENSIONS AND CORRESPONDING MONITORING MECHANISMS, WHICH CONSIDER NATIONAL STRATEGIC PRIORITIES AND SCIENTIFIC NEEDS AS WELL AS LIFECYCLE STAGES, TYPES AND MISSIONS OF THE RI

The evaluation of the scientific excellence of RIs and new proposals is a prerequisite for inclusion in the roadmap in 79% of the countries analysed by InRoad. However, methodologies and procedures vary significantly across them. An **independent and transparent peer-review process** to assess the excellence of RIs and their relevance with regards to identified scientific needs, uniqueness and added value is an important element of RI roadmapping processes at the national level. This also includes national relevance, societal value, maturity and potential impact of existing RIs and RI proposals. In turn, the results from this peer-review process are used to inform decision-makers and increase transparency and accountability within the process. To evaluate scientific excellence, 63% of the countries analysed use international expert panels, which is strongly recommended to limit risks of conflicts of interest and guarantee the required level of expertise.

Good practice 3: Identification of needs for new and existing RI at all levels. *The Swedish Research Council calls for proposals include new and existing, as well as national and European RIs, which are evaluated through the same process. This ensures that only top-class and most relevant RIs are eligible. It also means that the process is streamlined, with clear common criteria for evaluation and there is a balance between long-term stability of existing RIs and necessary renewal of the landscape. Based on existing good practices, InRoad recommends a minimal set of evaluation criteria to ensure accountable, transparent and sustainable funding for RIs. A common understanding of these criteria between all relevant actors - decision-makers, evaluators, funders and applicants - is essential. The following minimal criteria are not to be seen as an exhaustive list, but as a common basis to develop methodologies and procedures that are adapted to each context.*

Based on a review of national RI roadmapping processes in Europe, criteria that are commonly used in evaluation procedures RI can be classified into four broad categories:

1. **Scientific dimension:** collaboration and degree of internationalisation; strong user base; scientific and technological excellence of the RI; etc.
2. **Management dimension:** mission and value proposition; governance and management; impact assessment and societal challenges; user strategy and access policy; data management plan; financial plan and funding framework; stakeholder engagement strategy; communication and outreach; implementation, monitoring and risk management; ethical and regulatory aspects; intellectual property rights management.
3. **Strategic dimension:** mission; visibility; identified priority areas; industrial relationships; innovation potential; etc.
4. **Societal dimension:** education and training; contribution to sustainable development goals; socio-economic impact; etc.



InRoad recommends that evaluation methodologies take into account those four categories – with priority to scientific and management aspects – and detail them into measurable indicators. As an example, the [ESFRI Roadmap Public Guide 2018](#) includes two annexes listing minimal requirements for both the scientific and implementation cases, which are used for its evaluation process⁴. These can be used as a starting point. It is important to note that different criteria may be needed for different targets, e.g. depending on the scientific domain of the RIs.

Good practice 4: Comprehensive and objective evaluation. *In the Czech Republic, all existing RIs and new proposals were evaluated in 2014 and 2017. The two-stage evaluation is carried out by international scientific panels. During the first stage of the evaluation process, proposals are assessed based on the definition of national RIs, as a prerequisite to pass on to the second stage. In the second stage, proposals are evaluated according to a more detailed set of criteria (e.g. socio-economic impact, uniqueness of technological facilities, etc.). The second stage also includes interviews with representatives of management of each RI, in order to address issues linked to operation and delivery of services to external users. Harmonisation of all panel results is carried out in a cross-panel session. All these elements contribute to an objective evaluation process.*

Another element to consider is the requirement of a business plan for RI roadmap and funding applications. Indeed, comprehensive business plans are essential when the roadmap evaluation is linked to funding decisions. In earlier stages of RI projects (e.g. design phase), presenting a *business case* instead of a full business plan may be sufficient, depending on the applicable procedures. Therefore, it is recommended that all applicants of national RI proposals submit a business plan to the national roadmap and funding application, whether they belong to a pan-European RI or not. This would allow national policy makers and funders to reflect on essential elements of the RI business plan (see recommendation 8).

Good practice 5: Assessment of RI business plans. *The involvement of international expert panels is a practice already in place in some national RI evaluation procedures. These international experts are involved mainly in the assessment of the scientific dimension. For example, the Research Council of Norway (RCN) aims at having a balanced panel consisting of professionals with research and business expertise, for the evaluation of RI proposals at the initial stage of their roadmap procedure.*

Another important element of the RI roadmapping process is monitoring. Periodically monitoring the quality of RIs in relation to their mission, relevance and other jointly elaborated criteria can also allow for corrective measures to be taken when needed, in order to maintain the high standards expected from national and European RIs. This information can be used to support decision-making for individual RIs included in the roadmap, as well as the update of the roadmap itself.

There is limited information on the monitoring (follow-up) practices carried out in European countries in relation to RI roadmapping, thus no strong trends could be identified. Yet, monitoring is essential to adequately manage RI portfolios. Therefore, InRoad recommends developing and using a set of measurable, simple, relevant and reliable indicators, designed to fa-

⁴ ESFRI (2016a) Public Roadmap 2018 Guide, p. 22-23.



facilitate the supervision of targets and achievements of all RIs included in the roadmap. In order to enhance mutual understanding, InRoad also recommends including visits to the facilities and interviews with RI managers, as well as giving the possibility for the applicants to react to the results of the processes.

In many evaluation and monitoring processes, RIs are assessed with the same methods and questions regardless of their lifecycle stage. This can lead to inadequate or redundant questions and limit the comparability of the results. Furthermore, since the societal impact varies across scientific fields and types of RIs, evaluation and monitoring are most accurate when considering the mission of the RI. When assessing scientific and societal impact, it has to be acknowledged that these impacts often only show in the long- or very long-term. Furthermore, the scope and type of impacts vary again across scientific domains and types of RIs. From our analysis, it appears that **existing evaluation and monitoring processes, including questionnaires, need to be better adapted to the lifecycle, type and mission of the different RIs.**

Good practice 6: Dynamic monitoring of RIs on the national roadmap.

In the [Finnish 2018 interim evaluation report on the Strategy and Roadmap for RIs 2014-2020](#), the Finnish Research Infrastructures Committee (FIRI-Committee) monitored and categorised all 32 RIs listed on their 2014 roadmap and classified them according to their level of maturity (lifecycle) and the fulfilment of predefined criteria into four different categories. Depending on their classification, the questions asked in future monitoring will be adjusted. RIs which were categorised as 'very advanced' and 'advanced' will be assessed more lightly for scientific advancement, as they were sufficiently advanced in the 2018 interim review to be considered reliable until the year 2020. Additionally, the development of RIs can be tracked through regular monitoring according to RI categorisation into the different maturity levels. The Finnish RI categorisation provided for more transparency, efficiency and supports.

PRIORITISATION OF NEW AND EXISTING RIS IN VIEW OF THE AVAILABLE FUNDING FOR RIS

Prioritisation of RIs and projects is reported in 79% of countries analysed by InRoad. It is often a challenging task but it is increasingly necessary, as resources are limited and not all excellent RI proposals can be funded. Therefore, the final important element of a RI roadmapping process at national level is a prioritisation of RIs according to the available funding for the respective roadmap cycle. This step allows to choose the highest priorities among the RIs that passed the prioritisation of needs and were evaluated as excellent. As such, InRoad recommends to involve all key stakeholders in charge of providing funding for RIs in the national roadmapping process, e.g. ministries, research funding organisations or agencies, regional authorities, host institutions (universities and other) in order to increase commitment for national and international RIs, as well as to identify joint priorities.



2

InRoad encourages better integration of RI roadmapping processes into the national research and innovation ecosystems and across other relevant national policies (education, health, etc.)

In many countries, there is scope for better integration of RI roadmaps into the national R&I system. Indeed, the importance of RIs and their services is not always well known or understood outside of user communities, funding agencies or other specific actors involved in the RI roadmapping process. For example, authorities in charge of industrial strategies or sectoral research programmes (e.g. health, agriculture, environment) could benefit from being better included into the roadmap process, and conversely, from connecting the national RI roadmap to their own strategies.

Good practice 7: Embedding the RI roadmap in a national R&I strategy. *In Finland, the national RI strategy and roadmap with implementation measures is a plan to contribute to a national R&I vision with clear targets and invites RI funders, hosts and users to align their strategies and capacities against this national plan. This creates coherence between different elements of the RI strategy: the long-term national plan, implementation and funding measures, RI roadmap and corresponding strategies, measures and roadmap elements at the host and user side.*

Moreover, regional authorities managing European Structural Investment Funds (ESIF) could play a key role in linking regional, national and European systems through the development of Smart Specialisation Strategies (RIS3). Efforts to better integrate RI roadmaps in that multi-level system could contribute to better linkages with other policies (e.g. energy and environment policies). In turn, **such integration would make the RI roadmaps and strategies at different levels (national and regional) more visible, more sustainable and less vulnerable to changing political cycles.**

Finally, there are opportunities to make better use of the RI roadmap to link the represented scientific fields with relevant policy areas, e.g. for instance with the [United Nations Sustainable Development Goals](#) or the [Paris Agreement](#) (2015). Addressing Sustainable Development Goals and global challenges requires international collaboration between RIs in different regions, efficient data sharing and user cooperation. To this end, policymakers, RI managers and users are encouraged to identify gaps and needs with regard to available data, research services and scientific insight in support of these global objectives. This integration of RI roadmaps and strategies would support both strategic planning and prioritisation, and contribute to the socio-economic impact of RIs.

Therefore, the success of priority-setting exercises for RIs appears to be dependent on the ability to set in motion national long-term perspectives and commitments, as well as on the linkages between RI roadmaps and different national and European policies.

Good practice 8: Coordinating national long-term RI strategies with relevant stakeholders. *The Netherlands and Finland each have introduced a RI committee, staffed with highly qualified professionals from various thematic*



disciplines and different R&I organisations which are tasked with designing, developing and coordinating long-term RI strategies and processes in interaction with their respective state governments. This way national RI decision-making processes, strategies, budget allocation and prioritisation are streamlined and shaped by an established group of experts.

NATIONAL RI ROADMAPS AND LONG-TERM FUNDING

3

InRoad recommends connecting national RI roadmaps to long-term funding plans.

Investments in new RI projects or upgrades need to be carefully planned and linked to national, regional and European RI strategic priorities, taking a long-term perspective into consideration. Aligning investments with previously established strategic priorities contributes to the effectiveness and socio-economic impact of said investments.

In view of long-term sustainability, it is important that prioritised RIs receive funding from the national budget to be constructed, operated and upgraded, as well as terminated (when applicable). Only 24% of the countries studied by InRoad include funding commitments in the RI roadmap, while 59% use the roadmap as an input for funding (the remaining percentage are countries with no active roadmap, or where the roadmap has no clear link to funding). In cases where the national RI roadmap is primarily an input for funding decisions at a later stage (e.g. through a competitive funding call), or serves mainly to identify national scientific needs and existing gaps, there is a potential uncertainty for sustainable planning and coordination of RIs at European level. In general, more clarity in national RI roadmaps regarding available funding commitments would facilitate coordination.

This is particularly relevant for the adaptability to a pan-European roadmap (e.g. ESFRI). The existing diversity in the levels of engagement poses certain risks, such as making the funding of RI across Europe unpredictable and inefficient, especially for pan-European RIs. The European level must be taken into account in national roadmaps in order to better match existing and prioritised needs with available RI funding, and therefore to increase the long-term sustainability of the European RI landscape.

Thus, **to ensure transparency and foster coordination between and across levels (regional, national, European), InRoad encourages the inclusion of long-term funding plans in the national RI roadmap**, even when it does not include direct funding commitments. For periodic evaluations, monitoring and socio-economic impact assessments, financial commitments and previous investments need to be continuously reviewed and related to the costs of RIs at different lifecycle stages.

Good practice 9: Long-term RI funding through collaboration in the RI-ecosystem. Finland follows a systematic, integrated and cross-ministerial approach for the development of their RI ecosystem and has developed an overall vision and roadmap for its research innovation system. Coherently, the 2014–2020 RI strategy specifies objectives and a program of interlinked short- as well as long-term measures for RIs. These measures are regularly monitored, discussed and adjusted if necessary. The longevity of infrastructure



funding in Finland is achieved through collaboration. While the Academy of Finland provides funding primarily during the RI construction, the operating costs are paid by the RI host. To extend the RI funding, opportunities and principles for cooperation at the national level and between RI are pursued.

SUSTAINABLE COLLABORATION IN THEMATIC AREAS

4

InRoad encourages user communities to prioritise their needs with a long-term perspective in order to increase sustainable collaboration in the same and/or interdisciplinary thematic areas.

For user communities, **identifying and prioritising common areas of interest with a long-term perspective and finding opportunities for sustainable collaboration within the existing landscape is advisable.** Some communities have longstanding experience in collaborating across borders and advocating for their RI needs in a more unified way (e.g. the particle physics community). It would be beneficial for other communities to adopt such approaches and organise themselves into mono-disciplinary or interdisciplinary groups of common interest. This would enable researchers to exchange experience, share good practices, and identify common needs and priorities. In turn, this would help them form strong user communities and submit common RI projects at national or European level, thus using synergies and avoiding redundancies.

***Good practice 10: Transparent prioritisation of needs.** The Swedish RI roadmapping process includes extensive consultations for prioritisation of needs as well as in view of funding commitments. The RFI, responsible for the roadmapping process, is comprised of researchers from different scientific fields from different major research performing universities, as well as a representative from the innovation agency Vinnova and the industry sector. This council consults with the other scientific councils of the Swedish Research Council, the management of the 10 major research universities (through URFI), as well as four advisory groups, representing different scientific areas (incl. e-infrastructures). This ensures that user communities are involved in priority-setting.*

To encourage user communities to organise, it is essential to recognise differences between user communities, such as differences in incentives and capacity to collaborate, or the specific needs of industrial users. For example, user needs are different when industry is involved in view of product development. The case of the synchrotron user community shows that cooperation on common projects and competition for scientific excellence can coexist.

For other communities, new ways of learning (e.g. by exchange of experiences between new and established communities, mono-disciplinary or interdisciplinary groups), adequate communication and leadership, as well as incentives to collaborate within and across communities would be needed. Such initiatives could be strengthened by policy instruments, as well as funding and award systems for user communities. For example, networking grants (e.g. COST) could assist newly formed communities.



HIGHER DEGREE OF COORDINATION BETWEEN REGIONAL, NATIONAL AND EUROPEAN FUNDING FRAMEWORKS

The present section reports the project's recommendations for a higher degree of coordination between regional, national and European funding frameworks, in favour of the long-term sustainability of RIs in Europe. The following recommendations are based on the extensive data collected during the project's activities but more specifically result from the cumulative process that encompassed the development of case studies with representatives of 17 European RIs, as well of five regional technical workshops (RTWs) that were developed in parallel.

For more information about the development of this cumulative process and evidence of the following section, please consult Annex II of this document.

The InRoad [consultation](#) showed that 93% of responding countries linked their RI funding decisions with the definition of strategic priorities, suggesting that this is perceived as an important aspect by the majority of consulted countries. In spite of this, funding from different sources (regional, national, European) along the different RI lifecycle stages – particularly for operation and termination – is not guaranteed within existing funding frameworks. Funding dynamics, when appropriately adapted to meet the requirements of the RI throughout its lifecycle, contribute to safeguarding its long-term sustainability and securing effective and efficient spending.

The richness of the European RI landscape, the specific requirements based on the different RI lifecycles and organisational structures, and not least the considerable financial resources required, result typically in very complex RI funding models. Therefore, timely planning, coordination and alignment of rules and procedures are pivotal.

FINANCIAL PREDICTABILITY AND STABILITY ACROSS THE ENTIRE LIFECYCLE OF RIs

5

InRoad recommends that EU Member States and Associated Countries improve financial predictability and stability across RIs' entire lifecycle and guarantee the ability to provide RI services to a broad user community.

Most RIs reach maturity after a few years of operation, but their operational costs cannot always be covered solely by the budget of host institutions. Therefore, additional sources of public funding are often needed. Consequently, **InRoad advises that the sustainable long-term financing of these RIs and additional operational and investment costs be considered already in the early planning stages** in order for new RIs to ensure their sustainable operation.

Good practice 11: Long-term perspective for funding commitments and cost predictions. *For the roadmap proposal, the Netherlands Organisation for Scientific Research (NWO) asks for a 10-year budget for the full costs of a RI. Additionally, in the Netherlands 50% of the operational costs are funded during a period of 10 years under the condition that the facilities applying for funding commit to paying the other half of the operational costs. For the proposals, the hosting organisations are asked to submit a letter of intent in which they commit to financing half of the operational costs for 10 years. This way, the NWO ensures that the applicants deal with a business plan and financing strategy while applying for the roadmap.*



Overall, the diversity of available funding instruments during early stages (concept development, design, preparation and implementation) stands in contrast with the lack of suitable funding instruments for the operational phase. This leads to a shortage of accurate and predictable funding mechanisms and models, necessary to cover the entire lifecycle. In particular, for a smooth transition between phases, the high burden of costs related to the early stages of RIs' operational phase requires special attention.

Good practice 12: Funding commitments for initial stages of operation.

The Czech Republic has introduced two measures for RIs and Centres of Excellence, which were built through investments from the Operational Programme Research and Development for Innovation (2007-2014). Cross-funding (up to 20%) using ESIF was introduced and negotiated for large (above €50M) projects. This facilitated the initiation of research activities and the building of scientific competences already in the construction phase of the large infrastructures. These resources allowed for a smoother transition from the implementation to the operational phase. Similarly, a national sustainability programme funded from the state budget was designed to provide the infrastructures with sufficient resources to bridge the initial period (five years) before competitive funding became active.

Budgetary fluctuations and unpredictability in political decision-making are identified not only as challenges for sustainable funding but also as risks in the operation of international large-scale facilities. Hence, they need to be addressed in order for Europe to stay at the forefront of science and technology. Political consensus at regional, national and European level is essential to ensure the technological and scientific RI capabilities needed to withstand increasing global competition. In light of this, it is particularly important to secure basic funding for the initial period of the operational phase (even in cases where competitive funding is assumed to be a major source of RI budget at later stages), and national contributions for continued operation. This would allow forward planning and timely preparation of RI strategies, and also facilitate the recruitment and retention of human resources needed to operate state-of-the-art facilities. At the national level, this requires strategic and budgetary commitments that can be sustained through several governmental mandates.

For RIs of international relevance, the securement of funding along their lifecycle implies the commitment of different national governments. Whereas for RIs based on intergovernmental agreements the securement of national budget allocations is assured throughout a robust governmental/parliamentary procedure, the European Research Infrastructure Consortium (ERIC) status is often perceived as implying weaker national commitments and the decision is usually taken at the level of a single ministry or funding agency. In this context, **InRoad suggests that, at national level, budgetary commitments for ERICs be planned in a similar way as for intergovernmental organisations.**

Furthermore, although some RIs are aware of the abovementioned challenges and anticipate the need for predicting the costs for upgrading and even decommissioning, the InRoad case studies demonstrate that they rarely have a clear funding plan for it. Ultimately, **a combination of long-term strategic vision, followed by stable funding and greater commitment from national governments, agencies and institutions would support the sustainability of these state-of-the-art facilities.**



BETTER INTEGRATION OF RIs IN THEIR RELATED SCIENTIFIC, INNOVATION AND EDUCATION SYSTEMS

RIs are intrinsically related to multi-level systems and take part in shaping different scientific, socio-economic and societal dynamics. The services and products provided by these RIs facilitate cooperation between facilities and sharing of equipment, techniques and expertise across scientific communities, industry and others. In addition to bringing communities closer and pooling resources, RIs play a key role scaling-up research, development and innovation capabilities to create value for various stakeholders. However, despite the increasing attention from policymakers and funders on the provision of RI services targeted at industry and broader society, RIs – similarly to public universities and research institutions – work under restricted economic models, serving the extension of the knowledge base. Moreover, scientific breakthroughs in certain disciplines may take decades to appear. In that context, **although the declared impetus for RIs to engage in industrial R&I activities is welcome, InRoad recommends avoiding pressing incentives to produce short-term results.**

In view of promoting a more effective integration of RIs in the abovementioned systems, a closer interaction with the broader user community (also as co-creators) can help increase the visibility of RIs and their services, as well as contribute to their sustainable development in the long-run. For this to happen, RIs are encouraged to continue communicating and engaging with relevant stakeholders (e.g. academia, small and medium enterprises (SMEs), industry and funders) regarding their scientific and technical capabilities, and also to gather their feedback on RI services and product development. At the same time, there is still potential for a deeper integration of RIs in educational and innovation systems, with an important role to be played by national governments and institutions in facilitating and promoting access. **At the European level, closer connections within thematic areas in the EU Framework Programme for Research and Technological Development (EU FP) could generate better integration of RIs in the mentioned systems, namely through closer links to the missions, partnerships, and pillars II and III of Horizon Europe.**

Furthermore, Citizen Science is also a topic worth exploring within the scope of public engagement and outreach in order to raise awareness and reduce the gap between society and both basic and applied research in certain fields (e.g. Structure of Matter, Personalised Medicine and Key Technologies).

STRENGTHENING NATIONAL AND INTERNATIONAL FUNDING MECHANISMS FOR ACCESS TO AND COORDINATION OF FACILITIES

State-of-the-art RIs play an important role in the provision of scientific and technical services to user communities by engaging with different stakeholder groups (i.e. scientific communities, public bodies, private companies and society at large). These resources and services enable key developments in a range of areas with societal relevance such as health, energy, and environment, where market failures exist, e.g. in the development of treatments for rare diseases or the development of cleaner and safer sources of energy such as fusion. Considering the contribution RIs make to scientific and technical progress, through their capabilities and by stimulating the growth of their surrounding innovation ecosystems, it is vital to design transparent access and user policies. **InRoad recommends designing policies on different access models adapted to each of the user categories.**

In this context, through the establishment of dedicated programmes for user access and the development of calls for expression of interest from industry and other research institutions,



some RIs have demonstrated the ongoing efforts for setting up specific measures aiming at an effective integration and the provision of services to their broader user community.

Good practice 13: Different access models adapted to different user categories. *CALIPSOPlus is a collaboration of accelerator-based light-sources in Europe and in the Middle East that provides transnational access to 14 synchrotrons and eight free electron lasers, as well as an access route tailor-made for SMEs. The project focuses mainly on newer EU MS, which are still underrepresented among users. Within the first 18 months, 16 visits to universities and research centres in these countries have been organised and more are planned to disseminate the knowledge on these facilities, provide free access and participate in a specially conceived twinning programme for users.*

On the promotion of access and usability of data by scientists and society, it is also possible to identify some measures that are being designed and implemented towards the provision of services to the worldwide community (e.g. the Group of Senior Officials' list of RIs).

As the long-term sustainability of RIs is dependent on their capabilities to serve broad user communities, a clear definition and planning of costs for access is therefore crucial. In this context, **InRoad recommends that these costs be considered in the discussion of the mission of the RI from early stages on**, in relation with the business plan (recommendation 8). Furthermore, due to the current lack of funding for these activities, there is a need to develop the potential of promoting better coordination between European and national sources, as well as with sectoral initiatives (e.g. League of European Accelerator-based Photon Sources (LEAPS) initiative, Laserlab Europe).

Moreover, InRoad recommends that **new and existing access funding instruments take into account the diversity of user profiles and needs**. Because of the ongoing digitalisation of processes, – especially for knowledge produced in the form of consultable data – it is also crucial that the forthcoming funding mechanisms contemplate the support of virtual and remote access to RIs.

Considering the growing trend of providing open access to RIs, as well as the goal of creating an integrated ERA, the defragmentation and optimisation of resources through common standards and harmonised access rules are important. However, this requires **designing policies that ensure access to RIs through the principles of transparency, non-discrimination, information and competition (i.e. the European Charter of Access to RIs) and ensuring their effective implementation**. The considerable benefit of the EU transnational access (TNA) funding instrument in this context was highlighted by representatives of the scientific community and of RIs in most of InRoad's workshops.

Nevertheless, although the focus is herewith set at the level of transnational access, interactions and feedback from the Validation Workshop also highlighted existing bottlenecks in assuring funding for national access to RIs. As the TNA instrument is not designed for providing access to national RIs, there is also a potential for reinforcing the national support for such a purpose.



6

InRoad calls for closer synergies across regional, national and European levels, both through greater coherence among priority-setting exercises within research and innovation policies and an adjustment of the regulatory frameworks of the different instruments.

Building pan-European RIs requires a combination of regional, national and European Union funds through different types of funding instruments, depending on the different stages of the RI lifecycle. In addition, there seems to be a lack of exchange and sharing of expertise on how to coordinate different sets of funding instruments at the level of RI management. Indeed, the suitability of those instruments varies depending on the type, scientific domain and lifecycle stage of the RI. Moreover, as the ESIF and EU FP have different objectives, coordination among these frameworks remains a challenge.

In view of closer synergies between funding frameworks, building on existing and future competences is also important. National calls for proposals, ERA Networks, European Joint Programmes (EJP), Joint Programming Initiatives (JPI), Article 185 of the Treaty on the Functioning of the European Union (TFEU) and missions and partnerships in Horizon Europe, all offer good opportunities to maximise synergies by bringing scientific communities, industry (including SMEs) closer to the services and resources provided by RIs.

Good practice 14: Synergetic approaches for research-based investments. *Since 2015, the National Institute of Health Carlos III (ISCIII) – the main funding organisation for biomedical research in Spain – includes ECRIN ERIC in its annual call text for proposals for clinical research, in order to foster the use of this RI's services by national biomedical research groups applying for funding, to align national strategic priorities with those of the RI, and to maximise Spain's return on investment for biomedical research. Spain is a member and financial contributor to ECRIN ERIC through the ISCIII.*

As stressed on several occasions during the RTWs, national RI roadmaps are often perceived among RI managers as a valuable tool for strategic activities. However, some processes for elaborating national research, development and innovation policies do not take them sufficiently into account. In this context, there is still potential for specialisation-based approaches through landscape analyses that explore the relevance of each RI for different national research and innovation policies. Moreover, the timing of roadmaps and updates is also a critical element in the stability of RI funding – notably, for new RIs.

The publication of the first ESFRI Roadmap in 2006 marked a milestone in the structuring of the ERA. Numerous examples highlight the important role that ESFRI Roadmaps have played in supporting a more coherent and strategy-led approach to policy-making on RIs in Europe, as well as their role in enabling multilateral initiatives that have contributed to a better use of research facilities at the EU and international level. One effect of this coherent and strategy-led approach is the increasing number of priority-setting exercises in Europe for strategic investments in R&I. For instance, among distributed RIs in particular, as the RTWs and case studies showed, there is a shared perception that the inclusion of a node in its corresponding



national roadmap is not just a key step to secure funding but also an opportunity to be part of the long-term national vision and strategy for R&I.

Furthermore, the implementation of national research policies in certain European countries depends to a great extent on ESIF, within the framework of Cohesion Policy. The feedback obtained from the RTWs shows that the use and implementation of ESIF across regions is quite diverse. When it comes to distributed RIs, the setting of objectives and their practical implementation highlight some of the difficulties involved in the application of this instrument. Moreover, aligning regional policy with a pan-European mission can also be challenging; while the latter looks at Europe as an assembly of Member States, the former looks at Europe as distinct regions. In view of this, where new measures are proposed, **further consideration should be given to identifying the possible coordination between regional, national and European R&I policies** (namely, RIS3, national research strategies, national roadmaping processes, ERA Roadmap, ESFRI Roadmap).

Good practice 15: Strategic coordination of priority-setting exercises.

In countries where structural funds play an important role in the funding of RIs, RIS3 gain particular relevance as they have become mandatory in the Cohesion Policy to streamline the investments in R&I funded by the ESIF in each region or country. In Portugal, the national RI roadmap evaluation included an assessment of its strategic relevance, measured through the facilities' strategic potential to the attainment of national R&I policy and RIS3 (both national and regional) objectives. Aligning both processes of priority setting (i.e. RI roadmapping with RIS3) could help create a favourable environment to maximise the potential of combining different funding sources (e.g. national funding, ESIF and EU FP).

Good practice 16: Coherent approaches for funding prioritised RIs through different mechanisms.

Italy has introduced one measure for RIs, under the National Operational Programme (NOP) Research and Innovation 2014-2020, aimed at strengthening the RIs identified by the Ministry of Education, Universities and Research (MIUR) as priorities in the National Programme for Research Infrastructures 2014-2020. RIs eligible for NOP are functional to the implementation of projects compliant with one or more ESFRI domains, have a significant impact on the specific development trajectories of the national RIS3, and will promote interventions in less developed or transition regions. This call, 'Enhancement of Research Infrastructures' (100% of eligible costs – €5-20M), acting outside 'State Aid' regulation, allows, mainly, for purchase of scientific instrumentation, upgrade (or extension) of scientific equipment, software licenses, etc. These investments and others related to RIs considered as a national priority are also supported with national funds, through the dedicated Ordinary Fund for Public Research bodies.

In this context, it is also relevant to point to the ongoing work on the abovementioned topic of convergence between the EU FP and the Cohesion Policy, as it is the case of [Stairway to Excellence](#)⁵.

⁵ Pilot project by the European Parliament and executed by DG-JRC: <https://ec.europa.eu/jrc/en/research-topic/stairway-excellence-s2e>



ADJUSTMENT OF THE FUNDING REGULATORY FRAMEWORKS ACROSS REGIONAL, NATIONAL AND EUROPEAN LEVELS

The combination of different funding sources throughout the stages of the lifecycle of RIs requires compliance with and coordination of different frameworks and sets of regulations across regional, national and European levels. Given the differences between funding requirements of national budgets, ESIF and EU FP, a coordinated effort among EU MS, AC and the EC for the simplification of rules would contribute to reducing the overall level of bureaucracy and financial uncertainty, thus improving long-term organisational and strategic decision-making. In particular, **InRoad calls for the simplification and alignment of rules between ESIF (for R&I) and EU FP – or even the adoption of a common regulation.** This would be welcomed by the RI community. It is also worth exploring the possibility of complementarity with other funding sources for R&I, especially for forthcoming periods (e.g. InvestEU, European Investment Bank loans and others).

In cases where the provision of national resources is generally lacking, national commitments tend to be substituted with ESIF (even in pan-European RIs). As a consequence, the applicable financial regulations of ESIF can become an obstacle in certain phases and for the planning of future expenditures of the RI.

Ensuring a transitional period between implementation and operational phase that allows partial funding of operational costs through ESIF would contribute to bridging the existing gap. This holds particularly true in disciplines like data and High-Performance Computing (HPC), where systems rapidly become obsolete and host organisations are under continuous pressure to cover expenses related to software, support and maintenance. However, some conditions need to be considered. Besides planning for funding of following stages, after the period covered by ESIF, this transitional period would need to be clearly defined (for example not surpass three years), as well as coupled and dependent on a compromise for national funding. This way, RIs could have their impact and sustainability positively reinforced.

Good practice 17: Funding of start-up research activities parallel to the construction phase for a smooth transition to the operational phase.

The ERDF-ESF cross-funding scheme in the period 2007-2013 (or the analogues 15% of flexibility under the present ESIF framework) has been applied by some RIs (when foreseen in the operational programmes) to bridge the implementation and operational phases of the RIs' lifecycle. Hereby, the RIs experienced twofold benefits from the early start of research activities: (a) the bridging funding allowed to settle the RI scientific support and prepare research projects already in the final stages of the construction, by which the transition to competitive funding was shortened (analogy of 'valley of death' for commercial start-ups), and (b) the presence of the research staff in the final construction phase allowed for the installation of scientific instruments to be adjusted to concrete user needs, therefore reducing the number of adaptations in later phases.

Moreover, InRoad recommends the development of a common approach among the different countries and the EC on issues that deeply affect the multilevel articulation of the European RI ecosystem. The provision of in-kind contributions, for example, would benefit from common and clearly defined methodologies for collecting, reporting and accounting. This is particularly relevant for in-kind contributions of equipment and secondment of staff in international large-



scale facilities.⁶ Another example that illustrates this point as well is the Value Added Tax (VAT)/excise duty. Regarding abovementioned needs for a common approach and greater coordination, already existing fora (such as ESFRI) can play a pivotal role by promoting exchanges of experiences and information.

Good practice 18: Promotion of greater coordination through common frameworks with implications for RI funding. *The ERIC framework was created as a legal personality for European RIs, which is recognised by all EU MS and that has certain advantages in comparison with others such as exemption from VAT and excise duty. Thus, many of newly implemented RIs have adopted it as it is seen as a rather flexible framework with many benefits. Nevertheless, there is room for improvement in the harmonisation of interpretations among EU MS.*

SHARING OF PRACTICES AND COMMON DEVELOPMENT OF FUNDING SOLUTIONS

7

InRoad calls for fostering communication, mutual learning and cooperation through the exchange of information between RIs and other stakeholders, to promote adequate and sustainable RI funding and enhance the societal value of RIs.

Considering the diversity of RIs and of available funding instruments for their full lifecycle, it is commonly assumed that there is a need for a more efficient coordination of efforts in aligning existing resources with the needs of each individual facility. As a precondition, this requires a shared understanding among all stakeholders (including funders), supported by a common terminology (e.g. RI, national RI roadmap, lifecycle approach, long-term sustainability, access policy, business planning, and so on). It has also been stressed that a complex bureaucratic environment tends to require people with highly specialised knowledge, even for mid-size projects, in order to fulfil all requirements. Thus, while navigating the information on different funding schemes, some RI managers consider the possibility of having external help and training on how to apply for funding instruments, including for interregional cooperation.

Good practice 19: Mutual learning through the exchange of practices. *For RI managers, aside from ESFRI, initiatives and training programmes such as RI Train and Executive Masters in Management of Research Infrastructures (EMMRI) can be beneficial to learn about funding and exchange on solutions. For some user communities, COST actions, Horizon 2020 clusters and TNA projects, could be used to network and foster mutual learning. Moreover, training workshops, among other discussion fora, information days, or even twinning schemes allowing managers and staff exchanges in different RIs are valuable mechanisms to promote the exchange of experiences and even to foster the common development of solutions.*

⁶ CERIC ERIC Annual report 2017: https://www.ceric-eric.eu/wp-content/uploads/2018/06/CERIC-Report2017_spreadsDEF.pdf.



Overall, during the Validation Workshop, the issue of exchange of experiences at different levels was highly supported. Actions could be taken both at national and European levels, but also besides the managerial scope, down to operational level.

In addition to the abovementioned reasons that support the exchange of experiences among RIs, it is also important to highlight the potential for exchange and learning mechanisms between countries with similar characteristics, allowing for the comparison of information.

Good practice 20: Exchange of knowledge through appropriate platforms. *There seems to be a potential for strengthening European platforms that assure the exchange of knowledge between national and European RIs, with the possible involvement of funding agencies, in order to promote the training of their national RI staff. ERF-AISBL, as the largest association of European level RIs and networks of RIs, has already demonstrated some efforts in this direction with potential for engaging more RIs in Europe.*

DEMONSTRATION, COMMUNICATION AND DISSEMINATION OF THE SCIENTIFIC AND STRATEGIC RELEVANCE OF RIs, AS WELL AS THEIR BROADER SOCIETAL IMPACT

As demonstrated through the case studies and RTWs, RI managers are aware of the present expectations to demonstrate the value of RIs following significant investments. In this context, current difficulties in **assessing the impact of RIs show the need for coordinated efforts to develop quantitative and qualitative models.** Indeed, specialized competencies are needed in view of effective communication between the RIs and their related ecosystems. This would assure that the scientific, socio-economic and societal value and the long-term return on investment of RIs – understood as their value to the scientific community and broader public compared to their total costs – are transparent and clearly perceived. Moreover, at the political level, there is potential to further raise awareness about the relevance and importance of RIs, with a role to be played by RIs themselves through proactive development of public representation and outreach outside their institutions.

Regarding quantitative assessments, despite the need to adapt each key performance indicator (KPI) to the mission of the RI, it would be beneficial to **commonly agree on a minimal set of indicators allowing for benchmarking and international comparisons.** Nevertheless, InRoad advises to account for variation according to the RI domain and to accompany KPIs with a narrative (e.g. complementary qualitative assessments). This would limit misinterpretations of results. With regard to the socio-economic impact assessment of RIs, ongoing efforts and projects specifically dedicated to the subject deserve close attention from RI managers, funders and policy makers, as it is a topic of high relevance for RIs and the forthcoming funding periods.

While the importance of developing KPIs and other monitoring tools for performance is broadly understood by RI managers, there is not yet a clear perception of the full potential of these processes. When engaging with the funding and other relevant public authorities in the development of KPIs, RIs are taking part in the creation of standards for measuring their impact⁷ and therefore enhancing the value of the monitored results and data.

⁷ The Global Science Forum (GSF) of OECD and H2020 projects such as [RI-PATHS](#) are conducting in-depth studies on the socio-economic impact of RIs. Their work is expected to contribute to a better understanding of the socio-economic impact of RIs as well as of appropriate ways to demonstrate it.



Good practice 21: Proactive involvement of RIs in the design of impact measurement standards. For RIs that produce large amounts of data, for example, the difficulty of tracing the usage represents a bottleneck that affects the impact assessment. The Earth science RI ICOS, being aware of this, has published its impact study report after the development of a specific methodology (through a H2020 project, with the help of a consulting company), which could be later used to develop models for other RIs as well.



BEST PRACTICES AND COMMON STANDARDS FOR RI BUSINESS PLANNING

The recommendations for business planning that are outlined in this report stem from evidence collected through several stages of data collection: the InRoad consultation, three in-depth case studies involving two distributed pan-European RIs ([EMBRC](#)⁸ and [BBMRI ERIC](#)⁹), a country case study including the perspectives of a funder and three RIs (Norway), individual case studies of national and European RIs, as well as feedback obtained RTWs.

ENSURING LONG-TERM SUSTAINABILITY DURING THE FULL RI LIFECYCLE

According to the [InRoad consultation](#), two thirds of respondents considered that business plans are needed and should be included in the eligibility conditions of RI roadmaps. The information gathered from the case study interviews reveals that business planning practices are diverse and often challenging. However, it also highlights that, in addition to the science case of the RI, business plans help create value beyond monetary aspects. As data on users, services, costs and budget change constantly, a sound business plan can facilitate continuous and periodic update and refinement of a RI' strategy. Therefore, business plans are to be understood as a valuable management tool to fulfil the RI' short- and long-term objectives, and not only as an imposed requirement from funding organisations, or as a document exclusive to profit-making organisations. This does not diminish the importance of the scientific case. Rather, the business plan is a supporting document at the managerial level, which ensures the appropriate delivery of RI services.

8

InRoad recommends all RIs to develop a business plan in order to align their strategy, resources and goals and to connect their mission with national and international strategic agendas.

The business plan is a relevant tool to align the RI's internal resources with its mission. The use of specific, measurable, attainable, relevant and timely goals (SMART) is a transparent and effective way to improve performance and impact within a realistic timeframe. Business plans provide an up-to-date framework for informed decision-making by RI managers and funders. Each stage of a RI's lifecycle is linked to a distinct timeframe with specific targets. Thus, when drafting a business plan, it is important to distinguish the short- and long-term strategic goals of the RI, as the inputs and expected outcomes will vary from phase to phase. Therefore, it is highly advisable for RI managers to apply both short- and long-term thinking when drafting each section of a business plan. Moreover, the content of a business plan depends on the stage of development and the type of the RI. The business plan has to reflect the mission of the RI, its specificities (governance structure, scientific field, etc.), and those political, legal and economic aspects that are relevant to its mission. Well thought-out guidelines, therefore, may help RI managers identify the most important aspects of their strategy.

⁸ European Marine Biological Resources Centre, <http://www.embrc.eu/>.

⁹ Biobanking and BioMolecular Resources Research Infrastructure, <http://www.bbmri-eric.eu/>.



MINIMAL COMPONENTS OF A RI BUSINESS PLAN

Executive Summary	<ul style="list-style-type: none">- Description of the environment in which the RI will operate and external factors that are important for the achievement of RI goals (political, economic, scientific, technological, legal and economic context, for example the PESTLE¹⁰ analysis).
Mission and value proposition	<ul style="list-style-type: none">- Strategic objectives of the RI;- Value proposition: specific benefits the RI will provide to users, as well as its importance for regional, national and European policies and strategic priorities;- SWOT analysis¹¹.
Governance and management	<ul style="list-style-type: none">- Legal framework and parties involved;- Governance structure (e.g. steering board, scientific board, advisory committees);- Management (e.g. mandate and responsibilities);- Human resources and talent development.
Impact assessment and societal challenges	<ul style="list-style-type: none">- Economic and societal impact assessment, societal challenges addressed and alignment with identified strategic priorities (e.g. Sustainable Development Goals).
User strategy and access policy	<ul style="list-style-type: none">- Market outlook and gap analysis;- User segmentation;- Products and services offered (service catalogue);- Training activities foreseen;- User engagement and commercial policy;- Access modes and conditions;- User fees and associated funding schemes.
Data management plan	<ul style="list-style-type: none">- Data collection, organisation, storage, maintenance and associated costs;- Data protection and distribution, implementation of FAIR¹² principles, cyber security;- Decommissioning of databases and repositories.
Financial plan and funding framework	<ul style="list-style-type: none">- Description of all present and estimated funding sources, including members financial and in-kind contributions, ESIF (if applicable), project funding, user fees and charities/sponsors;- Funding model to be used for the provision of funds of the central hub (e.g. Gross domestic product (GDP) per capita or nominal GDP)- Initial and planned investments;- Full lifecycle costs, i.e. CAPEX and OPEX separate.<ul style="list-style-type: none">- Capital costs (CAPEX), e.g. construction, implementation, upgrades and decommissioning.

¹⁰ PESTLE refers to Political, Economic, Social, Scientific/Technological, Legal and Ethical factors that influence the business environment. PESTLE analysis is a widely used tool in management to assess the conditions and environment in which an organisation operates. PESTLE factors are prime determinants of strategic planning and without them organisations might fail to achieve the desired goals.

¹¹ The SWOT analysis outlines the RI's strengths, weaknesses, opportunities and threats.

¹² Findability, accessibility, interoperability and reusability.



	<ul style="list-style-type: none"> - Operational costs (OPEX), e.g. full annual costs of operation of the facility (ies), e.g. personnel, rent of building space, office expenditure, travelling, meetings, miscellaneous. - Contingency plan, including a reserved budget to cover potential financial or unforeseen risks.
Stakeholder engagement strategy	<ul style="list-style-type: none"> - Stakeholder analysis and stakeholder engagement plan to attract and retain the interest of current and potential stakeholders of the RI; - Partnership strategy.
Communication and outreach	<ul style="list-style-type: none"> - Communication plan, describing the channels deployed to convey the added-value of RI activities for science and society.
Implementation, monitoring and risk management	<ul style="list-style-type: none"> - Activity plan and milestones throughout RI lifecycle, including upgrade and decommissioning; - Internal performance monitoring, KPIs; - Risk management plan: identification and analysis of risks and mitigation strategy; - Liabilities including those associated to the maintenance of databases and repositories, even when the RI is no longer in operation.
Ethical and regulatory aspects	<ul style="list-style-type: none"> - Ethical and regulatory issues related to the scientific strategy and activities of the RI, e.g. evaluation programmes, procedures, documents, etc.
Intellectual Property Rights (IPR) management	<ul style="list-style-type: none"> - Foreseen Intellectual Property (IP) assets to be owned by the RI; - IPR policy and strategy; - IPR protection plan.

A relevant point mentioned during the case study interviews is that while the widening of membership and strengthening of partner involvement are generally perceived as important for the long-term sustainability of the RI, **bringing added value to the user communities is fundamental**. In this respect, InRoad encourages careful consideration to the questions listed below when defining the mission and value proposition of the RI:

- Who is the RI serving?
- What do users need?
- How to engage with users effectively?
- How to position RI services?

Moreover, when designing the value proposition, **RIIs are strongly encouraged to take into account the relevant external developments, in particular the national strategic agendas for science, technology and innovation in their research domain, in order to align their mission with the policy level**. Conversely, it is highly advisable that RI funders take into account the national strategic agendas when evaluating RI projects.

Good practice 22: Linking business plans with national strategic agendas. *More than 70 stakeholders in the Netherlands (including universities, foundations, industry, insurance companies, RIIs, and patient organisations)*



have committed to a nationwide initiative for personalised medicine. This bottom-up initiative stems from the national communities' desire to work together to defragment the health system in the Netherlands, as there is a general belief that there is room for further efficiency. This self-organising system seeks to integrate all efforts and capacities to connect their mission with national strategic agendas through an ambitious yet realistic business plan¹³ that will assemble all stakeholders and create a sustainable infrastructure that will facilitate world-class personalised medicine & health research in the Netherlands.

Good practice 23: Alignment of RI needs and investments with national strategic priorities. The RCN publishes national strategic priorities in different domains, the so-called 'national priority areas', in the Norwegian Roadmap for RIs. The strategic areas contain research objectives, existing RIs and possible future needs for infrastructures in various thematic areas, disciplines and technology areas. They are revised on a regular basis in response to changes in national priorities and needs specified by the research institutions. Thus, RIs applying for funding are aware of the identified national strategic priorities against which their proposals are assessed and prioritised, within their respective fields of research.

RI roadmap applications provide input to the RCN's analysis of national infrastructure needs and investments made, which makes the RCN better equipped to set strategic priorities and to target funding announcements towards specific thematic areas. This combination of top-down and bottom-up processes is an example of how integration of RIs in the national strategic research priorities can be supported.

SHORT- AND LONG-TERM FINANCIAL FORECASTING FOR ROBUST RI GROWTH

Despite the complexity of gathering **annual and lifecycle cost data**, the benefits of financial forecasting for RI evaluation in the frame of the national roadmap and for RI business planning have already been demonstrated in some cases.

Good practice 24: Annual RI full cost calculation promoted at the national level. Support measures aimed at implementing RI annual full cost calculations were initiated in 2011 by the French Ministry of Higher Education, Research and Innovation through a pilot project involving several large RIs, which was carried out in collaboration with a consulting agency. The methodology for cost calculation was subsequently optimised. Since 2016, this annual full cost calculation is part of the national RI roadmap update. All RIs included in the national roadmap are expected to submit such calculations. Representatives from EMBRC France confirmed that this exercise was very beneficial for their financial planning, as it helped ministerial representatives to better assess national nodes' contributions to distributed European RIs, and to collect additional information for negotiations on France's participation. Additionally, it has also helped the Ministry to optimise their KPIs for RI evaluation. For example, the impact of RI participation in EU FP projects and other European initiatives can be better taken into account.

Another practice highlighted in one of the case studies shows the requirement for roadmap applications of separate cost estimates and funding sources throughout the implementation

¹³ Health-RI (2017), <https://www.health-ri.org/health-ri-business-plan>



phase and for the first 10-years period running the RI. Overall, a gradual move towards the collection of annual full costs and the identification of the funding resources for all distributed RIs (including nodes) would be a desirable achievement in the mid- to long-term but is perceived as a real challenge to implement.

In addition to compulsory monetary contributions, many European RIs rely on in-kind contributions from nodes and partner institutions. As a matter of fact, in-kind contributions from members are seen as an important asset and need to be reliably evaluated. Therefore, an **in-kind contribution valuation methodology** is an important and complex area that requires improvement in the short-term. InRoad advises stakeholders to foster the necessary dialogue and to also consider measures to support national RIs in the development of such methodologies.

Furthermore, long-term sustainability requires sound **risk management**. The feedback obtained from the interviews revealed that not all RIs have adequately protected themselves from an emergency scenario by setting aside a contingency budget. Although some of them have laid down in their statutes that in the event of financial risk a member's liability shall be limited to its respective yearly contribution, it is still unclear for some ERICs whether a member's annual financial contribution could be used to cover potential financial risks straight away. The reason behind this is that public funds may be used only for the purpose(s) for which the EU MS or AC's parliament appropriated them. It is therefore advisable for the governing bodies of RIs to discuss whether the establishment of an ex-ante financial provision, i.e. a credit reserve guarantee mechanism, is needed to cover any potential financial risks.

Good practice 25: Planning a risk budget. *In its 2015 financial plan, the Dutch node of BBMRI included a budget reservation to cover potential risks. Such funds were foreseen for unexpected expenses, such as the bridging of new funding to keep services running at the node level or the start of a new activity. The budget reservation was used in 2017 while waiting for the next national roadmap call and other funding opportunities. No formula was applied to calculate it, but according to the node's coordinator, the reservation amounted to approximately 5% of the total budget.*

Furthermore, adjustments to the risk management strategy are necessary when transitioning from one phase to the other. To help deal with uncertainty and mitigate potential financial and managerial risks during both phases, scenario building, KPIs and milestones are helpful tools to set expectations and priorities, as well as to monitor progress in a transparent and factual way.

ALIGNMENT OF CENTRAL-LEVEL AND NODE BUSINESS PLANS TO REFLECT COHERENT STRATEGIES IN DISTRIBUTED PAN-EUROPEAN RIs

To achieve a greater coordination and reduce fragmentation, it is important for all members of distributed RIs – including national nodes and central hubs of international RIs – to have interlinked business plans. The feedback from the case studies' participants shows that central business plans in European distributed RIs are expected to serve as an overall framework to steer the nodes' strategies in the same direction, guiding the specialisation of nodes, and enabling the implementation of quality assurance across the whole distributed RI.

When drafting the node's business plan, it is important to take into account the local political and economic conditions, relations with regional authorities and to align its strategy with the national strategic agenda. Furthermore, InRoad recommends the inclusion of aspects that are



not covered in detail in the central business plan, such as: the coordination of participating facilities at the national node level, the overarching governance of the national network of facilities and centres, the development of the physical infrastructure, associated investments and human resources, and the portfolio of services offered by those facilities and centres.

Good practice 26: Integrated business plans at hub and node level. *The managers of the French node of EMBRC are currently considering drafting a business plan in view of the next funding application. Although having a business plan is not yet an official requirement from the funder, the node's managers believe that having a sound business plan is indispensable to justify future long-term financial needs. While the business plan at the central level has been recently updated, reflecting the overarching strategy of the distributed RI as a whole, it still does not go into detail with each node's strategic planning needs.*

Performing business planning at the national node level would also help define the **financial and operational perimeter of the RI**, and to distinguish RI services and activities from other institutional activities.

According to Validation Workshop participants, it is not a desirable strategy to compose a RI central-level business plan (e.g. for ERICs) by simply aggregating the individual nodes' business plans / business cases. Even in cases where national nodes have drafted business plans of their own prior to joining the pan-European distributed RI, it is highly advisable for those nodes (or consortium partners in the preparatory phase) to be involved in defining a coherent business plan for the pan-European RI, from the early stages of its development.

While business planning is essential, it places an additional burden on the nodes, especially when there is a lack of dedicated managerial staff. One solution to this bottleneck could be that central hub managers prepare a business plan template to be adopted by the General Assembly and used by the individual nodes.

PROFESSIONALISATION OF BUSINESS PLAN DRAFTING AND IMPLEMENTATION

In many cases, it appeared that solid business and management expertise was lacking in business plan drafting. Based also on the information gathered during the Validation Workshop, there is a need to increase the professionalisation of administrative, financial and other strategic RI activities. Thus, when appropriate, the use of external services such as consultancies, management or communication specialists with a solid understanding of the needs of RIs can help increase the quality of certain activities and improve RIs visibility. Regarding business planning in particular, it is important that consultants understand the specificities of RIs and their services. Consultants could be hired to perform market analyses, develop communication and/or commercial strategies and draft business plans.

Nevertheless, InRoad recommends that the main focus be placed on the development of internal expertise for RI management, and **encourages the development of human resources strategies to attract and retain personnel with managerial, including financial, experience.**

Additionally, science and management professionals, with separate mandates ('double-headed management structure'), are of equal importance to run RIs. Indeed, the management of RIs requires a balanced combination of both scientific and managerial expertise to effectively execute the business plan and the RI's day-to-day management activities. To support this, funding organisations and host institutions at national and European level are advised to limit formal obstacles in their procedures for hiring and retaining RI professional managers. RIs, on



the other hand, are advised to design talent management schemes in their business plans in order to justify human resource needs and associated costs.

Good practice 27: Double-headed management structure. *As stated in its internal governance documents, the management structure of the European XFEL is composed of at least two managing directors; one of which is required to be a scientist and the other one an administrative director. The appointment and division of responsibilities of the two managing directors is established by the council in the rules of procedure for the management board and the by-laws in the guidelines for selection and appointment of directors.*

BUSINESS PLAN AS A REFERENCE FOR THE DEVELOPMENT OF OTHER MORE OPERATIONAL DOCUMENTS

9

InRoad recommends the use of the business plan as a management tool, in the form of a living document aimed at ensuring the long-term sustainability of the RI.

Long-term sustainability is an issue that raises concern among RI managers. State-of-the-art research facilities require stable and predictable funding frameworks to excel, and also effective management systems in place to execute their strategy with a long-term perspective.

Each of the aforementioned business plan components must be described in a short and concise manner, using diagrams and tables whenever applicable. Separate business plan sections can then be (and, in many cases, are) developed into separate, more comprehensive operational documents, such as Socio-Economic Impact Assessment, Access policy, Data management plan, Financial plan, Communication, Implementation plan. The business plan is also often used as a basis for drafting an Annual Work Programme. A concise business plan would facilitate their use as management tools and serve as a regularly updated reference document. Therefore, InRoad recommends using the business plan as a reference for the development of those documents.

Good practice 28: RI Business Plans as a reference point for other operational documents. *The initial business plan of ECCSEL ERIC¹⁴, a pan-European distributed RI in the field of Energy, was drafted and reviewed in the preparatory phase, updated during the implementation phase, and then used by the ERIC to develop the operational plan to be implemented also by the RI nodes. In quite a few areas the nodes use the business plan for the day-to-day management, using specific sections, e.g. for handling routines or as a reference to point out the direction in which they should develop. An important part of the business plan for this RI is the infrastructure investment plan for future investments, used directly by the central hub for planning.*

¹⁴ ECCSEL ERIC: European Carbon Dioxide Capture and Storage Laboratory Infrastructure <http://www.eccsel.org/>



USAGE AND PERIODIC UPDATE OF THE BUSINESS PLAN THROUGHOUT THE ENTIRE RI LIFECYCLE

It is important to note that business plans are living documents. Hence, reviewing them on a regular basis is beneficial to assess whether the RI' strategy is still in line with the initial objectives, or whether further adjustments are needed to meet them.

Successful engagement with existing and potential user communities is seen as a key factor to ensure the operational sustainability of the RI. A description of the potential user communities during the preparatory phase is as important as performing an updated **analysis of the user segments** throughout the RI's lifecycle.

Other important elements of continuous business planning are **monitoring mechanisms**. These are not only vital to ensure a constant flow of information among all relevant parties, but also to achieve greater organisational efficiency. KPIs, when appropriately used, can be a valuable tool to help retain focus on objectives and to better understand the factors involved in achieving them (or, conversely, in failing to achieve them). At the same time, relying on them as a single measure of success can distort the way in which the RI performs and how its performance is perceived. Therefore, it is advisable to combine their use with additional measures, such as regular meetings, periodic internal reports or feedback from external stakeholders.

For distributed RIs, KPIs developed centrally and adapted to meet specific node needs make it possible to supervise operational progress. Understanding KPIs and selecting those that are best suited to track performance is viewed as highly important by some of the interviewees. Furthermore, as funding for science in Europe comes under pressure to show what recent investments have returned, InRoad encourages RI managers to strive to gather evidence and not to see KPIs as a threat to the RI, but as an opportunity to demonstrate the value that their services bring to science, society and the economy. In particular, large-scale facilities with financial and in-kind contributions from various international stakeholders have a duty to collect such metrics to help funders understand the Return on Investment (RoI). However, different RIs might use different metrics in accordance with their type and scientific field.

Good practice 29: KPIs for monitoring short- and long-term performance. *ECCSEL started developing KPIs during its preparatory phase in order to measure its short-term performance. After two years of implementation, the RI applied for the ERIC status and included additional KPIs in the application. Now that ECCSEL ERIC is in operation, the central hub is preparing the monitoring of short-term KPIs on a running basis, gathering online reports from the facilities (e.g. on facility usage). The intention is that parts of the KPIs are also used by the nodes to monitor their own performance at the national level. And currently, at the ERIC central-level new KPIs to measure long-term performance are being developed, e.g. KPIs to track the closing of technology gaps.*



10 **InRoad recommends early and continuous stakeholder involvement for the development, implementation and updating of a sound business plan.**

The feedback obtained from some of the case study interviews shows that an early and continued involvement of all stakeholders is vital for the RI's long-term sustainability. Some respondents from the case studies pointed out that the involvement of users and other direct stakeholders, in particular host institutions and RI managers, in the design of the business plan and in subsequent updates can be useful to obtain feedback, direction and commitment for the long-term RI strategy. This will also allow the alignment of the RI business plan with the institutional research agenda and institutional strategic priorities.

Good practice 30: Involvement of stakeholders in the development of the RI business plan. *EMBRC is a European distributed infrastructure with nodes that are located and firmly rooted in peripheral maritime regions. The authorities and clusters in these maritime regions are part of the governance of EMBRC and have been actively involved from an early stage in the RI business model development. This is especially important for this RI, as regional financial support has been and continues to be an important factor for its long-term sustainability.*

BUSINESS PLANS AS A REQUIREMENT IN NATIONAL RI ROADMAP AND FUNDING APPLICATIONS AND AS AN EVALUATION CRITERION

The requirement from funders and policymakers of a business plan for RI roadmap and funding applications can lead to a greater understanding of the importance of business plans throughout all stages of the RI lifecycle and help further develop a management culture adapted to scientific communities. **InRoad underlines that comprehensive business plans are an essential criterion especially when the roadmap evaluation is linked to funding decisions.** Under special circumstances, in cases when the RI project is still in its early stages of development (e.g. design phase), presenting a business case instead of a full business plan can be deemed sufficient.

Regardless of whether they belong to a pan-European or a national RI, all applicants of national RI proposals are encouraged to submit a business plan to the national roadmap and funding applications. In that respect, support measures to improve business plan preparation could be considered. National policy makers and funders are therefore invited to reflect on essential elements of the RI business plan, as described in recommendation 8. InRoad encourages funding organisations to promote business planning expertise within their organisations – or to involve external experts – in order to reinforce the assessment of RI business plans in their roadmap and funding procedures.

To support this, a pool of international experts comprised of individuals with business management experience, scientific expertise and an understanding of RI development and operation could be developed, either at the national level or through joint efforts of national funding agencies and ministries. The involvement of international expert panels is already in place in



some national RI evaluation procedures, although those experts are mainly involved in the science case assessment. When the science case and the business case are brought together for an integral assessment of the RI application, it would be beneficial for the international panel to involve expertise on business planning.

DEVELOPMENT OF TRAINING SCHEMES, EXCHANGE OF PRACTICES AND MUTUAL LEARNING EXERCISES

The analysis carried out by InRoad shows that support measures for RI managers can facilitate the exchange of good practices and support coordination. At the European level, different fora (ERIC forum, LEAPS initiative, EIROforum, e-IRG) as well as ESFRI already provide platforms for discussions and sharing of experience.

Regarding training activities to improve the professionalisation of RI management, the RI-Train project and the corresponding EMMRI are excellent initiatives, which respond to a real demand and therefore enjoy great popularity. **InRoad calls for a broader offer and extension of training opportunities backed by R&I framework programme funding and other sources.**

Moreover, it was suggested by some of the Validation Workshop participants to create a pool of experts at the European level, so that RI managers can turn to them for advice. This action could be promoted by strategic RI bodies, such as ESFRI or the Science Europe Working Group on RIs and possibly implemented by funding organisations.

Good practice 31: Exchange of practices and mutual learning. *National research councils and other funding organisations could have a role in providing support to applicants for RI roadmap funding to exchange practices and learn from existing RI business planning. The RCN organises at least every second year workshops for RI managers. In these workshops, they have the opportunity to exchange about business planning, discussing best practices, challenges they face and learn from each other.*



CONCLUSION

The relevance of InRoad's findings was made clear throughout various developments, from the Bulgarian presidency's flagship conference on RIs in March 2018 – '[Research Infrastructures beyond 2020 – sustainable and effective ecosystem for science and society](#)' – to the recent [International Conference on Research Infrastructures](#) (ICRI) in Vienna, in September 2018. The launch of the [ESFRI Roadmap 2018](#), a few days before, also allowed European RI stakeholders to take stock of the progress made and developments to come in the European RI landscape. InRoad would also like to acknowledge the [Competitiveness Council conclusions](#) of May 2018, in particular the importance of the conclusions on coordination and long-term sustainability within the European RI landscape.

In this context, the results presented in this report aim to feed into crucial discussions that are currently taking place at European level. This report is designed to support the evolution of existing policies and the development of new ones. It must be stressed that RIs are an essential pillar of European R&I, and key to achieving the goals of the ERA. Moreover, as described in this report, they contribute to Europe's competitiveness and to solving societal challenges. Therefore, reducing fragmentation and achieving a higher degree of coordination is essential. To support this objective, InRoad has gathered evidence for two years and developed policy insights. As a culmination of this work, the present report put forward 10 recommendations in three key areas: first, the coordination between national RI roadmapping processes; second, the coordination between regional, national and European funding frameworks; and third, best practices and common trends for RI business planning. While all these areas are distinct and require different approaches to solve existing bottlenecks, they are all key to achieving a more sustainable RI landscape in Europe.

We believe that this report does not mark the end but the start of more in-depth discussions, which will have a clear impact on the structuring of the European RI landscape and the ERA. We call upon ESFRI, Science Europe, the ERIC Forum, ERF and others to take up our recommendations and insights, and to translate them into direct measures that will enhance coordination and support the uptake of best practices.

Therefore, as final words, InRoad would like to address the vast and diverse communities for whom this report was developed: policymakers, funders, scientific and industrial users, and RI managers. It will be up to them to continue the work started by InRoad, and to implement the policies and practices that will support the whole ecosystem of RIs, and keep Europe at the forefront of science. InRoad encourages all stakeholders to continue exchanging and working together to find common solutions to existing challenges, and to build a bright future for European research.



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ANNEX I: REPORT ON GOOD PRACTICES AND COMMON TRENDS OF NATIONAL RI ROADMAPPING PROCEDURE AND EVALUATION MECHANISMS

EXECUTIVE SUMMARY

The Annex I describes and analyses national research infrastructure (RI) roadmapping procedures, as well as evaluations and monitoring processes in Europe. For this purpose, four case studies (Finland, Netherlands, Czech Republic and Sweden) of national roadmapping processes were conducted, from which good practices and key results were derived. Furthermore, a desk study was carried out to compare national procedures for the evaluation and monitoring of RIs and to identify additional good practices. On the basis of a cross-country analysis, the results of the consultation and survey (compendium) conducted in 2017 on national roadmapping processes were also evaluated and compared. The results of the different data sources as well as the good practices were the basis for the policy insights on coordination between national and European RI roadmapping processes and embedding RI roadmapping processes in national research and innovation systems formulated in the InRoad final report. In general the results showed a great diversity and heterogeneity in the respective national roadmapping processes, yet also some good practices were identified which could contribute to a better coordination of these processes.



ABBREVIATIONS

AC	Associated Countries to Horizon 2020
ECS	Dutch Ministry of Education, Culture and Sciences
ERA	European Research Area
ERDF	European Regional Development Fund
ESFRI	European Strategic Forum for Research Infrastructures
ESIF	European Structural and Investment Fund
FIRI-Committee	Finnish Research Infrastructure Committee
Formas	Swedish Council for Environment, Agricultural Sciences and Spatial Planning
FORTE	Swedish Council for Health, Working Life and Welfare
GDP	Gross Domestic Product
HR	Human Resources
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
M&E	Monitoring and evaluation
MEYS	Ministry of Education, Youth and Sports (Czech Republic)
MS	Member States
NRRI	National Roadmap for Research Infrastructures (Bulgaria)
NWO	Netherlands Organisation for Scientific Research
OP RDI	Operational Programme Research and Development for Innovation
R&D	Research and Development
R&I	Research and Innovation
RDI Council	Research, Development and Innovation Council (Czech Republic)
RFI	Swedish Research Council for Research Infrastructures (Rådet för forskningens infrastrukturer)
RI	Research Infrastructure
STI	Science, Technology and Innovation
SUHF	Association of Swedish Higher Education Institutions (Sveriges universitets – och högskoleförbund)
URFI	Universities' Reference Group for Research Infrastructures (Sweden)
VINNOVA	Swedish Agency for Innovation Systems
VR	Swedish Research Council (Vetenskapsrådet)



INTRODUCTION

The objectives of this Annex, based on the InRoad Deliverable 3.3 (D3.3), are to describe common trends and good practices in national RI roadmapping procedures and evaluation in Europe. This should serve to clarify whether or not European Member States (MS) and Associated Countries (AC) coordinate with the European Strategy Forum on Research Infrastructure (ESFRI) roadmapping processes and what opportunities and constraints that presents in terms of coordinating RI from national to EU-level. The target group for this report are primarily actors in charge of coordinating national RI roadmapping processes, policy makers and funders.

The research interest of the four case studies follows the overall research interests of InRoad. To strengthen the sustainability of the RI landscape in Europe, InRoad seeks to define good practice in national RI roadmap processes in order to increase harmonisation and coordination across national processes and at a European level (ESFRI roadmapping process).

Based on this research interest, the case studies should contribute to identifying good practices and lessons learnt in terms of RI roadmapping at national level and their alignment with the ESFRI roadmap.

The main research questions were formulated as follows.

1. What are the detailed steps taken in the realisation of the national RI roadmap?
2. What are the mechanisms in place for coordination with other countries and with the roadmap process at European level (ESFRI roadmap)?
3. How do the relevant actors identify benchmark elements within a national RI roadmap processes that would contribute to better coordination with other countries and with the roadmap process at European level (ESFRI roadmap)?

METHODOLOGY

The identification of common trends and good practices in national RI roadmapping and evaluation in EU Member States/Associated Countries (MS/AC) was organised in four major steps: 1) Consultation, validated compendium, national roadmaps, 2) Case studies and desk studies, 3) Validation workshop, 4) Analysis and Discussion.

The data gathered from 27 EU MS/AC during the InRoad consultation conducted from May to June 2017 with its subsequent [consultation report](#) and the [InRoad compendium](#), formed the basis of the analysis. Moreover, national roadmaps and further national RI documents were used not only to assess common trends, but also to identify good practices in national RI roadmapping processes, and evaluation and monitoring procedures.

The unit chosen for the case study analysis is the entire decision-making process for one cycle of a national RI roadmapping process. This includes all relevant aspects at the system level, the process level as well as the actor level. In order to identify good practices, the selection of cases considered countries with more experience with national RI roadmapping over broad representation and therefore the selected national RI roadmapping process had to meet the following criteria:

- is based on previous RI roadmapping exercises (min. one roadmap update);
- includes an assessment of the European and national research landscape;
- includes a scientific and economic evaluation of new and existing projects;
- includes a business plan as an eligibility criterion;
- is linked to national research priorities in general;



- is linked to funding commitments;
- is coordinated with roadmapping at EU level.

Moreover, the selection of cases focused on relatively small European countries from different parts of Europe with particular demand for prioritisation of public funding for large-scale RIs and that participated in the InRoad consultation process. The selection matrix is detailed in Annex 1 of Deliverable 3.3.

Based on these criteria and preconditions, the following four countries were selected: Sweden, Czech Republic, Netherlands and Finland.

The analyses and results presented in this report are based on a total of 30 interviews conducted with actors involved in RI roadmapping processes in these four selected countries: representatives from ministries and funding agencies, advisers and RI representatives. The interview guide and list of interviewees can be found in Annexes 2 and 3 of InRoad Deliverable 3.3 respectively. The interviews provide detailed background information on the processes and actors in national RI roadmapping processes, and evaluation and monitoring procedures. The interviews were transcribed and good practices from these four countries were extracted.

Similarly, desk studies regarding Bulgaria, Czech Republic, and Ireland on the monitoring and evaluation in national RI roadmaps in Europe was carried out and corresponding good practices identified (see details in synthesis of country desk studies on monitoring and evaluation). Desk studies from a larger set of countries in Europe were used to derive common trends in monitoring and evaluation.

The identified good practices were generalised and potential recommendations developed. Together with the description of needs and first trends in the development of ESFRI roadmap processes, the recommendations were further described and structured in two thematic sections; 1) coordination between national and European roadmapping processes, and 2) embedding RI roadmapping processes in national research and innovation systems.

Finally, during the Validation Workshop (2-3. October 2018), the potential recommendations from the four country case studies were introduced to all participants in a plenary session. The potential recommendations were then interactively discussed during table discussions and broadly validated by the 73 participants coming from 21 different countries.

ANALYSIS

Data was analysed based on the compendium indicators and information from national roadmaps. A trend is understood here to be either a certain development over time or a certain pattern of parameters that can be observed over a given time period. These common trends were interpreted with respect to their potential connection to ESFRI processes or other influences (regional, country or country internal influences), if evidence was available from the data. Common trends were also interpreted in terms of the direction of development, converging, diverging or stabilising, respectively.

The results were further discussed with respect to applicability in different country settings in Europe (e.g. countries with a small national budget for RI compared to countries with a larger RI budget). In summary, the positively tested recommendations and the set of good practices are presented as key findings.



SYNTHESIS OF CASES STUDIES ON NATIONAL RI ROADMAPPING PROCESSES

The following case studies provide an overview of the national RI roadmapping processes of Finland, Netherlands, Czech Republic and Sweden according to the methodology described in the introduction. For each case study, the implementation of the roadmapping process is described, as well as the current roadmapping process and the actors involved. An analysis of the process (in terms of strengths and potential bottlenecks) is provided, and good practices are identified for each case.

THE FINNISH RI ROADMAPPING PROCESS

In the following the implementation of the RI roadmapping process in Finland, as well as its current design and methodologies are described. The primary actors active in the process and their roles are identified. The analysis identifies good practices in the Finnish roadmapping process. This overview is based on a desk review of the documents related to RI roadmapping in the Finland, as well as interviews with key actors involved in the process.

IMPLEMENTATION OF THE FINNISH NATIONAL RI ROADMAPPING PROCESS

Following the first ESFRI roadmap needs assessment to construct and update RIs at the European level in 2006 and the EU's Competitiveness Council recommendation on the preparation of national-level roadmaps to the MS, Finland prepared its first national roadmap which was published in 2009. The purpose of this first national roadmap was to identify RIs that would be required for the following 10–15 years to meet both national needs and international RI developments such as ESFRI.

For this roadmap, an intersectoral steering group including representatives from administration, scientific communities, funding parties and the private sector was tasked with:

- 1) Developing a proposal of procedures to identify and evaluate the needs for establishing new national RIs or for developing existing RI and the procedures for prioritising such projects;
- 2) Developing a proposal for a RI funding system including the division of tasks among financing parties with respect to common RIs associated with multiple organisations or different sectors of administration as well as international RI;
- 3) Conducting a preliminary inventory in collaboration with the Research Councils of the Academy of Finland and Tekes of significant national RI and to make proposals for their renewal and development (Ministry of Education 2009).

Inventory of needs

With funding from the Ministry of Education to carry out the inventory, the intersectoral steering group was appointed. The inventory and the preparation of the roadmap during 2008 was then conducted by the Federation of Finnish Learned Societies in connection with various parties that made additional proposals for participation in present or future international RIs.

The resulting Finnish roadmap published in 2009 covered the inventory of 24 existing projects of significant national-level infrastructures in Finland including information on their estimated operating costs and numbers of users in 2007, grouped according to thematic ESFRI categories. The roadmap also detailed Finnish involvement in significant international infrastructures, with information on membership fees in 2007 and the year of affiliation.



New national-level and ESFRI RIs with Finnish participation for the roadmap were listed including the estimated time of construction, estimated construction and operational costs for Finland and their connection with ESFRI. Additionally, national or international proposals that may develop into significant national RIs by the merging of particular projects in order to reinforce the national RI capacity or by meeting other requirements were detailed.

General recommendations as well as specific recommendations for each thematic RI area were described, based on the needs of the Finnish R&I system as a whole and for its contributing thematic areas. These recommendations cover issues such as clustering and interdisciplinary cooperation, funding and costs recording, internationalisation, digitisation, as well as the need for a RI policy, among others in a qualitative manner (Ministry of Education, Science and Culture 2009).

CURRENT FINNISH RI STRATEGY AND ROADMAPPING PROCESS

The 2009 roadmap and its recommendations resulted in a broader discussion of Finland's RIs. Finland's Ministry of Education, Science and Culture assigned the task of administering the country's national RI policy to the Academy of Finland. The Academy established a broad-based committee of experts across disciplines, ministries and innovation partners, the Finnish Research Infrastructure Committee (FIRI-Committee), for this purpose.

Finland's Strategy and Roadmap for Research Infrastructures 2014–2020, published in 2014, includes Finland's first-ever RI strategy and an updated roadmap for 2014–2020. This RI strategy governs the Finnish RI ecosystem including major national RI, Finnish partnerships within ESFRI projects, memberships of other international RIs and research organisations' strategically significant RIs.

The Strategy and Roadmap for Research Infrastructures is a plan. It covers the national RIs to be developed and what will require renewal over the next 10 to 15 years. The 2014–2020 roadmap includes 31 national RIs, 18 of which are with ESFRI. The selection criteria include; RI importance to the Finnish scientific community and to the research strategies of the host organisations, the breadth of the user community, the need for funding and the long-term commitment of the host institutions (Academy of Finland 2014).

Landscape analysis

The Finnish roadmap includes a description of opportunities and challenges for the systematic development of RI in the hope that Finland will gain recognition for its internationally competitive science and high-quality RI, which would enable the renewal of learning, society and the business sector by 2020.

Action plan

In order to meet this vision by 2020, clear actions were described with respect to the long-term development of all RI, improvements of access to and collaborative use of RI, shoring up of the funding base of RI, the provision of a firm basis through the roadmap for the methodical development of RI and the evaluation of the impact and significance of RI. The selection process and criteria were described in a transparent way and published.

The plan is targeted to be useful to universities and research institutes in their development of research quality within their research environments, while strengthening the impact of research and promoting internationalisation. Additionally, the overview of the development phase of the RI ecosystem will support the work of the ministries, as well as innovation within the private sector (Academy of Finland 2014).



Methodology to select RIs for the roadmap

The Academy of Finland provides funding for RIs based on competition. This means that a RI that succeeds in a competition to be listed on the national Finnish roadmap is not necessarily guaranteed funding and must compete with others in further open calls on an annual basis. Academy of Finland funding is dedicated to upgrading high-quality RIs e.g. in order to proceed to international RIs like ESFRI and to cover some membership fees.

National roadmap RI proposals from research organisations are evaluated in a two-stage process by international panels of experts representing the specific proposal disciplines. The assessment criteria include general and specific criteria. The specific criteria include:

- Scientific quality and potential;
- Open access and utilisation, Finish and international users;
- Relevance to the strategies of the host institutions;
- National and international relevance;
- Feasibility.

Based on the assessment results, the FIRI-Committee decides which RIs to include on the national roadmap. The process is schematically depicted in Figure 1.

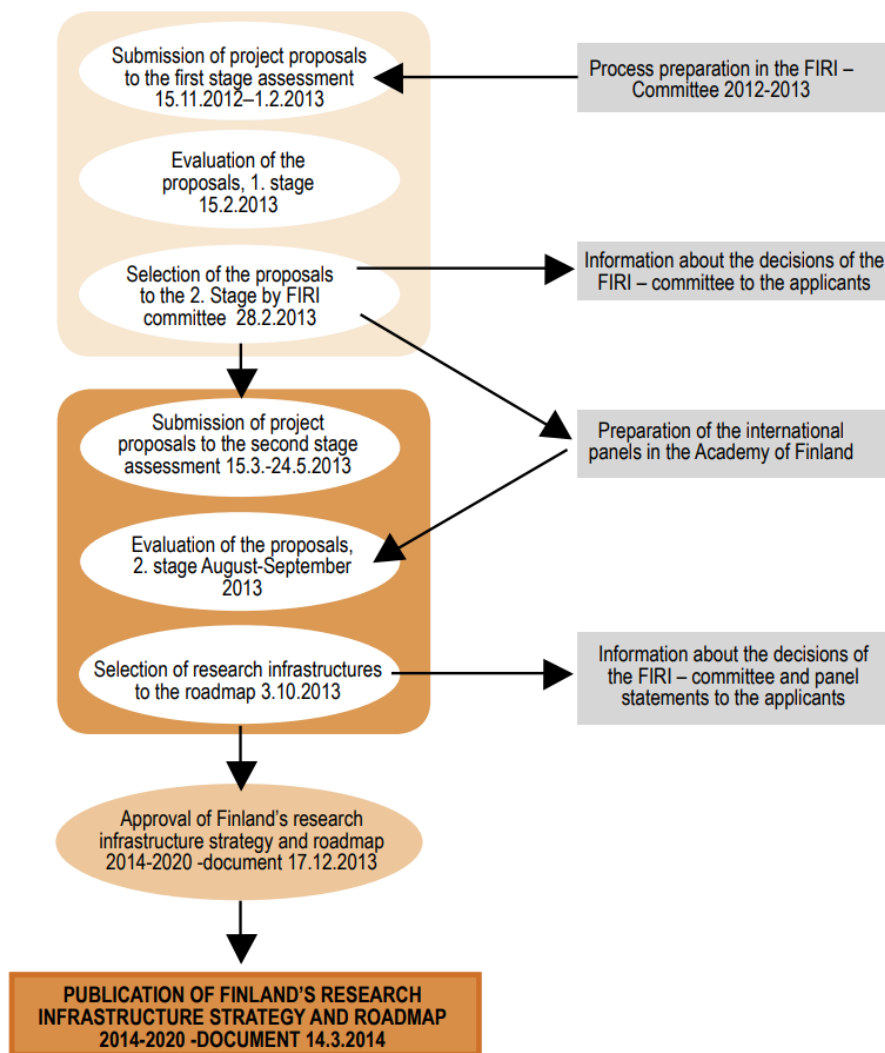


Figure 1: Process for selecting RI for the national roadmap in Finland (Academy of Finland 2014, p. 17).



Methodology to monitor existing RIs which are already on the roadmap

In 2017, the Academy of Finland performed the mid-term evaluation of the Finnish strategy and roadmap and finished this process in May 2018. The decision to perform such an evaluation halfway through the period of roadmap validity was strategically planned in the 2014 roadmap. The steps for this process included a call for RI that were already on the roadmap, an evaluation, assessment of the fulfilment of the plan, and public seminars to report and discuss the results, as illustrated in the figure below. The RIs included on the Finnish roadmap 2014–2020 are shown in Academy of Finland (2018, p. 16).

The procedure for the mid-term evaluation is presented in the Figure 2.

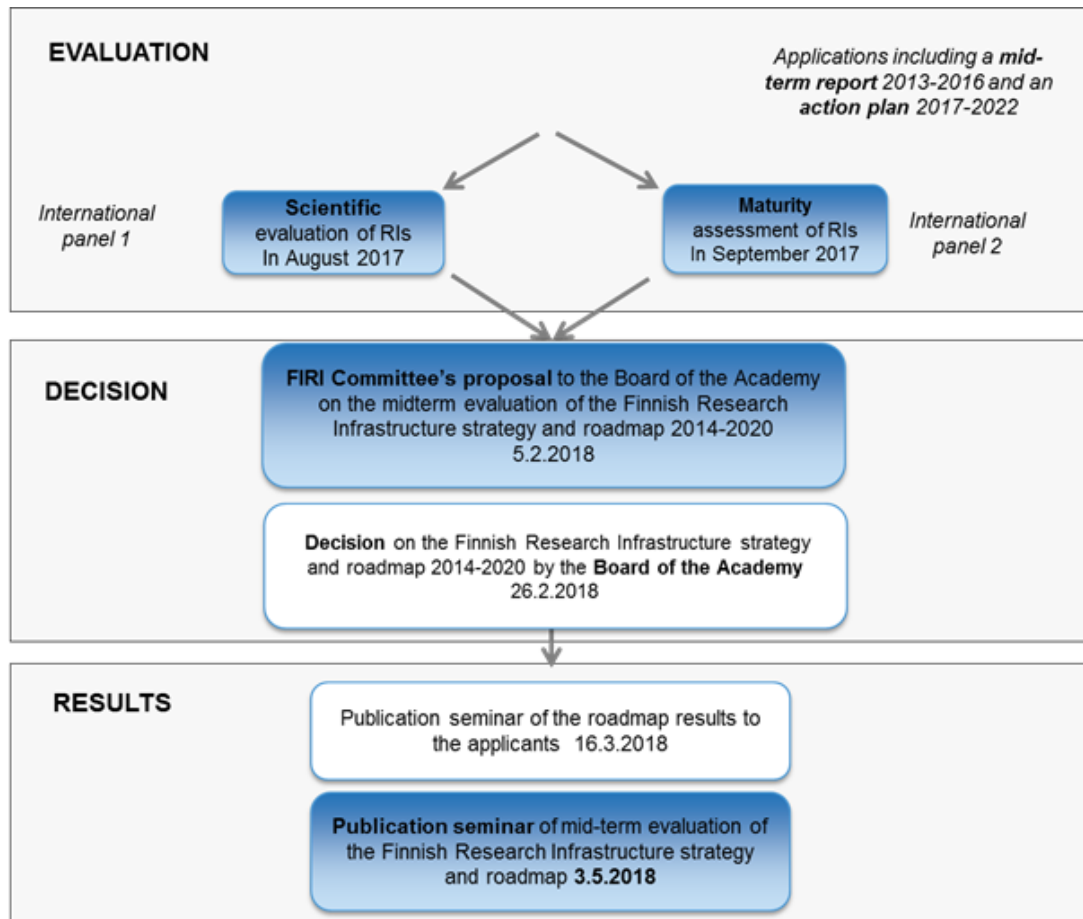


Figure 2: Finnish mid-term evaluation procedure (adapted from Academy of Finland 2018, p. 15).

For this mid-term review, the Academy of Finland opened a call for RI mid-term evaluation to those RIs that were already on the roadmap and also those eight RIs that got funding outside of the roadmap from 2013 through to 2016. Based on the strategic plans of the Finnish research organisations and universities and their willingness to commit to funding these RIs for decades, they submitted 41 RI proposals altogether to the Academy of Finland (Academy of Finland 2018).

All of the proposals were evaluated by two different panels: the scientific panel and after that the so-called RI panel. The scientific panel evaluated all aspects of scientific relevance and the RI panel evaluated RI-specific issues such as governance, long-term sustainability, organisational and managerial issues, etc. The same criteria were used for all proposals irrespective of

their specific scientific field by one evaluation panel, which required the selection of panellists with expertise that covered a wide range of areas. However, different evaluation criteria were applied in 2018 which were dependent on the specific RI lifecycle phase that was presented in the proposal, distinguishing RIs that are already on the roadmap from those that are not yet or those that belong to other international memberships. Likewise, there will be FIRI funding calls with respect to RI roadmap inclusion and categorisation (Table 1).

Table 1: Finnish roadmap evaluation criteria for RI on the roadmap 2014–2020, international memberships, and RI outside of the roadmap (Academy of Finland 2018 p. 19).

Review RI	RI on the roadmap					
	A: Very ad- vanced	B: Advanced	C: Promis- ing	D: Under Ob- servation	E: Other intern. Member- ship	F: Outside road-map
Level of ad- vancement	yes	yes	yes	yes	yes	yes
Promotion of science	no	no	yes	yes	no	yes
Development needs	no	yes	no	yes	no	no
Funding in FIRI call						
Roadmap call	eligible	eligible	eligible	eligible	eligible	in-eligible
New initiatives call	ineligible	ineligible	ineligible	ineligible	ineligible	eligible

All RI applications were evaluated on their specific level of advancement; however, RIs in the very advanced or advanced categories and international member infrastructures no longer needed to present the ways by which they have advanced scientific research in their applications. For these RIs, the results of the 2018 interim review are sufficiently convincing to be considered reliable until 2020.

Scientific advancement will continue to be evaluated annually for applications filed as promising RIs, RIs under observation, and RIs outside of the roadmap, including new initiatives. Future FIRI funding calls will also evaluate how RIs in the advanced category have been able to address the developmental needs identified in the mid-term review. As a prerequisite of continued FIRI funding, these development needs must have been successfully addressed. In the case of RIs under observation, if the identified developmental needs are significant, they must be addressed as a prerequisite to continued FIRI funding and the continued inclusion of the RI in the next roadmap. For the evaluation of RI proposals that are attempting to enter the ESFRI Roadmap, one crucial criterion that must be met is that there is a sufficient number of users for the RI in Finland.

The evaluation results of the two panels were submitted to the FIRI-Committee who then made the final decision on which RIs out of the 41 are to be taken into the roadmap for the next three years. Simultaneously, the mid-term evaluation fed into the development of a new

RI strategy for the years 2017 until 2020 carried out by the FIRI-Committee, which was approved by the board of the Academy of Finland.

The results from the mid-term evaluation and the new strategy were published in two seminars to inform the wider public and to collect feedback with a view to further improvements. The first seminar (March 2018) with focus on the roadmap took place to inform the RI managers who submitted proposals on the outcome of the evaluation, while the subsequent seminar included the presentation of the new strategy (May 2018) and presented the whole report to the wider public. The evaluation criteria for RIs including eligibility, general and specific evaluation criteria are shown in Academy of Finland (2018).

ACTORS INVOLVED IN THE FINNISH RI ROADMAPPING PROCESS

The table below summarises the role of the actors involved in the Finnish roadmapping process. This is a summary and not a comprehensive overview as, for example, the full list of stakeholders involved in the amendment procedure is not public. The detailed description of the actors and the Finnish R&I system is described in the InRoad Deliverable D3.3.

Table 2: Composition and tasks of actors involved in the national RI roadmapping process in Finland.

Actors	Composition	Tasks
FIRI committee	<p>A broad-based expert group with key actors in RI policy, such as representatives of</p> <ul style="list-style-type: none"> • Academy of Finland; • Ministry of Education, Science and Culture; • Ministry of Employment and the Economy; • Ministry of Social Affairs and Health; • Business Finland; • Finnish universities; • Universities Finland UNIFI; • state research institutes; • the Council of Research Institute Directors; • Rectors' Conference of Finnish Universities of Applied Sciences. <p>The chair of the expert group must be broadly representative of the RI field</p>	<p>Monitoring and developing national and international RI operations;</p> <p>Proposing a long-term plan for RI to the Board of the Academy;</p> <p>Deciding on the selection of RI projects and the oversight of their progress;</p> <p>Attending to other matters concerning RI, as assigned by the Board of the Academy.</p>
Two international expert panels	See Academy of Finland, 2018, p. 27	One of the panels evaluates the RI for their scientific quality, potential for renewal and impact. The second panel focuses on evaluating the organisational



		level of development of the RIs in terms of their ability to provide their stated services
Academy of Finland	<ul style="list-style-type: none"> • Research Council for Biosciences and Environment • Research Council for Culture and Society • Research Council for Natural Sciences and Engineering and • Research Council for Health. <p>After the merging of two of these councils, from January 1st, 2019, there will be:</p> <ul style="list-style-type: none"> • Research Council for Biosciences, Health and the Environment • Research Council for Culture and Society, and • Research Council for Natural Sciences and Engineering 	Facilitating and supporting scientific research through the provision of funding and through international cooperation. It also plays an important role in science policy development and implementation and provides other expert services as laid down by government decree or as prescribed by the Ministry.
Finnish Research and Innovation Council	<ul style="list-style-type: none"> • Prime Minister (chair) • Minister of Education and the Minister of Economic Affairs (Vice-Chairs together with one more minister) • Five other members appointed by the Government 	Discussing key issues relating to the development of R&I policy that supports wellbeing, growth and competitiveness; Advising the Finnish government on R&I.
Department for Higher Education and Science Policy of the Ministry of Education, Science and Culture		Participating in the development of RI collaboration at national, Nordic, European and international level; Discussing key issues relating to the development of R&I policy that supports wellbeing, growth and competitiveness; in charge of Finland's membership in several international and European RIs; Participating in ESFRI, eIRG, ERIC Committee and in the preparation and governance of several ERICs and other European RIs;



		Engaging actively in the Nordic Council of Ministers and its sub-organisation, NordForsk, to develop RI collaboration at Nordic level.
Strategic Research Council at the Academy of Finland	Representatives from <ul style="list-style-type: none"> • Ilmarinen Mutual Pension Insurance Company • Aalto University • University of Helsinki • Fortum Corporation • University of Tampere • University of Jyväskylä • VTT Technical Research Centre of Finland 	<ul style="list-style-type: none"> • Developing a reference framework for strategic research in Finland, and to provide funding to long-term and programme-based research. • Responsible for project follow-up and impact assessment

ANALYSIS OF THE FINNISH CASE

From the beginning the Finnish RI roadmap process has been designed as a transparent national RI strategic plan balancing national RI needs with RI costs information and available research capacities towards a national vision. The tight integration of the RI strategy and roadmap in a plan is fully implemented and expressed in the last documents, '[Finland's Strategy and Roadmap for Research Infrastructures 2014–2020](#)' and its related [interim review report 2018](#). In order to fulfil this plan, intensive consultations with all national actors and international advisors involved have taken place. Structural changes were implemented, such as the establishment of the FIRI-Committee and the revision of the task distribution among the other involved actors. Concrete measures to implement the strategy and roadmap recommendations were setup for different time-frames and the progress and challenges have been continuously reviewed and publicly reported.

The perspective of the Finnish ecosystem integrates national, international and local RIs as elements of one dynamic system with respect to the RI lifecycle and synergies among RIs. Finland also recognised the need for core RIs that provide data and IT services for the whole Finnish RI ecosystem as all RIs have been providing more and more data and require similar services such as storage and retrieval. Through a continuous public engagement process and understanding of the Finnish RI ecosystem, the RI strategy and roadmap has been developed and mainstreamed nationally and internationally.

While the main elements of the roadmap process and the strategy were both established early, the Finnish internal and public engagement process has also been beneficial to foster collaboration and collect feedback in order to continuously further improve, fine-tune and adjust roadmapping elements to better fit to the Finnish R&I system and vision, as well as to promote the joint use, openness and funding base. For coherence between national RI strategies and the roadmap, related strategies and structures have been similarly adjusted in RI host and user organisations such as universities, research organisations, innovation and funding bodies, as well as education institutions.

The results of the first impact assessment of these steps seem promising and point to the overall soundness of the implemented measures at national level. One challenge is to more clearly identify actual RI users in the different disciplinary and interdisciplinary scientific, in-



novation as well as socio-economic domains, trace the RI impacts to these different users and get a more comprehensive assessment of the scientific, innovation and socio-economic impacts. This would again provide evidence for further improving the RI ecosystem, its supporting measures related to the RI strategy and RI roadmap processes. Furthermore, with that assessment, both users and also new funders could be more closely integrated to the RI ecosystem, thus further improving the overall Finnish R&I system performance. For this impact assessment, the current ESFRI process on monitoring ESFRI landmarks might also be inspiring from a national perspective.

GOOD PRACTICES FROM THE FINNISH CASE

1. *Finland has introduced a RI committee, staffed with highly qualified professionals from various thematic disciplines and different R&I organisations which are tasked with designing, developing and coordinating long-term RI strategies and processes in interaction with their respective state governments. This way **national RI decision-making processes, strategies, budget allocation and prioritisation are streamlined and shaped by an established group of experts.***
2. ***Finland follows a systematic, integrated and cross-ministerial approach for the development of their RI ecosystem and has developed an overall vision and roadmap for its research innovation system.** The 2014–2020 RI strategy specifies objectives and a program of interlinked short- as well as long-term measures for RIs. These measures are regularly monitored, discussed and adjusted if necessary. The longevity of infrastructure funding in Finland is achieved through collaboration. While the Academy of Finland provides funding primarily during the RI construction, the operating costs are paid by the RI host. To extend RI funding, opportunities and principles for cooperation at the national level and between RIs are pursued.*
3. ***In Finland, transparency and a feedback culture is practiced in the national roadmap process.** For example, livecasting of seminars in Finland offered national stakeholders as well as stakeholders from other countries the option to participate in the public discussion of the interim review of the strategy and roadmap for Finnish research infrastructures 2014–2020. The discussions provided feed-back to the Academy of Finland to improve the national RI roadmapping strategy and process and foster the linkages with national and international stakeholders.*
4. *In the 'Finnish 2018 interim evaluation report on the Strategy and Roadmap for RIs 2014-2020', the Finnish Research Infrastructures Committee (FIRI-Committee) monitored and categorised all 32 RIs listed on their 2014 roadmap and classified them according to their level of maturity (lifecycle) and the fulfilment of predefined criteria into four different categories. Depending on their classification, the questions asked in future monitoring will be adjusted. RIs which were categorised as 'very advanced' and 'advanced' will be assessed more lightly for scientific advancement as they were sufficiently convincing in the 2018 interim review to be considered reliable until the year 2020. Additionally, the development of RIs can be tracked through regular monitoring according to RI categorisation into the different maturity levels. **The Finnish RI categorisation provided***



for more transparency, efficiency and supports long-term decision making.

5. *In Finland, the national RI strategy and roadmap with implementation measures is a plan to contribute to a national R&I vision with clear targets and invites RI funders, hosts and users to align their strategies and capacities against this national **plan. This creates coherence between different elements of the RI strategy: the long-term national plan, implementation and funding measures, RI roadmap and corresponding strategies, measures and roadmap elements at the host and user side.***
6. *During the monitoring of the RI proposals, the same criteria were used for all proposals, irrespective of their specific scientific field, by one evaluation panel. The panel applied different evaluation questions according to the specific RI lifecycle phase presented in the proposal, distinguishing RIs which are already on the roadmap from those which are not yet or which are from other international memberships. Likewise, there will be FIRI funding calls for RI inclusion in the roadmap according to specific RI lifecycle phases. **Depending on their classification, the questions asked in future evaluations will be adjusted** and RIs that were categorised as 'very advanced' will be assessed more lightly. Additionally, the development of RI will be tracked through regular evaluation and categorisation into different maturity levels.*
7. **Finland assesses its RI strategy together with the RIs on the roadmap.** *Finland has produced a report on the interim review of its roadmap. The report investigates the topicality of the RI strategy and its procedures, as well as assesses the progress, in terms of scientific quality and organisational development of RI that are included on the roadmap or are not included but have received funding from the FIRI Committee.*
8. *The Finnish RI-service offers persistent identifiers (PID) for each RI it contains descriptions for. The PID is assigned to the object for its entire lifecycle. It allows each RI to be identifiable in a unique manner. **This facilitates the stock-taking of each RI both within and between organisations and evaluations and allows academic merit for RI service providers.** PID are used for automated data transfer between information systems and organisations thus improving interoperability between data systems. PID complement and link research information such as scientific publications, research datasets and researchers themselves that already have a PID which facilitates assessing scientific and socio-economic impact of RIs.*



THE DUTCH RI ROADMAPPING PROCESS

The following chapter describes the implementation of the current RI roadmapping process in the Netherlands, its individual steps and main actors involved. The chapter concludes with an analysis of the process and identifies good practices applied in the Netherlands. This overview is based on a desk review of relevant documents related to RI roadmapping, as well as qualitative interviews with key actors involved conducted in early and mid-2018.

IMPLEMENTATION OF THE DUTCH RI ROADMAPPING PROCESS

A first 'Netherlands Roadmap for Large-Scale Scientific Infrastructures' was published in 2008 and has been developed as a direct response to the development of a European roadmap for RIs by ESFRI. In 2011, the State Secretary for Education, Culture and Science requested that the NWO organised a review of this roadmap at the beginning of 2011. A new funding round emerged from this process in 2012 followed by an additional funding round over the period of 2013/2014 using NWO's funds for large-scale RIs. In 2013 and 2016, the NWO published updates to the Dutch roadmap. The next roadmap update is expected to be published in 2019.

CURRENT DUTCH RI ROADMAPPING PROCESS

Landscape analysis

In 2016, the Permanent Committee for Large-Scale Scientific Infrastructure conducted a landscape analysis in which it reviewed 164 existing facilities and identified a total of 113 RIs of interest in need of future funding. However, the Permanent Committee stated that the demand for RIs in the Netherlands is considerably higher than the financial budget available and investments are often needed over a long-time period which requires agreements with the various stakeholders concerning sustainability, collaboration as well as prioritisation of needs. (NWO 2016)

The Permanent Committee used the following selection criteria for identifying suitable RI during the landscape analysis.

Table 3: RIs selection criteria for the landscape analysis (NWO 2016, p. 6).

1. Facility meets the definition of large-scale infrastructure and the type of infrastructure it involves (national/international, single sited/distributed/virtual, hardware/e-infrastructure/data/collection)
2. Cohesion between the various facilities (Uniqueness overlap and cohesion, affiliation with ESFRI, cooperation and selectivity in the field)
3. Affiliation with strategic developments (Affiliation with the Dutch National Research Agenda (NWA); strategic goals and priorities of institutions, scientific fields, top sectors)
4. Participation and use (The facility's national and international target and user group)
5. Facilities' significance to science and society
6. Status and maturity level of facility (Phase of lifecycle, support, governance and organisational structure, substantiation of the investment plans, institutional commitment, long-term funding)



Additionally, RIs under investigation had to meet the financial lower limit (€10M) for large-scale research facilities and shouldn't have been included into or be part of an existing landscape analysis. Moreover, an open access policy for researchers is a key requirement for the RI to earn a spot on the national roadmap.

Strategic prioritisation

The NWO continuously monitors the quality and complementarity of different national research funding streams to align them to their national RI strategies. This coherence between funding and prioritisation strategy is intended to maximise both the synergy and impact of the various research funding streams where RIs are embedded and connected in the national and international R&I ecosystem. However, this may imply that occasionally the priorities of researchers or RIs cannot be financed if they do not align with national strategies. Moreover, the NWO is planning to develop a national investment agenda in cooperation with the Dutch universities and the Royal Netherlands Academy of Arts and Sciences (KNAW), to which all parties involved contribute.

Clustering of facilities to promote cooperation

While performing the landscape analysis and overviewing the landscape the Permanent Committee concluded that many facilities were needed for the same research fields and that identical equipment was needed. Consequently, the Permanent Committee decided to encourage facilities with similar RI needs or complementary thematic focus to form a cluster and submit joint applications. Moreover, cluster members were asked to develop a long-term investment agenda as well as a business plan, to guarantee the infrastructure's long-term financial sustainability and were also invited to set priorities in view of the limited resources available. Per predefined thematic areas, which were identified while conducting the landscape analysis, only one joint application was accepted for the 2016–2020 roadmap per such an area. Furthermore, applicants were asked for a commitment of funding the RIs'. Regarding the operation costs, the Permanent Committee decided to fund up to 50% of the operation cost during a period of maximum 10 years under the condition that the hosting institutes are obliged to fund the other 50%. (NWO 2018)

Selection of proposals for the national roadmap

The Permanent Committee first selected 32 RIs, of high scientific priority to be included on the current 2016–2020 national roadmap. Eventually the national roadmap consisted of 32 facilities including 15 individual RIs and 17 facility clusters of the three scientific domains listed in InRoad Deliverable D.3.3.

Every two years, the NWO organises a competition for funding RIs on the roadmap. The Permanent Committee decided that every research field should receive grants for establishing RI in case the quality is high enough. Therefore, the Permanent Committee decided based on historical data to make 45% of the budget available for the science and technology domain, 45% for the life sciences domain and 10% for the domain of social sciences and humanities. The Permanent Committee is also recommending using the ratio for upcoming national roadmap calls.

By mid-2017, 21 of the selected RIs submitted a funding proposal. The NWO appointed an independent international selection committee to assess these proposals. This international selection committee consisted of experts with a broad knowledge of scientific developments and experience considering large-scale scientific RIs. Each application was sent to at least 5 international reviewers and the applicants were given the opportunity to send in a rebuttal on



the peer's comments. The selection committee selected 14 proposals for interviews, which were held in the beginning of 2018. Based on interview performance, the selection committee compiled a ranking which was submitted to the NWO executive board for the final granting decision. (NWO 2018)

The evaluation criteria are detailed in the InRoad Deliverable D3.3.

Funding of facilities included in the roadmap

Usually, the NWO has an annual budget of €40M available for funding of RIs included in the roadmap, yet for the competition in 2017-2018 the NWO was able to use an extra €90M through an additional budget of the Dutch Ministry of Education, Culture and Sciences (ECS) and savings from earlier years. Additionally, the Permanent Committee will also provide the possibility of allowing limited additions to the recent 2016 national roadmap in urgent situations prior to its planned formal update in 2020 (NWO 2016).

Methodology to evaluate RIs to be included in the national roadmap

As of November 2018, the development of evaluation and monitoring criteria for RI included in the national roadmap by the Permanent Committee is ongoing and will be decided upon early in 2019. These will include the evaluation of the present facilities as well as the facility clusters. In preparation for the evaluation, the Permanent Committee decided to ask the RIs currently receiving funding for annual progress reports and is planning to conduct site visits at the granted facilities.

ACTORS INVOLVED IN THE DUTCH ROADMAPMING PROCESS

The following table presents the different actors involved in the Dutch RI roadmapping process, from strategy to evaluation and implementation. For more information on the actors involved in the process also see InRoad Deliverable D.3.3.

Table 4: Composition and tasks of actors involved in the national RI roadmapping process in the Netherlands.

Actors	Composition	Tasks (related to RI)
Netherlands Organisation for Scientific Research (NWO)	Four science divisions allocate subsidies and grants, the divisions have their own budget, Council Board and Council Executive Committees. The NWO is also a research performing organisation. It has eight research institutes that make strategic contributions to university research. Furthermore, it incorporates three Task Forces which have a semi-permanent status.	Planning and setting the strategic guidelines for RI in cooperation with the Ministry of Education, Culture and Science; Publication and administration of Call for the roadmap; Supporting the Permanent Committee in the inventory and landscape analysis, mapping of infrastructures and eligibility check; Decision the funding of RI, based on the advice of the independent selection committee.
Strategic Committee for Large-Scale Science	Currently 14 members including a chairman. Recently two	Planning and setting the strategic guidelines for RI;



tific Infrastructure (advisory body of the board of the NWO)	members where added with specific expertise in the field of ICT infrastructures.	Performing the inventory and landscape analysis, mapping of infrastructures and eligibility check; Performing the evaluation for establishing the roadmap.
Ministry of Education, Culture and Science	The ministry is headed by a secretary general and a deputy secretary general, who head a system of three directorates general: <ul style="list-style-type: none"> • Primary and Secondary Education; • Higher Education, Professional Training and Sciences; • Culture and Media. Additionally, the ministry oversees nine autonomous agencies and councils	Has tasked the NWO with the establishment of the Permanent Committee and to define the Terms of Reference.
International selection committee	13 international experts from various scientific backgrounds	Assessment of proposals for RI for the roadmap funding scheme.

ANALYSIS OF THE DUTCH CASE

The introduction of a Permanent Committee responsible for large-scale scientific infrastructure has replaced the former ad-hoc committees responsible for roadmapping processes in the Netherlands. Contrary to practice in many other European countries, the Dutch Research Council, NWO, and its Permanent Committee are almost solely in charge of designing the roadmapping process and deciding on strategic prioritisation and selection criteria, thus streamlining the decision-making process and creating the foundation for long-term strategic planning.

A limiting factor for the roadmapping process in the Netherlands is the imbalance between available funding resources and needed investments for RIs, which makes harmonisation and long-term financial planning challenging. A first key action taken by the Permanent Committee was the clustering approach, which forces facilities with similar or compatible thematic backgrounds to submit a joint proposal for each predefined thematic cluster and to develop an investment agenda considering the strategic prioritisation of the respective research field. A second key step taken was allocating the available budget for RIs to three research domains.

Furthermore, the NWO guarantees taking over 50% of the operational costs for a period of 10 years under the conditions that the facilities applying for funding commit to paying the other half of the operational costs. In addition, all other costs incurred will be funded. The mentioned steps ensure that new RIs of high priority can continue to be included in future national roadmaps, even though funding is limited. Initial feedback by the RIs suggests that the clustering approach was positively received in the Netherlands. Moreover, funding decisions on RI in the Netherlands are linked to strategic priorities. As a result, RIs need to orient themselves stronger towards national priorities.



GOOD PRACTICES FROM THE DUTCH CASE

9. For the roadmap proposal, the NWO asks for a ten-year budget for the full costs of an RI. Additionally, in the Netherlands 50% of the operational cost are funded during a period of 10 years under the conditions that the facilities applying for funding commit to paying the other half of the operational costs. For the proposals, the hosting organisations are asked to submit a letter of intent in which they commit to financing half of the operational costs for 10 years. This way, **the NWO ensures that the applicants deal with a business plan and financing strategy while applying for the roadmap.**
10. In the Netherlands, the Permanent Strategic Committee for Large-Scale Scientific Infrastructure was introduced in 2015. **It reviews and visits RI sites during the Dutch landscape analysis to identify potential for clustering of RI facilities.** By visiting the facilities, the Permanent Committee can better assess the demand and thematic focus of the Dutch RIs.
11. The imbalance between available and needed investments for RI in the Netherlands is limiting funding of new RIs. By forcing RIs with similar or compatible thematic backgrounds to submit a joint proposal to apply for the National Roadmap, **redundancies with regard to equipment can be avoided and synergies can be used.** Moreover, **funding decisions on RIs in the Netherlands are linked to strategic priorities.** As a result, RIs are required to orient themselves more strongly towards national priorities.
12. **The NWO continuously monitors the quality and complementarity of different national research funding streams to align them to their national RI strategies.** This coherence between funding and prioritisation strategy is intended to maximise both the synergy and impact of the various research funding streams where RIs are embedded and connected in the national and international R&I ecosystem. However, this means that sometimes the priorities of researchers cannot be financed if they do not synchronise with national strategies.



THE CZECH RI ROADMAPPING PROCESS

The following pages describe the implementation of the RI roadmapping process in the Czech Republic, as well as its current design and methodologies. The primary actors active in the process and their functions are identified. Finally, the analysis identifies good practices and explores remaining bottlenecks in the Czech RI roadmapping process. This overview is based on a desk review of the documents related to RI roadmapping in the Czech Republic, as well as interviews with key actors involved in the process.

IMPLEMENTATION OF THE CZECH RI ROADMAPPING PROCESS

The first Czech roadmap for RIs, the 'Roadmap for Large Research, Development and Innovation Infrastructures in the Czech Republic', was published by the Czech Ministry of Youth, Education and Sports (MEYS) in 2010. The first roadmapping process was largely inspired by discussions taking place within ESFRI, and by the ESFRI roadmapping process itself. An advisory body for RIs, the Council for Large Infrastructures for Research, Experimental Development and Innovation (hereafter Council for Large Infrastructures), was set up and contributed to forming working groups. Those working groups included Czech experts from six scientific domains: Social Sciences and Humanities, Environmental Sciences, Material Physics and Space, Informatics/e-infrastructure, Energy and Biomedicine. They worked on the first landscape analysis of RIs in the Czech Republic. International experts were also invited to provide advice.

The roadmap was defined as *"a strategic document for development of large infrastructures for research, development and innovation. [...] The document aims to describe the situation and significance of large research, development and innovation infrastructures within the Czech Republic, as well as the European Research Area, opportunities arising from financing of these types of facilities from the Structural Funds, and participation of the Czech Republic in projects under the so-called ESFRI Roadmap"* (MEYS 2010, p. 7). Key strategic elements of this first roadmap include: the Czech Republic in the context of the ERA, the role of ESIF in funding RIs, and the involvement of industry.

The 2011 roadmap update

A roadmap update was produced in 2011. This update intended to include information on the new funding frameworks for RIs in the Czech Republic, the targeted support for RIs and the ESIF. Previously, large RI projects located outside the Czech Republic were financed from the International Non-Governmental Organisation (INGO) Programme, and national infrastructures were funded through the Centre for Basic Research and Research Aims (MEYS 2011). For the 2011 roadmap update, a consultant from the ESIF was involved in the process and a call for proposals was organised. The thematic working groups were maintained to work on the landscape analysis and a peer-review group was composed of national experts. Some RIs from the 2010 roadmap were re-classified as promising projects, based on the assessment of the peer-review group.

The 2011 update emphasised the 'integrative role of infrastructures' in the context of the ERA and *"the creation of synergy between the Cohesion Policy and the future strategic framework for financing research and innovation at the European level; strengthening the mobility of research infrastructure workers, even those holding technical positions; and the possibility of using large infrastructures to meet the needs of today's society"* (MEYS 2011, p. 8). The strategic elements of the Czech roadmap therefore continued to consider European developments.



The new methodology for evaluating RIs

In 2014, the MEYS designed a comprehensive methodology for evaluating RIs. The criteria contained in this document serve to evaluate all RIs striving to receive public support at national level or to be included in the Czech RI roadmap. These criteria pertain to management, IPR strategy, user strategy, development strategy, internal strategic research (details can be found in InRoad Deliverable D3.3). The evaluation by the peer-review experts constitutes an input for the funding of RIs, but the actual financing is decided by the MEYS and must be approved by the Czech government (see next section). The methodology developed by the MEYS was an important step in formalising the criteria for evaluation and providing a coherent evaluation framework.

CURRENT CZECH RI ROADMAPPING PROCESS

In 2014, for the first time, the MEYS organised a comprehensive evaluation of all RIs, irrespective of their funding source (national budget or structural funds) and their lifecycle stage. It was carried out by an International Evaluation Committee, comprised of experts from the six scientific areas represented in the roadmap: Physical Sciences, Energy, Environmental Sciences, Biomedicine, Social Sciences and Humanities, and ICT/e-infrastructures (two international and one Czech expert per area). The evaluation was carried out in two stages, based on the newly elaborated methodology: first, an assessment of all proposals according to the definition of RI, and second, an assessment of the quality of the RIs. The definition of RI is composed of three main elements: uniqueness, nation-wide importance and impact (with potential international overlap), and open access. The evaluation criteria are fully detailed in Chapter 4 of this Annex.

The second phase of the evaluation was based on a self-assessment report developed by RI managers, and an assessment report from the scientific advisory board of the RI. The international expert reviewed both documents and produced their own report (based on the criteria detailed above). The second stage of the evaluation also included interviews between the experts and management representatives of the RI.

This evaluation resulted in 58 positively evaluated RIs, including 42 high priority RIs. They were recommended for public funding by the International Evaluation Committee, according to a rating from A1 (highest priority) to A4 (lowest priority). This outcome formed the basis of the 2015 Czech RI roadmap, which presents the positively evaluated projects and their level of prioritisation (as well as their current source of funding). The process is illustrated by Figure 3 and a short description of the actors involved is available in Table 5.

Landscape analysis

As for the previous 2010 roadmap and the 2011 update, a landscape analysis was carried out by the expert working groups. The goal of the landscape analysis is defined as "*putting individual R&D facilities into the RI landscape of the Czech Republic and identifying persistent gaps, drafting the outlook for future development and presenting the possible scenarios for eventual clustering of research infrastructures (if applicable)*" (MEYS 2015, p. 17). All RIs evaluated positively by the International Expert Committee were included in this exercise. On top of the landscape analysis, each RI is individually described in the roadmap document, according to its background, outlook for future development and socio-economic impacts. The RI unit of the MEYS is responsible for the writing and editing of the roadmap document, in close collaboration with the expert working groups.



Reviewing and amendment procedures

Once the 2015 roadmap was completed, it was first reviewed by the advisory body of the MEYS, the Council for Large Infrastructures, and by the International Peer-Review Committee – composed of seven members from the International Evaluation Committee (one per scientific area) and a Chair. The same process as that applied for 2010 and 2011 was used: the Deputy Minister for Research and Higher Education adopts the roadmap, which then has to be approved by the Minister for Youth, Education and Sports. Afterwards, it goes through an amendment procedure, whereby it is sent to all ministries, to the Czech Academy of sciences, to the conference of rectors and to other stakeholders. They have a limited time (around 15 days) to send their consent or amendments. Considerable amendments require a resolution meeting. Once the amendment procedure is completed, the RI roadmap is presented at the government meeting and it is adopted with or without a discussion. Once it is adopted, there is a government resolution. The government also has the responsibility of approving individual RIs for funding, as their inclusion on the roadmap is only a precondition for funding, not a direct commitment.

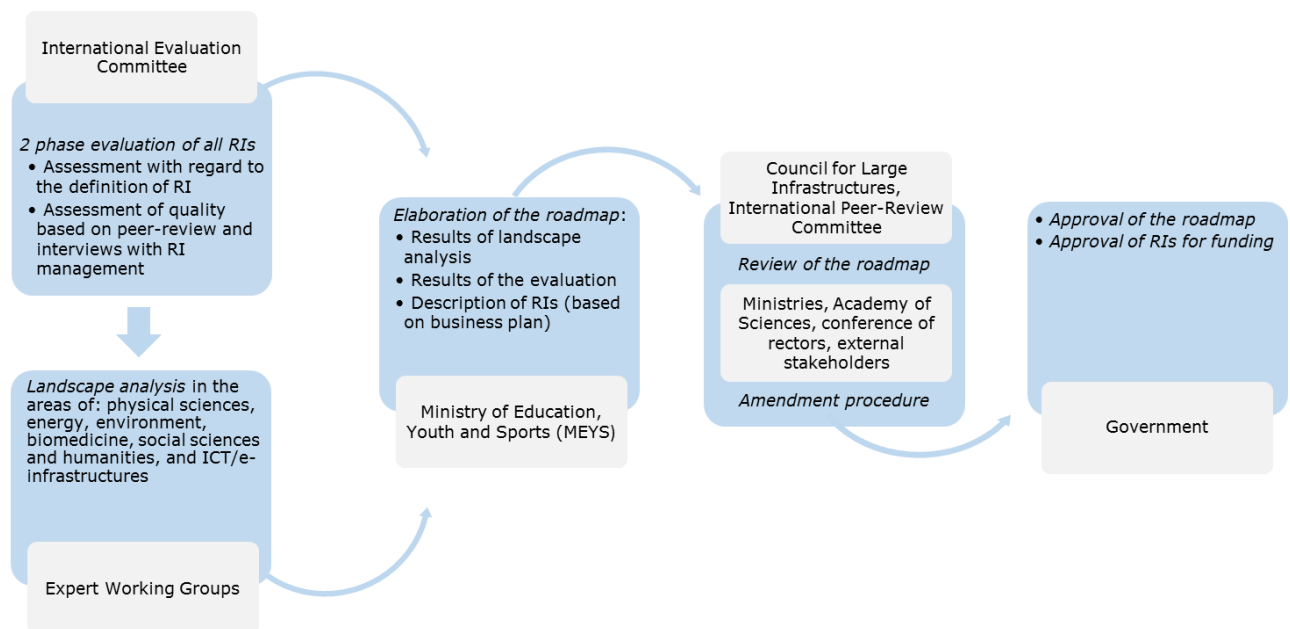


Figure 3: Czech RI roadmapping process, 2014-2015 (by Alexandra Griffiths, 2018)

ACTORS INVOLVED IN THE CZECH RI ROADMAPPING PROCESS

The table below sums up the role of the various actors involved in the Czech RI roadmapping system. This is a summary and not a comprehensive overview as, for example, the full list of stakeholders involved in the amendment procedure is not public. Overall, the main actors driving the RI roadmapping process are the MEYS, the advisory Council for Large Infrastructures, the expert working groups and the international evaluators. The Czech government is mainly responsible for the political oversight of the roadmap and for approving funding.



Table 5: Composition and tasks of actors involved in the national RI roadmapping process in the Czech Republic.

Actor	Composition	Tasks
Council for Large Infrastructures for Research, Experimental Development and Innovation	Representatives of the MEYS, the RDI Council, higher education institutions, Academy of Sciences of the Czech Republic, and the large RIs operated in individual scientific fields (approx. 25 members)	Advising the MEYS on evaluation methodologies, on the evaluation process, and on the expert panels; Reviewing the RI roadmapping process and the roadmap document
Czech government	Prime Minister, Ministers and deputy Ministers	Final approval of the RI roadmap and government resolution; Approval of individual RI for funding
Deputy Minister for Research and Higher Education		Adopting the RI roadmap
Expert working groups	Five to nine national experts from the six scientific disciplines represented in the roadmap	Landscape analysis
International Evaluation Committee	13 international experts (two per scientific area and a Chair), six Czech experts (one per scientific area)	Two-phase evaluation of all RIs (from 2014)
International Peer-Review Committee	Seven members of the International Evaluation Committee (one per scientific area and a Chair)	Reviewing the RI roadmap document (from 2014)
Research Infrastructure unit of the MEYS		Organising the RI roadmap process; Writing the RI roadmap document
Minister for Youth, Education and Sports		Approving the RI roadmap and launching the amendment procedure
Other ministries, Czech Academy of Sciences, Conference of Rectors, and other stakeholders		Amendment of the RI roadmap (if requested)



ANALYSIS OF THE CZECH CASE

The Czech roadmapping process is currently well established in terms of methodologies and procedures. The processes for evaluating and funding scientific projects are well perceived by many actors in the Czech scientific and RI community. The MEYS and the Council for Large Infrastructures have continuously improved the process for identifying, evaluating, funding and monitoring RIs, with input from national and international experts. Furthermore, the MEYS has made great efforts to align this process with calls for the ESFRI roadmap. Thus, the Czech Republic has developed its national RI landscape and increased its participation in pan-European RIs. RI stakeholders in the country are planning to continue in this direction.

However, there are still some bottlenecks in the process. Indeed, while the evaluation and selection of projects for the roadmap is well established and transparent, the evaluations are frequent and extensive. This could become a burden for all actors involved in the process. Furthermore, the link between the evaluation results and funding decisions is not well understood. After the latest RI roadmap update, the highest rated RIs received budget cuts so that all positively evaluated RIs could be funded. It is unclear whether this decision truly reflected the evaluation results and expert opinions. Prioritisation is a challenging exercise, but in view of limited budgets, it is important to provide funding efficiently and according to transparent criteria.

Related to the point above, the high number of RIs in the Czech roadmap (58) could become another bottleneck. Indeed, a small country like the Czech Republic has limited resources to support such an extensive portfolio and each facility must provide a truly unique service. Therefore, international experts recommended developing more synergies and clusters. This process is already underway for e-infrastructures, which are being assembled under an umbrella organisation who are developing a common infrastructure for the whole country. Similar integration could be achieved in other scientific areas, for example nanotechnologies.

Finally, better communication could also be fostered between the MEYS and the RDI Council of the government, as well as with other Ministries and the Academy of Sciences. These actors could play a more important role in supporting the MEYS' RI strategy and roadmap in a context where political support for RIs is relatively unpredictable, due to changes in government. The importance of RIs for the whole research system and for solving societal challenges (e.g. environmental or biomedical research) could be better emphasised. For example, regular meetings (e.g. once a year) between the Council for Large Infrastructures and the RDI Council could be organised to exchange information and perspectives.

GOOD PRACTICES FROM THE CZECH CASE

13. *The MEYS developed an update one year after the first roadmapping process. The process for the update included an open call for submissions for the RI roadmap. **This made the process more transparent and rendered it more accountable to national stakeholders.***
14. *In the Czech Republic, independent panels of international experts review all proposals for the roadmap (new as well as existing RIs). The evaluation is based on self-assessment reports, assessments by the RI scientific advisory boards, and interviews with RI management. **This approach significantly increases the objectivity of the evaluation process.** To ensure that national stakeholders and the needs of national RI are taken into account, an advisory body to the MEYS composed of Czech experts, the Council for Large Infrastructures, reviews the RI roadmapping process.*



15. The Czech RI roadmapping process includes a landscape analysis, carried out by Czech experts from each scientific field represented in the roadmap (expert working groups). **This analysis identifies strengths and gaps in the national RI landscape, and supports the strategic vision of the MEYS for RI.**
16. The MEYS developed a comprehensive methodology for the evaluation of RIs based on the one elaborated by ESFRI. **This approach increases the transparency of the application process and is well coordinated with the process at pan-European level.** The process is also timed so that projects can receive political support from the Czech government prior to the calls for the ESFRI roadmap.
17. The Czech RI roadmapping process includes an amendment procedure, whereby the roadmap is submitted to other ministries and important R&D stakeholders for approval or amendment. While it is time-consuming, **this amendment procedure increases the accountability and legitimacy of the RI roadmapping process.**
18. Following the advice of international experts, the MEYS initiated the process of integrating the Czech Republic's e-infrastructures – CESNET, CERIT and IT4Innovations – under an umbrella organisation (CESNET)¹⁵. **This is a welcome step towards a more coherent and efficient e-infrastructure landscape in the country, with comprehensive services provided by one organisation.**

¹⁵ CESNET website: <https://www.cesnet.cz/cesnet/?lang=en>



THE SWEDISH RI ROADMAPPING PROCESS

A strategic roadmap in the form of a Guide to Infrastructure is published every four years with a five to ten years horizon for specific developments to safeguard Swedish researcher access to first-class RIs. The Guide is elaborated by the Swedish Research Council (VR) and also feeds into their input for the Government's Research Bill. The most recent guide (VR 2018a) was published in November 2018 and includes the recommendations for initiatives and system changes with a forward-facing view to the upcoming Research Bill 2020. In the following, the implementation process of the first national RI roadmap in Sweden is briefly elaborated to give some context. Then, the current RI roadmapping process is described in more detail.

IMPLEMENTATION OF THE SWEDISH RI ROADMAPPING PROCESS

After the VR was formed in 2001, its Scientific Council for Natural Sciences and Engineering Sciences Council had the main responsibility for national and international infrastructures. The RI roadmapping process in Sweden was initially developed when the discussions for ESFRI started. An independent committee was set up in January 2005 to manage new RI projects, as they could not be handled in the same way as smaller research projects that were handled by the VR. At this time, ESFRI was broadening the scope of infrastructures and stimulating discussions around distributed RIs in different areas. The VR established an Infrastructure Committee (KFI), to address these issues. Shortly after, in June 2006, the first Swedish RI roadmap, the Swedish Research Council's Guide to Infrastructure (VR 2006), was published. It represented the first national long-term plan for RIs in Sweden and was the first of its kind in Europe. It was intended that the guide would serve as a consistent basis for assessing what joint RIs were required for future top-quality research. It also laid out the scope for meeting requirements and underpinned discussions surrounding the funding of future national RIs, as well as discussions with other countries on joint RIs.

Establishment of the Infrastructure Council within the Research Council

The 2008 Research Bill, the most extensive so far, stipulated that the VR should assume responsibility of national coordination for the support of RIs. The Infrastructure Committee was permanently deployed as the Infrastructure Council (RFI) and new resources were introduced, enabling a larger call for support for national infrastructures in 2009. Work on the third edition of the Guide for Infrastructure was launched, and it was then published in 2011 (Science Council's Guide to Infrastructure 2012, Scientific Council's report series 8: 2011). In 2009, the Swedish Research Council also launched a call for National Comprehensive RIs. As a result, eight RIs were funded for the 2010 to 2014 period.

CURRENT SWEDISH RI ROADMAPPING PROCESS

In 2014, the Board of the VR adopted a new model for prioritising and funding RIs. The new model for the delegation of responsibility, prioritisation and reinvestment at local, national and international levels is in the process of being implemented with the aim of encompassing RIs at all levels. The model follows a two-year cycle starting with a needs inventory and ending with a targeted call. Since 2015, the needs inventory has been carried out every two years.

The model for the first step of the joint prioritisation and funding of national RI has been formulated by the VR in consultation with Swedish universities. The model includes recurrent needs inventories based on input from the universities, other funding bodies and research groups.





Figure 4: Timeline of the first half of the Swedish RI roadmapping process cycle (by Isabel Bolliger, 2018)

Step 1 – Inventory of Needs

Every two years, the VR makes an inventory of RIs in Sweden, which was initiated for the second time in 2017. In the inventory of needs in 2017-2018, it received just under 100 proposals from higher education institutions, public authorities with research responsibilities, funding bodies and research groups.

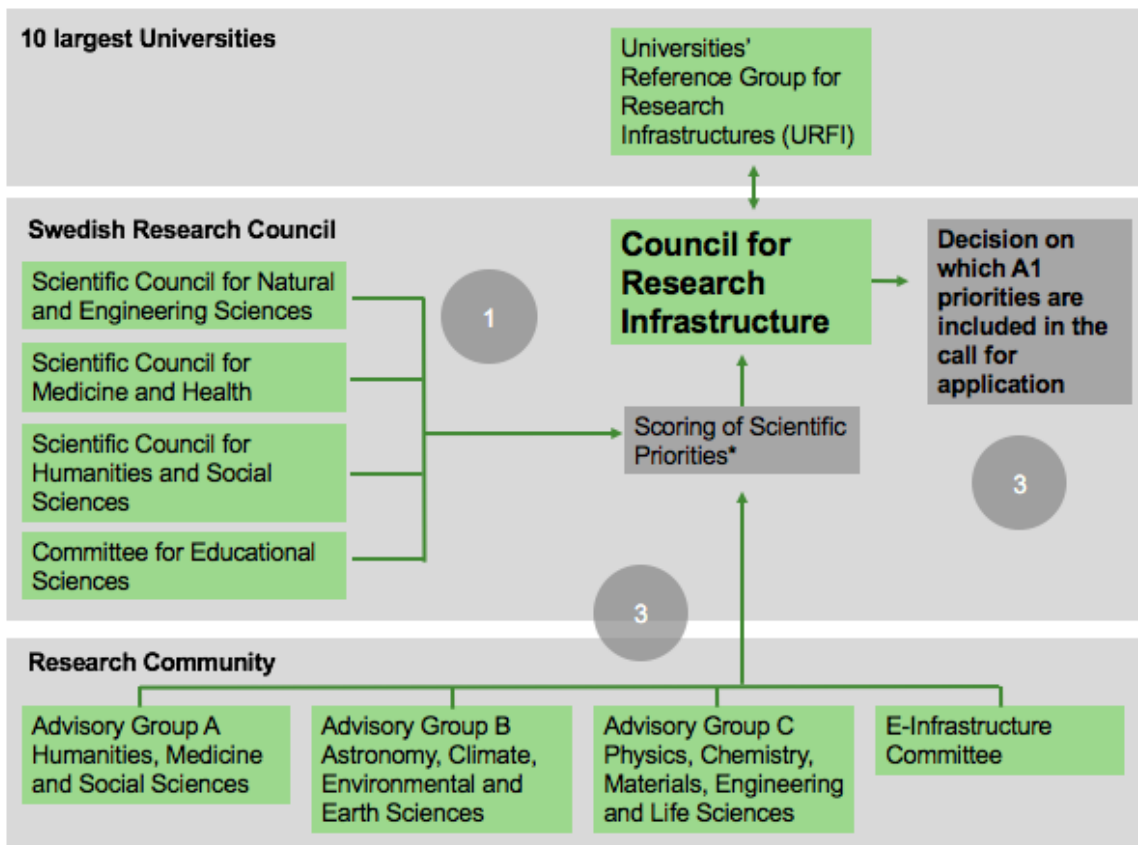
The purpose of the inventory is to capture proposals for new national needs for RIs. The proposals submitted to the Swedish Research Council cover the following needs:

- Proposals for entirely new infrastructure, or needs for bringing together and significantly developing existing resources into infrastructure of national interest;
- Proposals relating to major upgrading of existing RIs, meaning upgrading of existing RIs that are operational, shall also be submitted to the needs inventory. A major upgrade aims at creating a comprehensive change to the scientific production, or a significant change to the technical approach. However, routine maintenance or gradual improvements may not be included;
- Needs for new international RIs, which relate to both Swedish participation in the construction of new international infrastructure and Swedish participation in existing organisations;
- Infrastructure with ongoing grants from the VR, for which the grant period ends no earlier than 31 December 2019 are not covered by the needs inventory. These have the opportunity to apply directly for continued grants in the targeted call.

The inventory is aimed at higher education institutions, public authorities with research responsibility, research funding bodies and researcher teams. The VR requests each need to consist of a well-developed proposal backed by several universities or other research performing organisations.

Assessment and prioritisation of proposals for the inventory of needs

Once the inventory is completed, the VR's Council for RIs, RFI, starts the assessment and prioritisation of the proposals. RFI has three advisory groups and one e-infrastructure committee that review and prioritise the proposals from the needs inventory. The groups are appointed by RFI and consist of researchers who are well informed on RI issues within a specific field of activity, such as registers and databases, observatories and measuring platforms, high technology laboratories and e-infrastructure.



*** Scoring of priorities:**

A1 – areas considered to be scientifically and strategically important, and where the plans for national infrastructure are sufficiently clear that they can start being implemented during the coming year.

A2 – areas of high scientific and strategic value, but not prioritised by the Swedish Research Council.

A3 – areas of high scientific and strategic value, but requiring more time before they can be considered for implementation.

Figure 5: Assessment of Inventory of Needs for RIs in the Swedish roadmapping process (by Isabel Bolliger, 2018)

In a first step, the VR's three scientific councils and the Committee for Educational Sciences enter a dialogue with the Universities' Reference Group for Research Infrastructures (URFI). The advisory groups assess the various proposals for RI along their:

- Scientific excellence,
- national strategic relevance,
- as well as how feasible they are.

The proposals are then divided up into seven categories, from A1 to X, where A1 is assessed as having the greatest priority.

- A1 Areas considered to be scientifically and strategically important, and where the plans for national infrastructure are sufficiently clear that they can start being implemented during the coming year.
- A2 Areas of high scientific and strategic value, but not prioritised by the Swedish Research Council.
- A3 Areas of high scientific and strategic value, but requiring more time before they can be considered for implementation.



The results of the needs inventory then form the basis of a targeted call. The Appendix to the VR's Guide to Infrastructure includes a description of the high priority areas (A1, A2 and A3) and a list of RI where the grant period will end in 2019 or 2020. It is only the areas in Category A1 in the Appendix that may be considered in the next call. The areas assessed as A3 may be considered only after the next needs inventory. However, not all areas identified in the Appendix to the Guide are covered by the call. RFI takes the final decision on which high priority areas will be included the call for grant applications for RIs. The fact that an area has been categorised as A1 is therefore a prerequisite, but not a guarantee, for being included in the next call. The final decision on which areas are included in the call is taken by RFI, based on a strategic consideration of the scientific benefit to Swedish research.



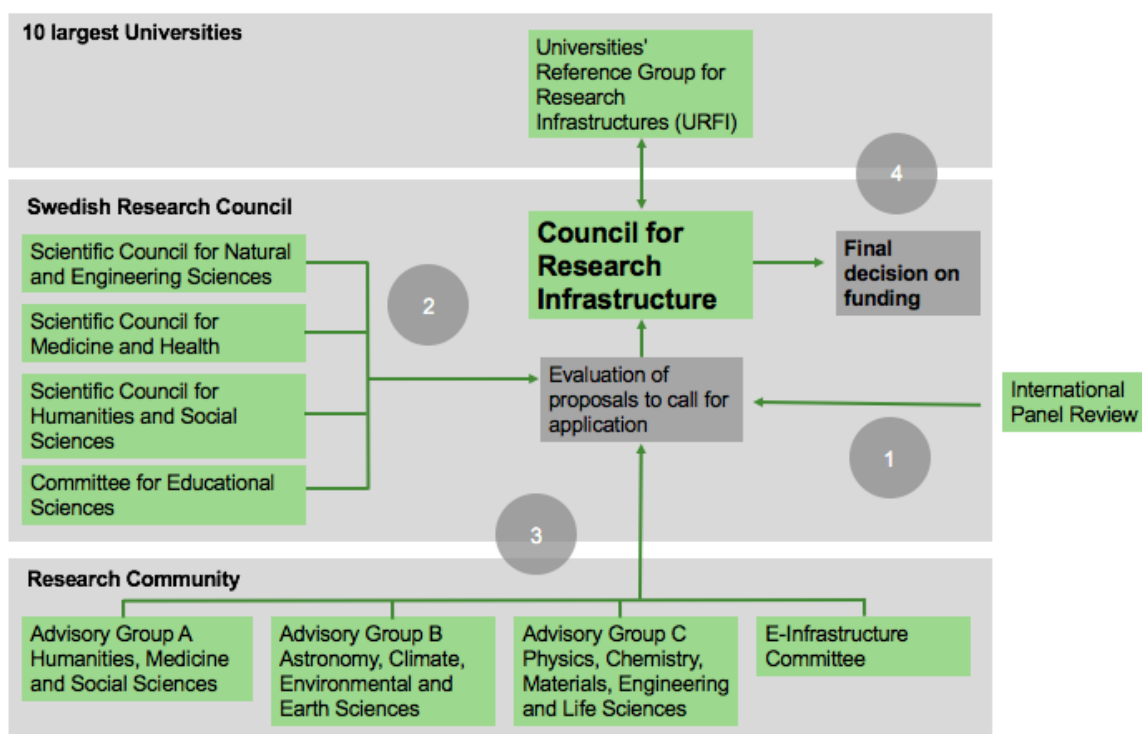
Figure 6: Timeline of 2nd half of the Swedish roadmapping process cycle (by Isabel Bolliger, 2018)

Step 2 – Call for Proposals for Grants for RI of national interest

After RFI has decided on what RIs are given the highest priority in the needs inventory, a call is issued which also includes application for grants for RI that already have an ongoing grant.

The assessment of the grant applications for RIs is done in three steps, as illustrated in the figure below. First, an international panel reviews each application based on scientific, organisational and technical criteria, but also on how the application relates to e-infrastructure and on the budget. The panel has 10–12 international members, who together have a broad perspective on RIs and can put Swedish applications into a larger, global perspective. In the second step, the VR's three scientific councils (Scientific Council for Natural and Engineering Sciences, Scientific Council for Medicine and Health and the Scientific Council for Humanities and Social Sciences) review the applications within their respective areas, and give a written statement, on the scientific and strategic value of the applications to Swedish research. In the third step the RFI's advisory groups make a summarising assessment based on the statements by the international panel, the scientific councils and its own scientific and organisational considerations. They also weigh in various national strategic aspects in their assessment.





Review of Applications:

1. The international panel reviews each application based on scientific, organisational and technical criteria, but also on how the application relates to e-infrastructure and on the budget.
2. The scientific councils review the applications within their respective areas, and give a written statement on the scientific and strategic value of the applications to Swedish research
3. The advisory Groups give and summarising assessment based on the statements by the international panel, the scientific councils and its own scientific and organisational considerations. They also weigh in various national strategic aspects in their assessment.

Figure 7: Assessment of Grant Applications for RIs in the Swedish roadmapping process (by Isabel Bolliger, 2018)

After the assessment, RFI takes the decision on applications that will be awarded with grants, which are normally depreciated over 3–5 years. The next needs inventory will start in autumn 2019 with the results will be presented in 2020. All applications are evaluated by using the same reviewing process. This means that existing RIs, applying for continued funding are prioritised in competition with new RI projects. This joint evaluation is expected to create balance between long-term stability and necessary renewal.

ACTORS IN THE SWEDISH RI ROADMAPING PROCESS

Key actors in the Swedish R&I policy system are public agencies such as VINNOVA, the Swedish Energy Agency and the Swedish Research Council (VR). VR is the principal actor for funding basic research, providing advice on the research system to the government and reporting to the Ministry of Education and Research. Moreover, the Swedish Research Council is in charge of the national RI roadmapping process and provides grants to RIs via calls, amounting to as much as 50% of the total budget (VR 2018). The other public agencies, which are involved in the national RI roadmapping process are VINNOVA, Formas and FORTE. VINNOVA, the central coordinating actor for innovation policy, is mandated with the implementation of the National Innovation Strategy and reports to the Ministry of Enterprise and Innovation.

Table 6: Composition and tasks of actors involved in the national RI roadmapping process in Sweden.

Actors	Composition	Tasks
RFI	<p>VR appoints the chair and members based on proposals from the VR's three scientific councils, and from the Forte, Formas and Vinnova research councils, who nominate one member each.</p> <p>In total thirteen members</p> <ul style="list-style-type: none"> • nine are active researchers from different disciplines • one member of Forte, Formas and Vinnova • one representative of industry <p>The term of office is three years and members can be re-elected for a further three years.</p>	<p><i>1. Needs inventory:</i> RFI decides on which high priority areas, that have been categorized as A+1, will be included in the call for grant applications for RI.</p> <p><i>2. RI grant applications:</i> RFI takes the final decision on which applications are awarded grants.</p>
Secretary General RI	<p>Secretaries General are active researchers and, as a rule, are employed by the Swedish Research Council on a part-time basis for a maximum period of six years.</p>	
<p>VR's Scientific Councils for Natural and Engineering Sciences for Medicine and Health for Humanities and Social Sciences</p>		<p><i>1. Needs inventory:</i> being consulted</p> <p><i>2. RI grant applications:</i> review the applications within their respective areas, and give a written statement on the scientific and strategic value of the applications to Swedish research.</p>
<p>FRI Advisory Groups A B C e-infrastructure committee</p>	<p>The groups are appointed by RFI and consist of researchers who are well informed on RI issues within a specific field, such as registers and databases, observatories and measuring platforms, high</p>	<p><i>1. Needs inventory:</i> assess the scientific, strategic and national impact of the various proposals for RI, and how feasible they are.</p> <p><i>2. RI grant applications:</i></p>



	technology laboratories and e-infrastructure.	make a summarising assessment based on the statements by the international panel, the scientific councils and its own scientific and organisational considerations. They also weigh in various national strategic aspects in their assessment.
URFI	The Vice-chancellors ¹⁶ of the ten largest universities President of the Association of Swedish Higher Education Institutions (SUHF)	
International Panel	10–12 international members, who together have a broad perspective on RI and can put the Swedish applications into a larger, global perspective.	<i>2. RI grant applications:</i> reviews each application based on scientific, organisational and technical criteria, but also on how the application relates to e-infrastructure and on the budget

ANALYSIS OF THE SWEDISH CASE

The Swedish RI roadmapping process started early in comparison to European countries and in parallel to the elaboration of the first ESFRI roadmap. Therefore, the Swedish RI roadmap represented the first national long-term plan for RI in Sweden and was the first of its kind in Europe. The Guide was intended to serve as a consistent basis for assessing what joint RIs were required for future top-quality research. It also laid out the scope for meeting the requirements and underpinned discussions on funding of future national RIs, as well as discussions with other countries on joint RI.

Since then, the Swedish RI roadmapping process as well as the funding system for RI has undergone major changes. National and European RIs lie now all within the realm of responsibility of the Swedish Research Council (VR), which is also a major funder next to universities. Swedish universities are today required to fund at least half of the cost of these RIs and there is no differentiation made between construction and operational cost. Moreover, each application for funding of a RI has to be supported by at least three universities. These changes lead to stronger involvement of universities in the decision-making process, although there are still voices claiming they should still be more involved, particularly in the strategic planning for the RI landscape. Another feature of the Swedish RI roadmapping process is the thorough prioritisation of RIs happening during several stages of the decision-making process. This resulted mainly from external pressure with the strong limitations of the available budget for RIs, due to currency fluctuations with regards to the CERN membership fees but also the commitment for a large number of new RIs in the 2008 roadmapping process. Additionally, the Wallenberg Foundation, which is the largest private research funder in Sweden, decided to stop funding infrastructures. Therefore, the universities were forced to coordinate their needs better in view of maintaining an excellent RI landscape for their users.

¹⁶ Or similar function with responsibility for RI.



Overall, the RI roadmapping process in Sweden is well established, with transparent methodologies and processes. The process is fully described in English and all documentation is easily accessible online. The main criteria during the prioritisation is the scientific excellence of RIs. The VR has also shown its ability to learn, and reached out to the universities to learn more about their views on the roadmapping process before adapting. However, some bottlenecks remain. The important sums tied into major RI projects may cause difficulties long-term for the sustainability and renewal of the Swedish RI landscape, especially for distributed infrastructures. Therefore, in the future, a portfolio approach, also considering to close down certain RIs, will be very important.

GOOD PRACTICES FROM THE SWEDISH CASE

19. *The Research Infrastructure Council represents various scientific fields, other scientific councils of the VR as well as different sectors, e.g. a representative from Vinnova and industry. **This ensures that all relevant stakeholders are included in the roadmapping process.***
20. *Within the RI roadmapping process, the Research Infrastructure Council consults with advisory groups, which also represent different scientific fields and universities as well as a specific group dealing with e-infrastructures.*
21. *The Swedish Research Council encouraged universities and RPOs to prioritise their own needs and develop institutional roadmaps, which some have started to do (e.g. Chalmers University, KTH). **This provides a solid foundation for institutions to justify and negotiate their RI needs.***
22. *The major research performing universities in Sweden formed a specific group to discuss the matter of RIs where the vice-rectors are represented (URFI). This group is actively contributing to defining strategic areas and reviewing proposals.*
23. *The Swedish Research Council calls for proposals include new and existing, as well as national and European RI, which are evaluated through the same process. This ensures that only top-class and most relevant RI are eligible. It also means that **the process is streamlined, with clear common criteria for evaluation and there is a balance between long-term stability of existing RI and necessary renewal of the landscape.***
24. *The evaluation of the scientific quality of RI grant proposals is evaluated by an international panel. **This increases the objectivity of the process.***
25. *The university staff of the URFI universities, dealing internally with RIs, are continuously **exchanging in view of mutual learning.***
26. ***The Swedish Research Council adapts to changes in the national and international RI landscape and new challenges.** For example, the growing importance of e-infrastructures and matters of data management are being recognised in the Swedish RI roadmapping process.*



SYNTHESIS OF DESK STUDY ON EVALUATION AND MONITORING OF RIS

The following chapter summarises the findings from the desk study on evaluation and monitoring practices in Europe, as described in the introduction. First, general concepts related to evaluation and monitoring are described. Then, individual case studies are presented in order to illustrate good practices.

GENERAL CONSIDERATIONS AND DEFINITIONS IN THE MONITORING AND EVALUATION OF NATIONAL RI ROADMAPS IN EUROPE

As identified in the [InRoad Compendium](#), strategic priority setting for RIs developed through RI national roadmaps is already normal practice in most of European countries. To facilitate a better understanding of this practice we include below a general figure developed adapted from OECD (2008) which schematically depicts the interlinking between the different stakeholders that contribute to the national RI roadmapping processes and the monitoring and evaluation activities specifically linked with national RI roadmapping processes in Europe, based on analysis performed during the first part of the InRoad Project

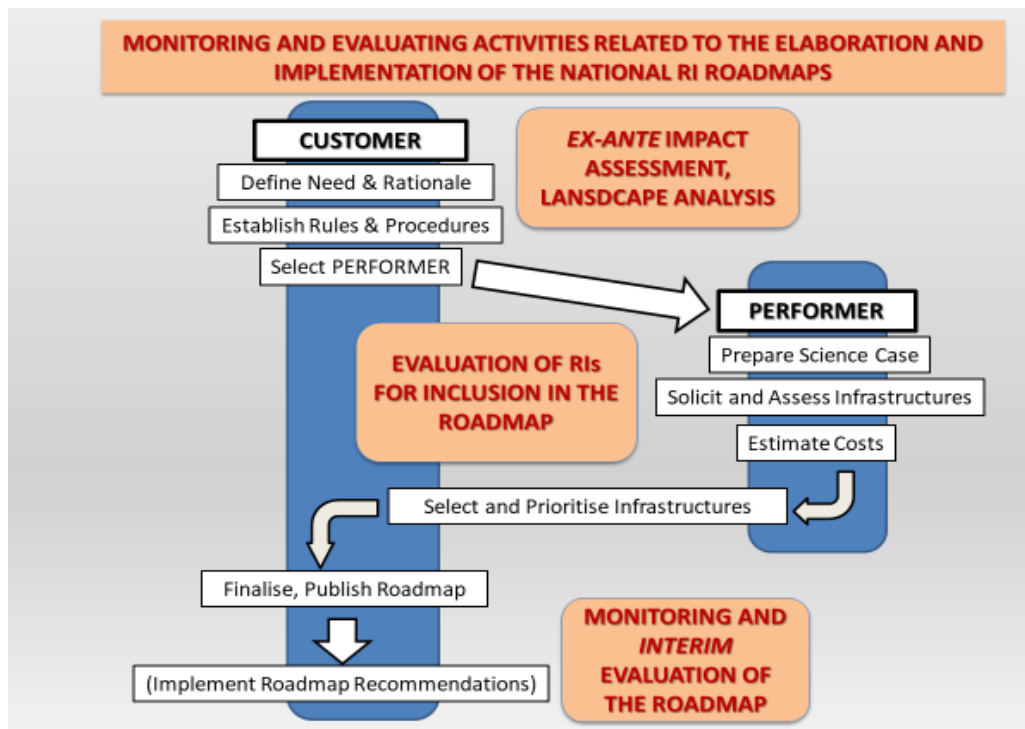


Figure 8: Monitoring and evaluation process linked to national RI roadmapping processes (adapted from OECD 2008, p. 9).

We use the term 'ex-ante impact assessment' to denote the evaluation of the rationale for an intervention, including the landscape analysis, carried out before the launch of a RI roadmap. This can include the planned monitoring and evaluation procedures which follow the realisation of the expected objectives in the roadmap, with the intention of correcting any deviation from operational objectives.

Proposals for roadmap inclusion are frequently submitted by RI managers. This may happen in different phases of the RI lifecycle: definition, planning, implementation, operation, etc., sometimes predefined, as for example in Germany. Governments frequently determine a set

of rules and procedures for being included in the national RI roadmap, providing concrete details on the process for the selection of RIs, including eligibility criteria, the timing and resources needed and the evaluation/selection of the RI methodology (composition of reviewers/expert panels, criteria to be used, etc.), which are denoted here as 'evaluation of RIs for inclusion in the roadmap'.

Finally, 'monitoring and interim evaluation of the roadmap' refers to activities related to the monitoring and evaluation of the performance of RIs included in the roadmap, together with other monitoring and evaluation activities specifically related to the roadmap itself, for example, the specific collection of data for roadmap monitoring, assessment of the realisation of general roadmap objectives, and so on. Based on this information, governments obtain the necessary evidence to make informed decisions on the roadmap as a whole, for example, proposing new areas of interest, increasing/decreasing the number of RIs to be included in the next roadmap, etc. Evidence obtained from periodic reporting and other monitoring activities normally supports the interim roadmap evaluations, which also could be carried out with some periodicity.

At policy level, evaluation activities are generally used for ensuring accountability, promoting organisational learning and for improving informed decision-making. Monitoring involves collecting evidence on progress towards expected results, analysing such evidence and, in when needed, taking the appropriate decisions.

Although most EU countries share general monitoring and evaluation requirements, the defined function of monitoring and evaluation depends on the political and administrative system in which the monitoring and evaluation practices are carried out (Molas-Gallart 2012). As Europe has rather diverse national R&I systems, it is difficult to make general observations when analysing these issues or trying to identify good practices suited for all EU countries. However, the information gathered and analysed on various practices across Europe allowed us to identify good practices described in the following section. These need to be related to their context, but they can provide a framework to better understand evaluation and monitoring principles, as well as a basis to develop future processes in other countries with similar characteristics.

GOOD PRACTICES IN EVALUATION AND MONITORING

This information on good practices is based on the analysis of official publicly available policy documents dealing with monitoring and evaluation (M&E) approaches and methods for RIs in Europe, information directly provided by national government bodies, together with a literature review focused on M&E approaches and methodologies considered in national RI roadmapping processes. Based on the national reviews carried out previously, we have identified valuable practices in the RI selection process for roadmap inclusion, ex-ante evaluation and monitoring from Bulgaria, Czech Republic and Ireland which are described in this section.

DETAILED INFORMATION ON NATIONAL RI ROADMAP PLANNED MONITORING (BULGARIA)

The first national roadmap for RI (NRRI) in Bulgaria was adopted in 2010 and the latest update was finished in 2017, which covers the period from 2017 to 2023. The following figure illustrates the various policies and instruments that are linked to the NRRI.



Policies and instruments of influence on the National Roadmap for Research Infrastructure (NRRI) of Bulgaria

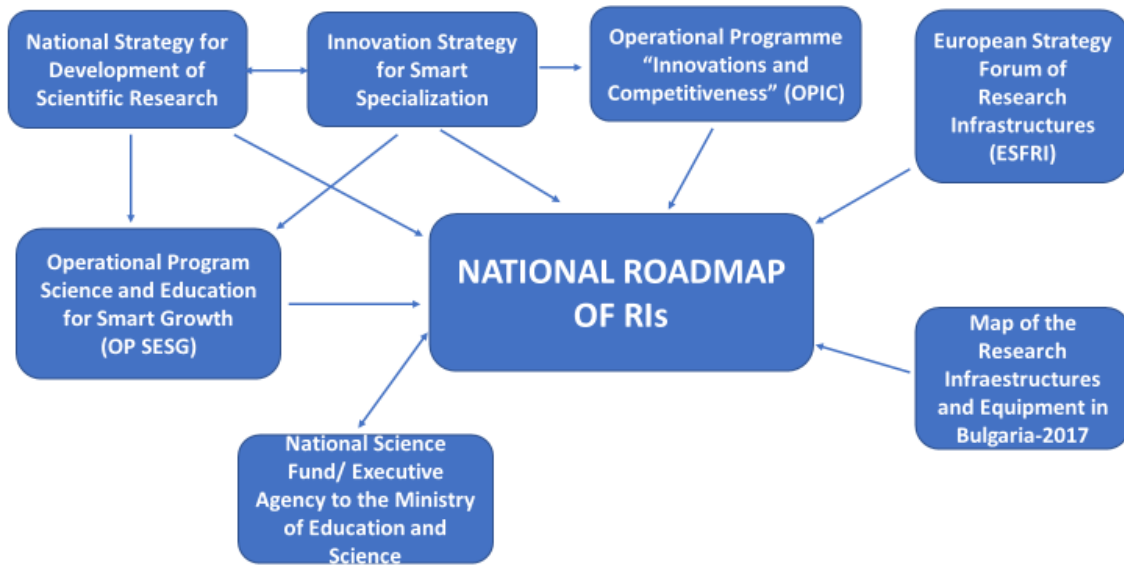


Figure 9: Monitoring the implementation of the roadmap (Ministry of Education and Science Republic of Bulgaria, 2017)

The general implementation of the Bulgarian RI Roadmap (NRRI) and the development of the individual RIs are subject to regular national and international M&E. This includes a general review of the implementation of NRRI policies at a national level, as well as corrective measures and possibilities for the introduction of new instruments and schemes. For the overall monitoring of the implementation of the NRRI, a new Standing Committee (SC) will be constituted as a consultative body to the Minister of Education and Science (MES).

The SC meetings are expected to take place at least twice a year, as the committee reviews the report of the Executive Council of the National Scientific Fund (NSF) on the scientific achievements and the financial reports of the individual research complexes. The mechanism for decision making is the following:

- Establishment of the NRRI SC by Order of the MES and the adoption of its rules of procedure;
- The sites included in NRRI perform a self-evaluation, the results of which are presented to the Science Directorate, MES, and the NSF;
- The Science Directorate performs independent socio-economic evaluation of NRRI site support;
- The NSF reviews self-assessment results;
- The NSF submits a proposal for annual financing of the NRRI sites;
- The NRRI SC proposes a decision for site prioritisation to the MES based on the annual report by NSF and the evaluation, assigned by the Science Directorate;
- The NSF pays the financial resources of the prioritised sites for the respective year and performs financial monitoring of the implementation of the NRRI;
- The NRRI SC reports annually to the Minister regarding the implementation of the NRRI.



The NSF is expected to organise an independent external evaluation of the research activity of the national RI every two years, which includes conducting surveys and cost-benefit analyses for the regional and national economy

EVALUATION METHODOLOGY FOR RIs ENTERING THE NATIONAL ROADMAP (BULGARIA)

The inclusion of RIs in the Bulgarian National Roadmap occurs through a diagnostic review, the development of research priorities under the National Research Strategy and the participation of Bulgarian research projects in the ESFRI Roadmap.

A first assessment is conducted by a national working group, formed by representatives of national ministries (Education and Science Transport, Information Technology and Communications), the Bulgarian Chamber of Commerce and Industry (BCCI), Universities, Academy of Science, non-governmental organisations and other relevant national institutions. The national working group reviews, assesses and selects the projects based on thematic areas. Projects that receive a high score are recommended for validation from an international expert panel and other projects and are recommended for re-processing and/or consolidation. The evaluation methodology covers quantitative and qualitative criteria based on three predefined criteria, which follow the ESFRI evaluation criteria. These criteria are detailed in the table below. All RIs entering the National Roadmap need to comply with priorities defined in the National Research Strategy, the Innovation strategy for Smart Specialisation and the ESFRI agenda.

Table 7: Evaluation criteria for the Bulgarian RI roadmap (Ministry of Education and Science Republic of Bulgaria, 2017).

Evaluation criteria	Sub-criteria
<p>Scientific and technological excellence of the RI</p> <p>50% weight of the assessment</p>	<p>I. The significance of the RI for the specific research fields: Relevance of the scientific objectives of the RI to facilitate and promote top-level science in Bulgaria; Capacity of providing potential for world class research and scientific breakthrough; Expected benefits for the national scientific and technological system for conducting cutting edge research at an international level, namely to increase the participation in international collaborative research projects, such as those of the Horizon 2020.</p> <p>II. Adequate identification of the RI's strengths, weaknesses, opportunities and threats (SWOT analysis)</p> <p>III. Degree of internationalisation, including the integration in international RI initiatives, namely those of the European Strategy Forum for Research Infrastructures (ESFRI) Roadmap</p> <p>IV. Degree of interdisciplinarity, including the effect of the RI on strengthening interdisciplinarity research in Bulgaria</p> <p>V. Quality of the proposed training of researchers</p>
<p>Governance capacity and implementation feasibility</p> <p>25% weight</p>	<p>I. Degree of adequacy of the management structure and governance of the RI to the proposed scientific aims</p> <p>II. Adequate management and action plan implementation (<i>leadership; distribution of responsibilities; experience and capacity; identification of RI's strengths, weaknesses, opportunities and threats, SWOT analysis</i>)</p> <p>III. Competence and complementarities of the nodes and added value of the national RIs at regional, national and international levels, including contribution to increasing access to</p>



	<p>knowledge resources and scientific capacity in the field of operation of the RI</p> <p>IV. Adequate equipment and relevance of improvements to the existing and/or acquisition of new equipment, considering the scientific aims of the RI</p> <p>V. Quality of the access policy and data management plan (transparent policy for access to the infrastructure, including international access activities, conditions for provision of access, addressing remote access needs in relation to availability of e-infrastructures and data management issues; access policy for industry (addressing IP rights, if applicable, fees and confidentiality issues)</p> <p>VI. Operational readiness: maturity of the RI and appropriate relations between partners of the infrastructure and, if relevant, of integration in an international RI</p>
<p>Budget and sustainability</p> <p>25 % weight</p>	<p>Includes technical feasibility, human resource costs and cost-effectiveness of the proposed infrastructure based on the adequacy of requested funding, funding sources information and long-term sustainability plan of the investment.</p>

This evaluation criteria are used for both assessing RI entering the roadmap as well as for midterm evaluation/update of the roadmap.

METHODOLOGY TO EVALUATE RIs TO BE INCLUDED IN THE NATIONAL ROADMAP (CZECH REPUBLIC)

The Czech Republic has a well-defined methodology to evaluate RIs that are included in their national roadmap, with clear connections to both national funding of RI and international commitments in EU RI policy (ESFRI and EU Cohesion funds).

The Czech Republic evaluation methodology is inspired by ESFRI evaluation procedures and has been elaborated within the framework of the Individual National Project and is denoted as 'Effective System of Evaluation and Funding of Research, Development and Innovation' financed by the ERDF, and is known as the IPN Metodika project. In the context of this project, RIs are categorized as Scientific Research Organisations.

This project, commissioned by the MEYS was carried out between 2012 and 2015, with a view to introducing periodic, systematic and objective evaluations of the RDI support system in the Czech Republic at all levels. The need to have a new evaluation methodology which includes a system that combines the use of indicators, peer-review and an element of prospective thinking was one of the conclusions of an International Audit of the Czech RDI System, carried out during 2010–2011.

The fact that the project was funded by the ERDF, and included a public tender to carry out a study called 'R&D Evaluation Methodology and Funding Principles', a small-scale pilot test of the methodology, and a final international conference makes it possible to have several documents that describe in detail the methodology used to evaluate R&D infrastructures in the Czech Republic.

Based on the methodology developed by the Metodika project, the MEYS commissioned a comprehensive evaluation of RI of the Czech Republic in 2014 by an International Evaluation Committee, of 19 members, composed of a Chairman and six Scientific Boards composed of three experts on the R&D areas of: (1) Physical Sciences; (2) Energy; (3) Environmental Sciences; (4) Biomedicine; (5) Social Sciences and Humanities; and (6) ICT/e infrastructures. These experts came from a pool of experts with long-term experience with RI in their roles as



users or RIs policymakers, and at least one of the members of each board came from the Czech Rep, so as to provide knowledge on the R&D context of the country.

A well-defined methodology for the evaluation of RIs has been implemented in the Czech Republic. This responds to the fact that the results of the evaluation are used to inform decision making in connection to both national funding of RIs and international commitments in EU RI policy (ESFRI and EU Cohesion funds).

Evaluation Methodology

The evaluation of the RIs is carried out using a two-stage evaluation process, combining the methods of panel and international peer-review, and interviews with the managers of the RIs. This evaluation is quite in-depth and prolonged, which is justified because the results are taken into account, among other things, in the the allocation of funding to RIs.

During the first stage, the proposal is assessed against the national definition of a RI to pass on to the second stage. This definition is composed of three elements:

- Operation of unique technological R&D facilities;
- Having at least nation-wide importance and impact in the Czech Republic and potential international overlap;
- Managing the RI on the basis of an open access policy consistent with international good practice.

This first stage evaluation is carried out exclusively by the six Scientific Boards, that act as evaluation panels, holding several meetings

In the second stage, the proposals are evaluated against a set of criteria pertaining to the following dimensions.

- **Socio-economic impact**, how does the RI contribute to solve socio-economic challenges in the context of the R&I system of the Czech Republic.
- **Uniqueness of technological facilities**, the technological level, knowledge intensity and uniqueness of the RI within the R&I ecosystem of the Czech Republic.
- **Existence of a management and sustainable development strategy**, that includes
 - a. a well-defined governance structure;
 - b. an intellectual property rights strategy;
 - c. a human resources development strategy;
 - d. a long-term sustainable development strategy and;
 - e. a public relations and marketing strategy.
- **Open access policy**, in that the RI is operated on the basis of an open access policy to its facilities for a broad range of potential users from the R&D community.
- **R&D strategy**, a substantial part of its R&D activities focuses on R&D to improve its services and expertise for the users, and the further development of technologies and expertise within the RI, and to a limited extent on the collaborative and contractual R&D.
- **Cooperation with other research organisations and RIs** operating in the respective scientific field or multidisciplinary R&D area and industrial sector (the RI has established a relevant formal framework determining rules of cooperation developed



with partner research organisations and RIs in the Czech Republic and abroad as well as with the industrial sector.

- **Quality of R&D results achieved by using the RI**, R&D results that are achieved by using the facilities and expertise of a RI must be of high-quality and adequate from the point of view of **'value for money'**.
- **Potential for the development of new technologies**, based on how far the RIs are operated in high-tech and knowledge-intensive areas and used for the development of new advanced technologies.

The second stage evaluation is carried out by international peer-review (two or three reports per RI proposal) to obtain additional independent expert opinions beyond the assessment conducted by the respective six Scientific Boards of the International Evaluation Committee.

In this second stage, the scientific panels who participated in the first stage carry out interviews with the representatives from the RI management teams in order to address questions about the operation of the RI and the delivery of services to external users.

Harmonisation of the panel results is done in a cross-panel session chaired by the head of the International Evaluation Committee. The decision on economic issues contains also a verification/negotiation phase, where the proponents have to explain and justify the budget proposal. The decision on funding is taken by the government and implemented by the ministry.

Positively evaluated RIs recommended by the International Evaluation Committee for public funding are divided into four performance-related groups indicating the priority for public funding in direct proportion to the quality-differentiated output of the evaluation: A1 (highest priority), A2 (high priority), A3 (middle priority), A4 (low priority).

The Czech Republic has developed a complete methodology for the evaluation of large-scale RIs, which is part of a broader system for the evaluation of the R&D support system in the country. The evaluation of RIs follows a two-stage approach, combining the use of six scientific boards with international experts (covering six R&D broad areas), followed by an international peer-review (two or three reports per RI proposal). Interviews with the representatives of the RI management team are also used to gain more insight on specific aspects of the RI.

The results of the evaluations are used to inform decision making in connection to:

- **Funding the large-scale RIs of the Czech Republic**, combining state R&I budget and EU Cohesion funds. In this regard, the roadmap acts as a stable, predictable and long-term funding framework for operation, further technological development and capacities and the capabilities of building RIs.
- **Declaring the political and financial commitment of the Czech Republic** to the pan-European RIs with Czech involvement and participation that will be submitted for future ESFRI Roadmap updates;
- **Joining the emerging ERICs** to be established within the ERA in the years to come.

The evaluation of RIs carried out by the Czech Republic in 2014 involved not only long-time operating facilities but also those newly built by using the ERDF within the Operational Programme Research, Development and Innovation (OP RDI) in the course over the 2007-2015 period. The results of the evaluation are considered as an ex ante evaluation as they were used to prepare the next multiannual financial framework covering 2016-2022. This evaluation will be used to carry out continuous interim assessments of large-scale RIs, which will be financially supported by the MEYS. This evaluation will be carried out after the end of the first



and third years in the seven-year large-scale RIs funding framework, followed by another comprehensive evaluation by the end of the period, to inform the preparation of the next multi-annual programme.

The evaluation methodology, both, as a means to select RIs for the roadmap and for the evaluation of RIs included in the roadmap when periodic interim assessments are carried out, is very well documented (see for example the *Czech Republic RI Roadmap for the years 2016–2022* and the MEYS document 'Ex-ante evaluation methodology for large research infrastructures'). These documents present the framework for the assessment of new concepts/projects of large-scale RIS, which have not been included in the 'Roadmap of the Czech Republic of Large Infrastructures for Research, Experimental Development and Innovation for the years 2016–2022', but might have emerged since the last roadmap update in 2015 (based on the outcomes of the 2014 comprehensive evaluation of large-scale RIs). The documents have been prepared to inform the evaluators in the context of the evaluation exercise launched to obtain an independent expert basis and science-based recommendations for the 2018 update of the roadmap.

GAP ANALYSIS AND EX-ANTE IMPACT EVALUATION TO DEFINE PRIORITIES IN THE NATIONAL RI ROADMAP (IRELAND)

As part of the Irish RI roadmap, in depth ex-ante assessment and prioritisation work, including gap analysis and ex-ante impact evaluation to define priorities, was performed.

As a means to support the preparation of the national Science, Technology and Innovation (STI) for the period 2006–2013, the Irish government carried out a comprehensive review of existing RIs, results of which were presented in the document 'Research Infrastructure in Ireland - Building for Tomorrow', published in 2007 by the former National Policy Advisory Board for Enterprise, Trade, Science, Technology and Innovation (FORFAS) and the Higher Education Authority (HEA). This document has been used as the Irish RI roadmap. The report was carried out to provide an overview of the quality of facilities currently available to third-level researchers and to identify gaps in the existing RIs that are most in need of attention in forthcoming rounds of national RI funding under the SSTI (Strategy for Science, Technology and Innovation).

To prepare the Irish RI roadmap, a review of existing RIs was carried out, as a means to identify gaps and design future funding of RIs, all in the context of the national STI strategy for the period 2006-2013.

For this National Review of RIs within the higher education system, all RIs were considered; there were no eligibility conditions as it involved the benchmarking of RIs in Ireland and the identification of gaps in the national platform of RIs. The results of this review were used to inform future RI funding. The review of the existing RIs was carried out across 9 broad disciplinary areas: Arts and Humanities; Biological and Agricultural Sciences; Computer Sciences; Creative Arts and Media; Earth, Atmospheric and Ocean Sciences; Engineering Sciences; Medical Sciences; Physical Sciences and Mathematics; and Social Sciences and Psychology.

This evaluation process followed a mixed approach that included consultation with stakeholders to gather their needs, site visits by 34 international experts, a workshop to obtain inputs from industry and business and finally a forum to discuss the outcomes of the visits, the workshops and the consultation. All the work was coordinated by an independent international Steering Committee composed of five experts.

The results of this evaluation were not used to inform the selection of RIs to enter the roadmap, but to inform future investments in RI in the higher education sector, as part of the



national Strategy for Science, Technology and Innovation covering the period 2006–2013. The report set out the strengths, weaknesses and gaps in existing RIs as well as recommendations for future investments and suggestions for greater utilisation of existing national and international research facilities on a multi-user basis.

As part of the process of updating Ireland's STI priorities for the next period (2014–2020), a study to update Ireland's strategy with respect to RIs was commissioned to the Technopolis group by the Department of Jobs, Enterprise and Innovation in 2015. This study had the following objectives:

1. Take stock of the RI investments made to date, in light of the national STI priorities (retrospective study).
2. Identify any future investment needs in the period to 2020 (and beyond) that may be strategically required for the achievement of national STI priorities (prospective study).

The study approach combined desk research, interviews, a survey about future RI needs and six workshops.

The study report pointed out that in total, the Irish National government invested between €60M and €80M per year in RIs during the studied period, and that due to these investments, Ireland's research community was able to use a broad range of RIs for a variety of scientific domains and application areas.

The study also highlights the fact that in Ireland, the RI strategy, mainly the financial resources available for RIs, is clearly dependent on and influenced by the national STI, which sets the priorities in terms of scientific challenges, business opportunities and societal challenges that require investments in, among other things, RIs.

One of the recommendations of this study was that: *"Ireland needs a RI roadmap to establish the prioritisation of national and pan-European Research Infrastructures; align RI priorities with STI priorities; facilitate political support at all policy levels; help to define national and regional budgets; and allow for long-term financial commitment by public and private stakeholders. The process of developing the roadmap should engage relevant ministries, agencies, industry, etc."* (FORFAS 2017).

The Irish government commissioned another study on national RIs, as part of the process for updating Ireland's STI priorities for the period (2014-2020). This study, which included both a retrospective and prospective study, concluded that the RI strategy, mainly the financial resources available for RIs, is clearly dependent on and influenced by the national STI and recommended the Irish Government the need to prepare the roadmap, as a tool to design the national RI strategy.



CROSS-COUNTRY ANALYSIS: TRENDS AND GOOD PRACTICES

Over the past decade, the number of national RI roadmaps and their updates have increased. This development is accompanied by a multiplicity of factors driving national roadmap processes: the establishment and development of the ESFRI Roadmap, the establishment of Smart Specialisation Strategies (RIS3), and budgetary fluctuations that make it essential to have clear mechanisms for prioritising RI projects.

InRoad's preliminary findings highlighted the need for a common understanding of methodological aspects related to RI roadmapping, the purpose of the roadmap exercise, as well as the interplay between national, European and institutional RI roadmapping processes. At a minimum, a better mutual understanding of the definitions and terms used by national authorities is essential to help with the classification of facilities and the application of specific terms. The following cross-analysis develops InRoad's findings on the diversity of national RI roadmapping processes and identified trends. Furthermore, it identifies some key areas for intervention. In general, InRoad findings show that successful attempts to increase coordination between different levels take into account the specificities of national R&I systems, as well as opportunities for a higher degree of coordination through transparent processes and public accountability. Explicit purposes and well-defined processes for RI roadmapping, clear definitions, a clear vision of what the missions and needs of RIs are, are all elements that can better support mutual exchange, policy learning and coordination.

RI DEFINITIONS IN NATIONAL RI ROADMAPS

ESFRI structures its RI definition in its public roadmap 2018 guide according to three main issues; 1) purpose and users of RI, 2) kind of RI or organisational model, e.g. central and remote resources and laboratories, and 3) type of RI: single sited, distributed, virtual, global RI (ESFRI, 2016).

However, variations in RI definitions of EU MS/AC make it difficult to refer to the same subject matter in the coordination of RI roadmapping processes with other countries and with ESFRI. There is a clear need to foster a better understanding of how a country defines its RI beyond national relevance and what are the deviations between the national roadmap definitions and those in ESFRI and the reasons for such disparities.

More than half of the investigated EU MS/AC share the same RI definition as ESFRI (19 out of 27; 70%) including Austria, Belgium (RI definition, but no roadmap exists yet), Bulgaria, Estonia, Finland, France, Hungary, Ireland, Italy, Lithuania, Norway, Poland, Portugal, Spain and Switzerland which has a RI definition very close to the ESFRI RI definition. However, there are seven countries (30%) that have an RI definition that deviates from that of ESFRI. These countries are Denmark, Germany, Greece, Israel, the Netherlands, Slovenia, and Sweden. The remaining country, Iceland, does not yet have a roadmap (Ruecker, et al, 2018).

The deviation of the RI definition from the ESFRI form in these countries mainly concerns:

1. Specific minimum threshold values, e.g. Denmark specifies approximately €3–14M investment needs for construction and/or implementation; Germany considers construction costs of at least €50M. For RIs in the fields of humanities and social sciences or educational research, a threshold of €20M applies; the Netherlands specify a lower threshold value in terms of total capital investment and operating costs for five years of M€ 10 for their large-scale RIs. These costs do not include accommodation costs for the facility. The operating costs pertain exclusively to the costs needed to make the facility accessible. These therefore do not include costs for the research programme.



2. Specifications of which RIs are included in the roadmap and which are not, e.g. Denmark excludes memberships of convention-based international RIs (e.g. CERN, ESO) and some other national RI collaborations from the roadmap process; Greece includes RIs that are relevant to the ESFRI roadmap, but in addition also RIs which are important according to national priorities; Israel's RI definition also includes a number of pieces of equipment which, used as a whole, contributes to a specific research area.
3. Service life of the RI, e.g. Germany considers a service life generally of at least ten years, the Netherlands of at least five years with at least another extension of five years; Czech Republic a four-year period with a possible prolongation of three years.
4. User access regulations to RI, e.g. access to German RI on the roadmap is generally open, and their utilisation is regulated on the basis of scientific quality standards; in Sweden, RIs must be generally accessible to Swedish researchers and need to be open and easily accessible to researchers, industry and other stakeholders; in Israel, RIs need to be available to all scientific researchers in Israel, while access to international users is not described.
5. Systems supporting RI, e.g. in Slovenia, RIs often require a structured information system for data management and for enabling information and communications as specified in the RI definition.
6. Distinguishing National Strategy for RI from the ESFRI strategy, e.g. in Greece priorities regarding ESFRI RI are aligned to the National RI Strategy, however the national strategy for RI is independent from the ESFRI strategy.
7. Technological developments of RI and innovation capacity; e.g. Sweden defines RI in addition to introducing new cutting-edge technology and Finland considers RI to develop both research and innovation capacity.

This list of deviations of national RI definitions from the ESFRI definition, as well as the recognition that national RI definitions vary considerably in the level of detail, point out that general guidelines on key elements of a RI definition would be beneficial for better understanding of the RI basis of discussion in the national roadmap of Europe, thus improving transparency and facilitating RI coordination at EU-level. In addition to the ESFRI RI definition, the RI definition should also include the following criteria:

- Threshold criteria for RI costs;
- Minimum service life of the RI;
- Specification of which RIs are included in the national roadmap and to what extent and which are excluded;
- Access regulations and specification of users;
- Technological and innovation capacity building and development.

PURPOSE OF NATIONAL RI ROADMAPS

Understanding the exact purpose of national roadmaps is essential for political decision makers, funding agencies and the user community to improve understanding of the strategic interest, scope, and orientation of other countries with respect to RI as well as the specific functions of the national roadmap. This understanding is a key requirement for identifying joint strategic interests and negotiating joint RIs with other countries at European level.



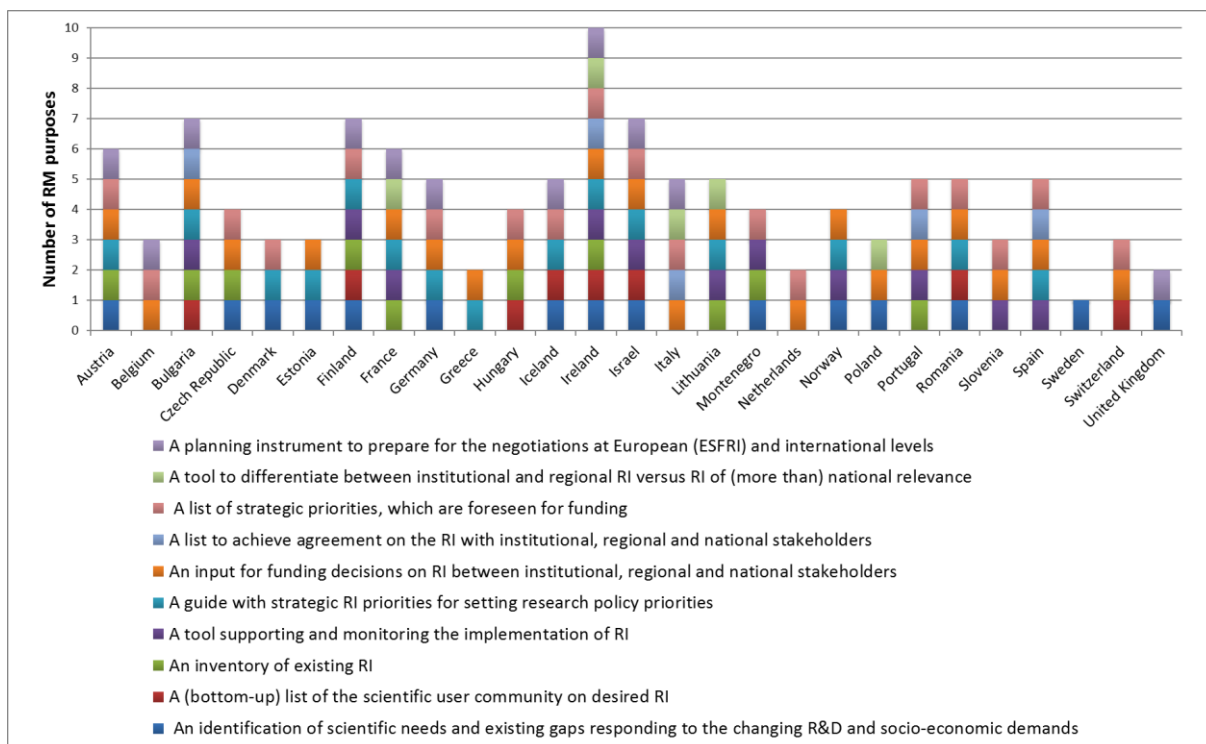


Figure 10: Purposes of national RI roadmaps as indicated in the validated InRoad compendium (by Ruecker, 2018).

It is striking that the number of roadmap purposes that were selected from a predefined list at the InRoad consultation and then validated in the country fact sheets of the subsequent InRoad compendium varies considerably from country to country. The majority of countries have three to five purposes in their roadmap (10 out of 27 countries; 37%). The maximum numbers of purposes were found in Ireland that captured all 10 purposes in their national roadmap, while the minimum numbers of purposes were in Sweden (1), Greece, and the Netherlands (both 2). Larger numbers of purposes (5–10) were found in countries like Ireland (10), Finland, Bulgaria and Israel (all 7), Austria and France (both 6), Germany, Iceland, Italy, Lithuania, Portugal, Romania, and Spain (all 5).

Additionally, country representatives specified further purposes during the validation of results, illustrated in the table below.

Table 8: Additional purposes in national RI roadmaps in four countries

Czech Republic	An inventory and an evaluation of existing RI
	A list of strategic priorities which are foreseen for funding subject to governmental approval
	An input for the ESFRI roadmap update
Greece	To support the decision-making process in compliance with strategic priorities in research, aiming to enhance the effectiveness of investment planning for RI at national and regional levels
	To support the development of an evidence-based national strategy in the framework of international negotiations linked to EU priorities and, where



	appropriate, the European Strategy Forum on Research Infrastructures
	To contribute to the Greek strategy for the ERA-National roadmap 2015–2020 objectives
The Netherlands	Better priority setting within a research field
Switzerland	Coordination instrument to respond to the needs related to RIs at national level

These findings indicate that predefined roadmap purpose options may not sufficiently capture the complexities of national roadmap purposes.

A further limitation of these predefined roadmap purpose options in the consultation was that the order of priority of the roadmap purposes was not specified. The importance of this point became evident when countries changed the selection of their roadmap purposes when they were asked to validate their responses. In the validation, additional roadmap purposes were selected, e.g. 'A planning instrument to prepare for the negotiations at European (ESFRI) and international levels' and 'A tool to differentiate between institutional and regional RIs versus RIs of (more than) national relevance', while certain purposes were deleted, e.g. 'An inventory of existing RIs', 'A (bottom-up) list of the scientific user community for the desired RI'.

Furthermore, when comparing the roadmap purpose in the actual roadmap texts, the main purpose is clearly specified, e.g. the national roadmap in Finland is a plan for key RIs in Finland that are under development, will be newly required during the next 10–15 years, or will be upgraded. It also includes participation in international projects and memberships of international RIs. The plan includes both RI opportunities and challenges for Finland and recommendations with measures to further improve the Finnish RI ecosystem. The indicated measures serve to monitor the development regularly.

In order to increase understanding of the primary purpose of national RI roadmaps and, with this, enhance strategic coordination of RIs at EU-level, InRoad recommends that countries reflect on the relative importance of the roadmap purpose in the context of their respective national R&I system. Practically, having one dedicated section to describe the purpose of the national roadmap would facilitate mutual understanding on this issue.

RI coordination at EU-level also benefits strongly from prior clarification of national strategic priorities foreseen for funding and the actual national funding decisions. Among the purposes most frequently mentioned by respondents as being relevant for national RI roadmapping the following factors were reported: (1) 'having an input for funding decision on RI between stakeholders' with 78% (21), followed by (2) 'listing strategic priorities for foreseen funding' with 67% (18), and (3) 'identifying scientific needs and existing gaps' with 56% (15). It turns out, that most countries that have the purpose (1) 'having an input for funding decisions on RI between institutional, regional and national stakeholders' also include the purpose (2) 'listing strategic priorities for foreseen funding' in their roadmap.

In summation, RI coordination at EU-level would benefit from better understanding of the specific national RI roadmap purposes. This requires further strategic and policy information that may be collected for the roadmap (e.g. inventories and landscape analysis). To facilitate such an understanding, it would be desirable that such documents would be made easily accessible, e.g. at a central online place reserved for each country such as the ESFRI Research Infrastructures Monitoring System ([ESFRI-MOS](#)) and written in English. For example, Finland includes in one document both its roadmap and its RI strategy and combines it with the de-

scription of the RI ecosystem as well as recommendations and measures to improve the RI ecosystem. With this integrated approach, all relevant information can be easily identified by the different stakeholders and more easily reviewed.

PERIODICITY AND ELEMENTS OF NATIONAL RI ROADMAPPING PROCESSES

While it is a feature of the European landscape and specific national R&I systems, the diversity of roadmapping processes, including their periodicity, makes coordination among EU MS and AC more challenging. The figure below shows that there is little alignment in terms of roadmap periodicity between individual countries or with the European level (ESFRI level). While it is not necessary or feasible to precisely align the timing – since it is due to national policy cycles and other internal factors –, the development of clear guidelines with defined steps for roadmapping and for the evaluation of RIs would allow for better coordination and promote the long-term sustainability of the RI landscape.

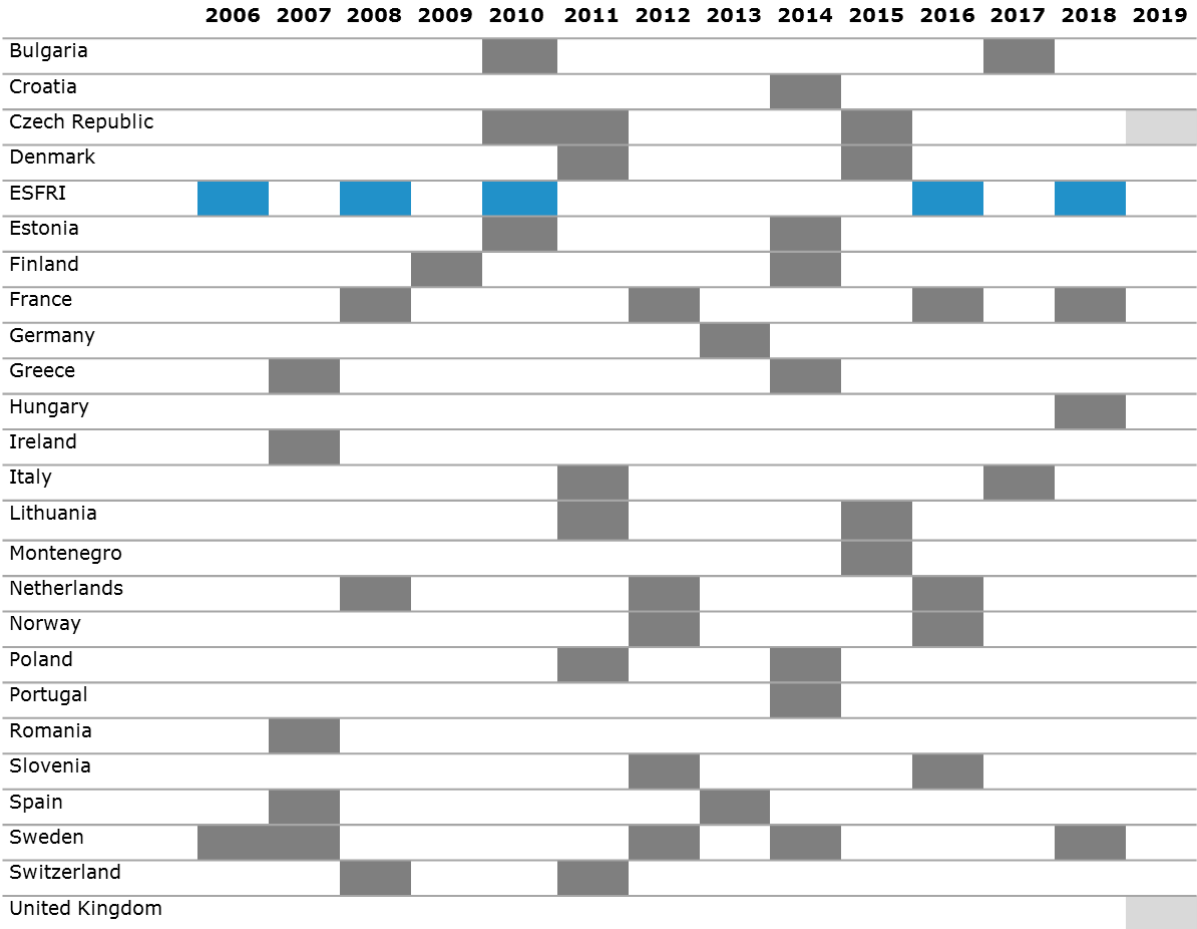


Figure 11: Year of publication of roadmaps and updates in 27 MS and AC compared to the ESFRI roadmap (by Isabel Bolliger and Alexandra Griffiths, 2018)

A first welcome step would be for each country to have a clearly defined timeline for reviewing and/or updating the roadmap, which is still not the case in some countries. Indeed, the periodicity of the updates is not always explicitly mentioned in the roadmap document. Updates are resource-intensive for the RIs, the evaluators, and the authority in charge of the roadmap. Moreover, RIs also need time to develop and mature between evaluations. Thus, they do not need to be too frequent. It is also understood that the periodicity of the national

roadmapping process may change after some time or experience delays if there are significant changes in the national context or new elements to be considered.

The link between funding and roadmapping also has an effect on timing. Only **24% of the countries studied include funding commitments in the RI roadmap, while 59% use the roadmap as an input for funding** (the remaining percentage are countries with no active roadmap, or where the roadmap has no clear link to funding). But even when funding commitments are not included, RI roadmaps and their respective updates enable countries to review and set their national priorities, to develop their strategy in view of investments for national and pan-European RIs and finally to link with regional Smart Specialisation Strategies, which are a prerequisite to use European Structural and Investment Funds (ESIF). In many countries, the RI roadmap could be better linked to long-term funding plans in order to increase predictability in the national RI landscape. As a counterpoint, many RI stakeholders interviewed by InRoad have pointed out that there is a lack of clarity within European programmes and calls for RIs; for example, links between the ESFRI roadmap and the EU Framework Programme for Research and Technological Development funding are not well understood. Strengthening those links would also facilitate roadmapping at the national level.

Considering these elements, some countries have designed their RI roadmapping process so that RIs are selected for the national roadmap prior to the ESFRI call (e.g. the latest Czech roadmap update), thus providing the required political support. Sweden has designed a dual process, wherein the roadmap as a strategy document is published every four years, but an Appendix (not represented in the figure) based on an inventory of needs is published every two years to define strategic areas and organise calls for funding. This process was designed in response to changing responsibilities and funding models for RIs. Overall, InRoad encourages countries to strive for a stable and predictable process based on commonly accepted principles and careful consideration of the ESFRI timeline.

Regarding the different elements of the roadmapping process, the analysis of the InRoad consultation results completed by a desk review¹⁷ showed that mainly the following are taken into account in roadmapping processes at the national level:

- **79% include calls for applications (bottom-up)**, wherein RI projects and existing RIs can submit applications to the roadmap;
- **79% include a prioritisation** of RIs or RI projects (based on applications or a pre-selection process);
- **79% include scientific evaluation** of RIs (from the call or pre-selection);
- **79% include monitoring of projects and existing RIs**, which is used as input for roadmap updates or is carried out in parallel to the roadmapping process;
- **79% include support from independent national experts** to 1) identify existing or new projects of interest, 2) conduct or contribute to landscape analyses, 3) evaluate proposals, or 4) take part in monitoring (usually more than one of those tasks).

There is considerable variation between countries in the way these elements are implemented and how they are used within the roadmapping process. Furthermore, there is often a lack of information about the methods used (e.g. for monitoring). More details about the elements

¹⁷ The following analysis considers Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Montenegro, Netherlands, Norway, Portugal, Romania, Spain, Sweden, and Switzerland. Other countries were not included due to lack of available data.



that compose RI roadmapping processes and suggested good practices (benchmark) can be found in Deliverable D3.3.

INSTITUTIONS RESPONSIBLE FOR THE ORGANISATION OF NATIONAL RI ROADMAPPING PROCESSES

The figure below once again illustrates the diversity of national RI roadmapping processes in the countries who responded to the InRoad consultation. It shows which institutions of the national R&I system have the responsibility of organising and coordinating the national RI roadmapping process. Whilst this map does not reflect the full nuance and complexity of national RI roadmapping processes, it indicates where the operational centre for RI roadmapping lies. Other actors in the national R&I system also play a role in the different steps described in the previous section (as illustrated in detail in the case studies).

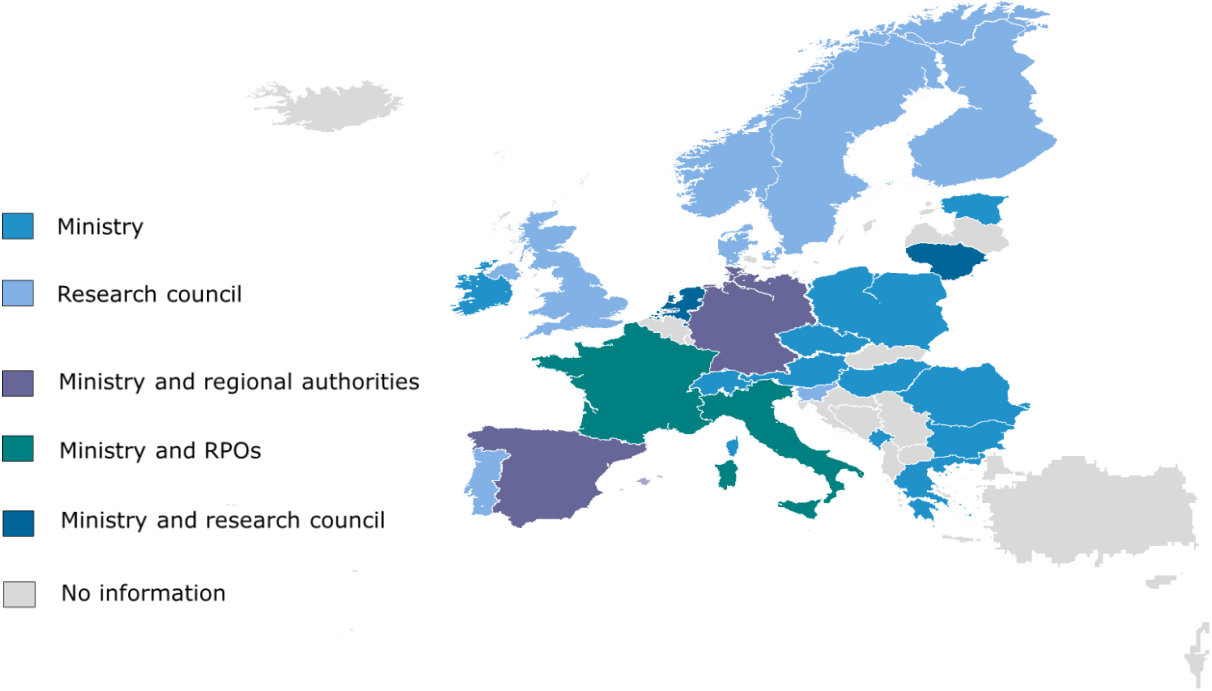


Figure 12: Institutions responsible for the organisation of the national RI roadmapping process in 27 MS and AC (by Alexandra Griffiths, 2018).

There are many explanations for these disparities. We can identify a few: first, the level of centralisation of the government administration. Typically, the more centralised decision-making is, the more centralised the process for RI roadmapping will be. This is the case for example in the Czech Republic and other Eastern European countries, where the Ministry in charge of research conducts the RI roadmapping. In countries with more decentralised administration, such as Sweden and other Northern European countries, agencies typically have more responsibilities. This is also reflected in the national RI roadmapping process. Federal countries with delegation of responsibilities to the federal level, such as Germany and Spain, tend to heavily involve regional authorities in the process (here regional authorities also refers to federal states). However, this is not the case for Switzerland. While there are some very broad patterns, such institutional arrangements also depend on other factors, such as the structure of the national R&I system, legal frameworks and funding rules.

Overall, these disparities are a feature of the European system and its subsidiarity, R&I policy remaining mostly the prerogative of national authorities. Thus, they organise themselves according to internal characteristics of the R&I system, and of the political system as a whole. Good practices in RI roadmapping take into account those internal characteristics. Indeed, there is no one-size-fits-all process for RI roadmapping and careful consideration of the specificities of the national system is essential.

This makes for a complex system, but a higher degree of coordination is achievable if countries can agree on common principles and coordination mechanisms that respect national specificities (e.g. benchmarking). Examples of such coordination can be found in recent history, with the establishment of ESFRI, the elaboration of the ERIC framework and many successful international agreements for RIs. Those examples show that challenges for the long-term sustainability of RIs can be addressed through common efforts. Finally, well-functioning national RI roadmapping processes are a prerequisite for a sustainable European RI landscape, and countries are encouraged to reflect on how different levels – regional, national, European – can be better linked and coordinated.

MONITORING AND EVALUATION PROCESSES IN NATIONAL RI ROADMAPS IN EUROPE

Ex-ante impact assessment for the RI roadmap

In general, the European national RI roadmaps are long-term, policy-relevant exercises based on strategic goals (see the [InRoad Consultation Report](#) for further information), but very few of them include precise information on the results expected at different time periods (short, medium and long term) and/or on the M&E activities to be carried out for assessing the accomplishments of RIs included in the roadmap. Information on ex-ante impact assessment (sometimes referred to as diagnostic review, prioritisation or landscape analysis) is quite scarce and in generally most countries do not provide enough or clear information on this strategic phase of roadmap elaboration. In this sense, a clear ex-ante impact assessment (in the sense of the EC concept, see for example: European Parliament 2015) is therefore missing in most of the European national RI roadmaps.

Selection of RIs for the inclusion/maintenance in the roadmap

Presently, the evaluation methodologies for selecting RIs to be included in the national roadmaps are quite similar across the EU countries and are mostly based on expert peer-review procedures, varying in specific methodological aspects such as eligibility conditions, phases of the evaluation, criteria for selecting the experts, RI selection criteria, etc. There are many gaps and much missing information in the publicly available information on methodological procedures followed in the evaluation process, which makes it difficult to follow the whole process in many countries.

Most of the countries reviewed use expert peer-review to evaluate the RIs that submit proposals to enter the RI roadmap, in many cases combined with strategic panel evaluation. However, differences have been found in issues such as the eligibility conditions, the different phases of the evaluation, the processes and requirements for selecting experts and reviewers, the configuration of panels, etc.

Interim evaluation/ monitoring (follow-up) of the RI roadmap

There is increasing awareness among policymakers and stakeholders that a periodic assessment of the real achievements of the RI roadmap portfolio, in comparison to expected results,



should be performed and corrective measures should be taken when needed. However, there is very limited information on the monitoring (follow-up) practices conducted by EU countries in relation to RI roadmapping procedures. This deficit of information could be linked to the lack of precise information on the expected results related to the implementation of the national RI roadmap, already discussed. This is something that was also pointed out by the Horizon 2020 Advisory Groups for RI and the ESFRI 2011 Evaluation report and it could be linked to more general issues such as the cultural, administrative and political differences in the way each country approaches internal planning, funding and organisation of their science and technology policy, including M&E practices.

Indicators for RI roadmapping, monitoring and evaluation

On the specific issue of indicators, the Global Science Forum (GSF) Expert Group for RIs of the OECD organised an International Workshop on 'Establishing a reference framework for assessing the socio-economic impact of Research Infrastructures' in March 2018 in Paris, with the objective of collecting targeted feedback on impact assessment indicators and methodologies from RI stakeholders, based on real case studies and to initiate the discussion on the draft assessment framework to identify potential gaps and limitations. During the Workshop, OECD representatives presented the results of their survey on 'Main indicators for establishing a reference framework for assessing the Socio-economic impact of RIs' sent out to RI managers from a diverse sample of RIs and to external stakeholders (policy makers, funders, local authorities and hosting organisations). The main indicators proposed by these two groups, with potential use for all the phases of the RI lifecycle and for the roadmapping process are detailed in D3.3.

Another interesting initiative on RI indicators is the recently launched H2020 project 'Charting Impact Pathways of Investment in Research Infrastructures' ([RI-PATHS](#)) The objectives of this project are: i) to take stock of the existing approaches for the impact assessment of RIs and identify future data needs, ii) to design a modular impact assessment model that covers all main impact pathways of RIs, and iii) to define a set of core indicators, provide guidance and pilot the impact assessment model with RIs. They have recently published a deliverable that has compiled literature of the most common methodologies currently employed for the socio-economic impact assessment of RIs. They have grouped relevant contributions from the literature in six main approaches:

- 1) Socioeconomic assessment based on impact multipliers;
- 2) Methodologies applying the knowledge production function;
- 3) Cost-benefit analysis;
- 4) Approaches based on multi-methods, multiple partial indicators;
- 5) Theory-based approaches;
- 6) Case studies.

Their review highlights that there is not a single methodological approach that can appropriately answer all the questions that a socio-economic impact assessment addresses and they have included an interesting discussion on suitable indicators. This project expects to have a validated impact assessment model for RIs by September of 2019, and a final methodological handbook by May 2020.

The results of the ongoing initiatives from the OECD GSF and the RI-PATHS project already mentioned, together with the ongoing work on these issues by ESFRI, from the academic sector and from another H2020 projects, are expected to provide new insights and pragmatic approaches that would be of interest for the European countries developing national RI roadmaps in the near future.



KEY RESULTS FROM THE CASE AND DESK STUDIES

Different drivers of national RI roadmapping processes can be identified: the ESFRI strategy and roadmap, regional development strategies and the ESIF funding framework, but also national interests and R&I strategies. Institutional and cultural elements also play an important role: legal frameworks, funding frameworks, the structure of the R&I system, the type of administration (e.g. centralised/decentralised), and other national characteristics also shape individual roadmapping processes at country level. As a result, we can observe a diversity of practices, in spite of the common drivers identified. Among this diversity, we can identify some key elements for a good process that are summarised in the following section.

KEY RESULTS FROM THE FINNISH CASE

In Finland, the national RI strategy and roadmap with implementation measures is a plan to reach a national R&I vision with clear targets, which invites RI funders, hosts and users to align their strategies and capacities with this national plan. Thus, long-term sustainability and the strategic orientation of a national RI ecosystem requires coherence between a long-term national plan with related national strategy, implementation and funding measures as well as the roadmap on one side and the corresponding strategies, measures and roadmap elements in terms of the host and users on the other.

The Finnish RI strategy and roadmap process involves a continuous dialogue with national roadmap actors, RI hosts, funders and users as well as international experts to foster understanding of the national strategies and roadmapping processes, but also needs as well as international RI developments. For a national RI ecosystem to be internationally competitive, continuous reflection on its needs and performance is required combining the perspectives of roadmap actors, RI hosts, funders and users in a holistic system and adjusting strategies and roadmapping processes to meet changing needs.

KEY RESULTS FROM THE DUTCH CASE

The introduction of a Permanent Committee, which is almost solely responsible for developing the large-scale scientific infrastructure roadmapping process, has created the foundation for long-term strategic planning.

The imbalance between available funding resources and needed investments for RIs in the Netherlands is limiting the funding of new RIs. By forcing RIs with similar or compatible thematic backgrounds to submit a joint proposal to apply for the national roadmap, redundancies through using similar equipment can be avoided and synergies can be achieved. Additionally, the facilities applying for funding must commit to paying half of the operational costs for a period of ten years, thus guaranteeing sustainable budget planning.

Moreover, funding decisions on RIs in the Netherlands are linked to strategic priorities. As a result, RIs need to orient their research with more focus towards national priorities.

KEY RESULTS FROM THE CZECH CASE

The establishment of clear, transparent procedures and the involvement of stakeholders and experts are a prerequisite for a sound RI roadmapping process. This is demonstrated in the Czech case, where the following elements are particularly well received by the national RI community.



First, the presence of an advisory body such as the Council for Large Infrastructures of the MEYS ensures that key stakeholders with knowledge about the national RI landscape are able to give input to the roadmapping process. Moreover, the roadmap contains a strategic view based on current developments in the European RI landscape, the ERA objectives and work carried out in ESFRI. This allows Czech RIs to be positioned within the European context and shows that the strategy of the MEYS is based on a multi-level approach. As a complement to the overall strategy, the landscape analysis carried out by national experts in all the disciplines represented in the roadmap, provides information on the strengths, gaps and needs in the Czech RI landscape.

Regarding the evaluation, the advice of independent, international experts with extensive knowledge of RIs complements the knowledge of national experts. Moreover, the evaluation methodology includes clear criteria and procedures. All of these elements increase the objectivity and transparency of the roadmapping process.

We can therefore conclude that despite some remaining bottlenecks discussed in Chapter 3.3 of Annex 1, the Czech RI roadmapping process is well-established and the Czech RI roadmap is a key document in the national R&I strategy. Therefore, other countries with similar characteristics could learn from the Czech process and its good practices.

KEY RESULTS FROM THE SWEDISH CASE

The funding system and roadmapping process for RI in Sweden have undergone some major transformations in the last years, which resulted from thorough investigations into the matter. The interviews for the Swedish case study revealed a predominant satisfaction with the current process and particularly the changes towards stronger involvement of universities is well perceived. Distinct for the Swedish process is the strong involvement of the Swedish research community, and the consultation with different scientific fields, as well as the importance of scientific excellence, within the prioritisation process. Sweden also took a lead in the ecosystem approach, encouraging its universities to elaborate institutional priorities, and the aim to consider these institutional priorities within the identification of national and European priorities.

Overall, the Swedish process is very transparent in terms of available documentation, which is very detailed and all easily available online and in English. The relevant actors are well aware about the process and are informed well by the responsible authority, the Swedish Research Council.

KEY RESULTS FROM DESK STUDIES ON EVALUATION AND MONITORING

The Czech Republic is a good example of the use of evaluation and monitoring criteria to select the RIs that are included in the national RI roadmap. The methodology was inspired by ESFRI evaluation procedures. During the first stage, the proposal needs to comply with the definition of a RI to pass on to the second stage. In the second stage, proposals are evaluated against a set of criteria: socio-economic impact, uniqueness of technological facilities, the technological level, knowledge intensity and the uniqueness of the RI within the R&I ecosystem of the Czech Republic. The evaluation is carried out by international peer-review panels.

In this second stage, the scientific panels carry out interviews with representatives of management of each RI in order to address questions about the operation of the RI and the delivery of services to external users. Harmonisation of the panel results is done in a cross-panel session chaired by the head of the International Evaluation Committee. The decision on economic issues contains also a verification phase where the proponents have to explain and



justify the budget proposal. The decision on funding is taken by the government and implemented by the ministry.

Bulgaria demonstrates another example of evaluation methodology for the inclusion of RIs in the national roadmap, covering quantitative and qualitative criteria inspired by the ESFRI approach.

The assessment criteria of the individual RI include the following components:

- Demands and benefits of their scientific research;
- Development, maintenance and usage of research equipment;
- Scientific quality of the research and key beneficiaries of the research results (assessed through publications, patents, citations, number of consumers, etc.);
- Institutional capacity (composition of the scientists, who perform the scientific research; availability of habilitated staff; number of PhDs, age profile, etc.);
- Management of programs for scientific research, financed on a competitive basis from national and international sources;
- Activity in attracting funding from different sources;
- Social-economic benefits and relevance of the research results (availability of created product, technology, methodology, etc.);
- Established partnerships: regional, national and European.

An international peer-review panel with reputed and skilled scientists was used to evaluate RIs to be integrated in the Bulgarian roadmap.

Ireland's roadmapping process is a good example of the use of gap analysis and ex ante impact evaluation to define priorities in a national RI roadmap.

To prepare the Irish RI roadmap, a review of existing RIs was carried out, as a means to identify gaps and design future funding of RIs, all in the context of the national STI strategy. For this national review of RIs, all RIs were considered and there were no eligibility conditions as it involved the benchmarking of all RIs in Ireland and the identification of gaps in the national platform of RI. This study had the following objectives:

- Take stock of the RI investments made to date in light of national STI priorities (retrospective study);
- Identify any future investment needs in the period to 2020 (and beyond) that may be strategically required for the achievement of national STI priorities (prospective study).

The review set out the strengths, weaknesses and gaps in the existing infrastructures as well as recommendations for future investments and suggestions for the greater use of existing national and international research facilities on a multi-user basis. Noteworthy recommendations of this study were that Ireland needs a RI roadmap to establish the prioritisation of national and pan-European RIs; to align RI priorities with STI priorities; to facilitate political support at all policy levels; to help to define national and regional budgets; and allow for long-term financial commitment by public and private stakeholders. The process of developing the roadmap was considered essential to engage relevant stakeholders.



CONCLUSION

The objective of this Annex was to describe common trends and good practices in national RI roadmapping processes, as well as evaluation and monitoring mechanisms for RIs, in Europe. For this, four country case studies (Finland, Netherlands, Czech Republic and Sweden), three country desk studies on evaluation and monitoring mechanisms (Czech Republic, Bulgaria and Ireland), a cross-country analysis (including 27 countries in Europe) and feedback from the InRoad validation workshop in 2018 were taken into account. The findings of this Annex provide the evidence for the recommendations from the InRoad report on coordination between national and European RI roadmapping processes.

With regard to good practices, the results of the case studies indicated the importance of suitable and sustainable structures for coordinating, implementing and communicating national RI roadmapping processes as well as coherent strategies to successfully manage and implement them. Continuous dialogue between all national stakeholders is necessary to achieve a better understanding of the relevant RI terms and definitions. This dialogue serves as a basis for the orientation of national stakeholders towards common goals for the development of the national and European RI landscape.

The case studies also revealed that the identified good practices of RI roadmapping processes in the selected countries need to be related to the R&I system in which they are embedded and the different actors involved. Therefore, characteristics of the national R&I systems and the relevant RI actors in the investigated countries were described alongside the national RI roadmapping processes and good practices. Since the case studies investigated relatively small countries with a central political system and distinct national R&I strategies, the identified good practices need to be carefully considered and possibly adapted to the conditions of larger countries, or countries with federal political systems and different R&I strategies.

The desk studies showed that monitoring and evaluation terminology is used and understood in different ways across European countries, making it difficult to compare the different approaches. Evaluation methodologies for selecting RIs to be included in the national roadmaps vary in specific methodological aspects such as eligibility conditions, phases of the evaluation, criteria for selecting experts, RI selection criteria, and so on. There is very limited information on the monitoring (follow-up) practices carried out in European countries in relation to RI roadmapping. The definition and use of a set of measurable, simple, relevant and reliable indicators, designed to facilitate the supervision of the overall RI roadmap goals, could facilitate in a very significant way this monitoring process. Finally, a clear ex-ante impact assessment (in the sense of the European Commission concept) is missing in most of the European national RI roadmaps. Concrete definition of national RI roadmap strategic objectives and expected results could facilitate future coordination with the RI policy at EU level.

In summary, the case studies, desk studies and cross-country analyses indicated that there is a large diversity of national RI roadmapping processes. However, among this diversity, good practices can be identified and opportunities for a higher degree of coordination of national RI roadmapping processes at EU-level become apparent. Therefore, InRoad hopes to contribute to the exchanges of experience going on between European stakeholders and within ESFRI in view of improving the long-term sustainability of the RI landscape.



ANNEX II: FINDINGS FROM THE CASE STUDIES ON RI FUNDING

EXECUTIVE SUMMARY

The present Annex reports the development process and the general findings from the case studies on funding of Research Infrastructures (RIs) in Europe, which have been conducted within the scope of the activities of InRoad.

The information from the case studies described in this document was obtained through a series of interviews conducted between month 14 and month 18 of the project, respectively between 28 February and 29 June 2018 – with representatives of 17 European RIs from different scientific areas and typologies. Following a structured methodology, the interviews were organised to gather insights on the use and combination of funding sources throughout different stages of their lifecycles. The pool took into account (to the extent possible) the heterogeneous European RI landscape, selecting facilities from different scientific domains, different typologies (distributed or single-sited), in different lifecycle stages and with different funding models. This process was also supported by the organisation of five Regional Technical Workshops (RTWs), where stakeholders could discuss issues related to RI funding.

Overall, this document structures and analyses the information collected during the interviews. Where appropriate, inputs from the RTW were inserted. The cumulative process here-with described allowed for the definition of four main areas for recommendations, to be further developed in Deliverable 4.5 of the project: Lifecycle approach; Closer synergies among funding frameworks; Exchange of knowledge for funding solutions; Demonstration and communication of RI's scientific and strategic relevance and their broader societal impact.



ABBREVIATIONS

AC	Associated Countries
EC	European Commission
EJP	European Joint Programmes
ERA	European Research Area
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategic Forum for Research Infrastructures
ESIF	European Structural Investment Funds
EU	European Union
EU FP	EU Framework Programme for Research and Technological Development
FTE	Full-time equivalent
GSF	Global Science Forum
JPI	Joint Programming Initiatives
KPI	Key performance indicator
MS	Member States
NRIRMP	National Research Infrastructures Roadmapping Procedures
OECD	Organisation for Economic Co-operation and Development
R&D&I	Research, development and innovation
R&I	Research and innovation
RI	Research Infrastructure
RIS3	Research and Innovation Smart Specialisation Strategies
VAT	Value Added Tax



INTRODUCTION

The European RI landscape is undergoing a process of continuous change whereby RIs evolve from the early stages of their construction to their operational and subsequent phases. The diversity of available funding instruments during early stages (e.g. concept development, design, preparation and implementation) stands in contrast with the lack of suitable funding instruments for the operational phase. This highlights a shortage of adequate, realistic, and predictable funding mechanisms and models, necessary to cover the entire lifecycle. This is especially important given that the transition from implementation to subsequent phases often entails a change of funding sources. Therefore, closer synergies among different funding instruments and across different levels are needed to provide more stability throughout all stages of the RI development.

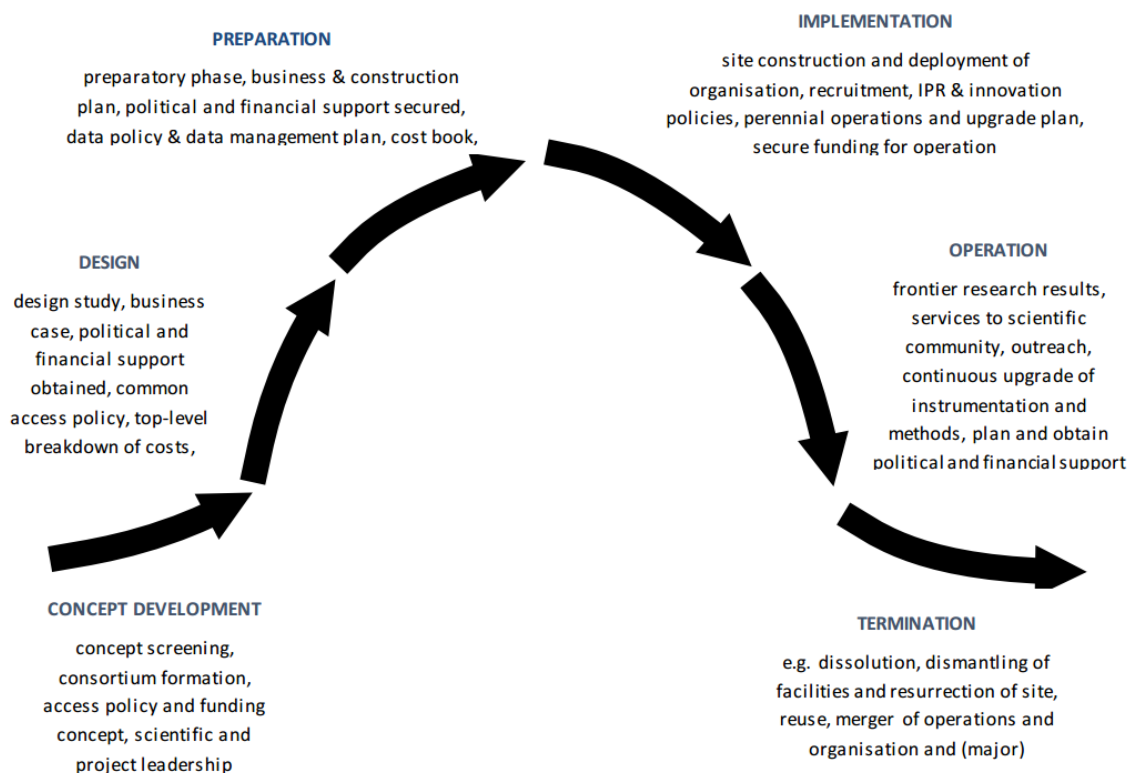


Figure 1 RI lifecycle ([ESFRI Public Roadmap 2018 Guide](#))

METHODOLOGY AND DATA COLLECTION

Building upon the results of previous tasks of the project (for more information, please see the [Consultation Report](#)), the InRoad case studies were designed to gather new information and refining already identified insights. In addition to the information collected through previous tasks, the preparation of the interviews involved the use of secondary sources such as documents that were particularly relevant to acquire a deeper understanding of the general context, existing bottlenecks in RI funding, key stakeholders, among other topics. RI managers from different facilities were contacted, as their experience on using and combining different funding schemes throughout the RI lifecycle stages is relevant for the development of insights and recommendations. The selection took into account (to the extent possible) the heterogeneous European RI landscape, selecting facilities operating in different scientific domains and different types of RIs (distributed or single-sited), in different lifecycle stages and with different funding models.



A common interview guide was designed to create a standard framework for all interviews, and to facilitate, at a later stage, the analysis of the data gathered from the interview process. In addition, specific adjustments to the interview questionnaire were made when needed or justified by the specific nature and context of the RI (e.g. inclusion of questions regarding the linkage of funding decisions to national roadmapping processes depended on the existence of such roadmap for RIs at the national level).

Overall, for the approach and design of the individual interview questions, the following topics served as the basis for the interviews:

1. Which funding schemes exist in different European countries and what phases of an RI's lifecycle do they cover?
2. How are funding decisions in different countries interlinked with RI roadmapping processes (or other ways of defining strategic priorities for RIs)?
3. How can the existing funding schemes be adapted to provide better framework conditions to cover each phase of a RI's lifecycle?

Consent forms were sent to each of the interviewees to make them aware of the purpose and terms of the study, and the implications thereof. Following the interviews with RI representatives, all answers were transcribed and shared with the interviewees, for their verification and approval. Once validated by the interviewees, the data for each individual case study was then inserted into a multi-level matrix, which had been designed to aggregate all relevant findings, quotes from interviewees, reflections from InRoad partners and also to allow a cross-case analysis. This instrument provided a simple overview of all related quotes (taken from the interview transcripts), inputs (from other project's activities in regards to a specific RI) and reflections (elaborated by the team that performed each interview). Through the matrix, good practices and bottlenecks were identified, which then helped develop InRoad's initial recommendations.

The data collection process also largely benefited from the regional technical workshops (RTW) that were developed in parallel, in a series of events organised between November 2017 and May 2018. The InRoad Regional Workshops, held in [Prague](#), [Rome](#), [Hamburg](#), [Aveiro](#) and [Wroclaw](#) between 2017 and 2018, provided a space for stakeholders to discuss and deliver a set of recommendations, that were organised and presented in the [Report from Regional Technical Workshops](#) around the following topics: the main bottlenecks encountered during the different RI phases, the importance of the national roadmap process, timing and funding, the experiences with regard to the long-term funding of RIs, and recommendations for a better coordination of the different levels of RI funding.

OVERVIEW OF LITERATURE ANALYSED

The [Regional Technical Workshops reports](#), the [Consultation report](#) and the literature sources listed below were used for the analysis.

- [Bulgarian Presidency Flagship Conference](#): Research Infrastructures beyond 2020 – Sustainable and effective ecosystem for science and society, Conference Conclusions. Sofia, 22-23 March 2018.
- [ESFRI Scripta Volume II](#): Long-Term Sustainability of Research Infrastructures. European Strategy Forum on Research Infrastructures, Long-Term Sustainability Working Group, Published by Dipartimento di Fisica – Università degli Studi di Milano, October 2017.
- [OECD – Strengthening the effectiveness and sustainability of international research infrastructures](#), OECD Science, Technology and Industry Policy Papers, No. 48, OECD Publishing, Paris, 2017.



- [Sustainable European Research Infrastructures – A call for action](#); COMMISSION STAFF WORKING DOCUMENT — Long-term sustainability of Research Infrastructures, 2017.

Once the case studies were defined, relevant information on the specific funding models and experiences of each RI was gathered. Prior to the 17 case studies, research work was conducted as a preparatory task for the inclusion of specific adjustments to the questionnaire. Besides policy documents from different *fora* (e.g. ESFRI, the OECD, Science Europe, the Royal Society and the European Commission, etc.), special attention was devoted to reports and other documents published by RIs (annual reports, business plans, statutes, deliverables, etc.).

OVERVIEW OF INSTITUTIONS AND PEOPLE INTERVIEWED

From their design, the InRoad case studies aimed to cover a broad spectrum of experiences and capturing the main differences in Europe with respect to different research and innovation systems. For that purpose, the selection methodology took into account different criteria. With the goal of assuring a broad representation of realities, the case studies **aimed to cover all scientific domains of RIs**, according to the categorisation of the 2018 Roadmap with ESFRI Projects and ESFRI Landmarks (i.e. Energy, Environment, Health & Food, Physical Sciences & Engineering, Social & Cultural Innovation and Data, Computing and Digital RI).

Recognizing that there are specific implications with regard to the type of RI, i.e. single-sited or distributed, the case studies sought to strike a **balance between the two typologies**. With 53% of the case studies being distributed RIs, for which national nodes or the central hub were interviewed, the remaining 47% were single-sited RIs.

Regarding the lifecycle approach, the selection of RIs took into account the **coverage of all stages** applied by [ESFRI](#) (vide infra), which is coherent and consistent with RI funding under the (i.e. concept development, design, preparation, implementation, operation and termination). By definition, operational RIs have experience in the previous stages of the lifecycle, and are therefore more capable of providing in-depth insights. Hence, a major part of the case studies focused on the operational phase of RIs. Moreover, in previous tasks of the project, it had become evident that RIs face more funding-related bottlenecks during the operational phase. Thus, around 70% of the covered RIs **are currently in their operational stage**, with the remaining percentage either undergoing the preparatory (about 12%), implementation phase (also 12%), or in transition from preparation to implementation (representing less than 6%).

Taking into consideration the different criteria, the following table provides an overview of the 17 selected RIs organised according to their specific scientific domain, typology, lifecycle stage and interview date.

Table 1: Overview of RI profiles selected for InRoad’s case studies on RI funding.

RI	Scientific domain	Typology	Lifecycle stage	Interview date
RI 1	Environment	Distributed	Preparation	28.02.2018
RI 2	Physical Sciences and Engineering	Single-sited	Operation	01.03.2018
RI 3	Physical Sciences and Engineering	Distributed	Operation	21.03.2018
RI 4	Environment	Distributed	Operation	29.03.2018

RI 5	Data, Computing and Digital Research Infrastructures	Single-sited	Operation	03.04.2018
RI 6	Environment	Distributed	Operation	03.04.2018
RI 7	Health & Food	Distributed	Operation	12.04.2018
RI 8	Data, Computing and Digital Research Infrastructures	Distributed	Operation	12.04.2018
RI 9	Physical Sciences and Engineering	Single-sited	Interim/Transition	12.04.2018
RI 10	Physical Sciences and Engineering	Single-sited	Operation	25.04.2018
RI 11	Health & Food	Distributed	Implementation	30.04.2018
RI 12	Physical Sciences and Engineering	Single-sited	Implementation	24.05.2018
RI 13	Physical Sciences and Engineering	Single-sited	Operation	24.05.2018
RI 14	Health & Food	Single-sited	Operation	25.05.2018
RI 15	Social & Cultural Innovation	Distributed	Operation	25.05.2018
RI 16	Health & Food	Distributed	Operation	29.05.2018
RI 17	Energy	Single-sited	Preparation	29.06.2018

In addition to the aforementioned selection criteria, the existence of contact persons from RIs was also an important factor in the selection process, as it guaranteed an entry point for interactions and gathering of information by InRoad.

The following section presents the analyses of the information collected during the interviews and RTWs according to the following structure: (i) NRIRMP and funding, (ii) Funding instruments used by RIs, (iii) Lifecycle approaches and decommissioning, (iv) Users and access policy, (v) Training, and (vi) Other mentioned topics and bottlenecks.

FINDINGS ON RI FUNDING

The InRoad [consultation](#) showed that 93% of responding countries linked their RI funding decisions with the definition of strategic priorities, suggesting that this is perceived as an important aspect by the majority of consulted countries. In spite of this, funding from different sources (regional, national, European) along the different RI lifecycle stages, particularly for operation and termination - is not guaranteed within existing funding frameworks. A higher degree of coordination is therefore needed through **a better understanding of existing RI funding instruments and regulations across all RI lifecycle stages**. This is specifically the case for long-term oriented RIs, where multi-source funding models, as well as transparent and simple application processes are necessary to ensure stability throughout all lifecycle stages.

Overall, the lifecycle model for RIs is a reference to realistically understand the needs and targets of RI at a given time and on various levels. Funding dynamics, therefore, should be adapted accordingly to meet the requirements of RIs, safeguarding the long-term sustainability while securing at the same time effective and efficient spending. The richness of RI typology, the specific requirements based on the different RI lifecycles and organisational structure, and not least the relatively large financial resources required, result typically in complex RI funding models.

While the **concept development, design and preparatory phases** are typically funded through singular grants (from institutional, national funding, or EC schemes), the **implementation phase** of RIs tends to be funded through the combination of several funding channels. In case of single-sited RIs, a large investment for the construction period (which

may last several years) is made. For this, financial resources from several sources are used from national funding agencies (typically), EU structural and investment funds (ESIF), research grants, donations from charities, loans, and from the involvement of other stakeholders including private companies. This multisource financing, with the restrictions from different underlying rules and regulations, represents an additional challenge in terms of financial management and planning. In the case of distributed RIs, the aspects abovementioned may also apply to the setting up of a Central Hub or the construction or upgrade of the national nodes. The **operational phase** of a RI is connected with operation, maintenance and upgrade costs, which are typically in the order of 10-20% (per year) of the initial capital investment. However, these costs can often not be covered from the same sources as the RI implementation costs, due to eligibility rules of the funding instruments. **It is of utmost importance that adequate funding sources are identified and prepared already during the planning of the RI implementation.** Similarly, it would be beneficial to include the costs of regular periodic updates in the financial planning of the RI operational phase and to prepare contingency measures in case of unforeseen developments. The operation costs are intrinsically connected with the RI governance model, and it is crucial for the smooth RI operation that the chosen legal structure is suitable for the corresponding funding streams. Not much experience has been gathered yet with regard to the **termination phase** of the RI, though it is obvious that it entails considerable costs – especially in the case of large-scale facilities.

All bottlenecks mentioned above are amplified for international and highly distributed RIs. The role of timely planning, coordination and alignment of rules and procedures is therefore pivotal.

Moreover, it is also worth stating that more than 58% of the RIs chosen for the case studies were included in the [2018 ESFRI Roadmap](#), as part of the 'ESFRI projects & ESFRI landmarks', more than 23% of the selected RIs have been awarded the ERIC legal status and only one of the case studies confirmed the existence of a formal funding plan for the termination phase.

Overall, the case studies focused on some specific discussion topics with implications on the funding of RIs. More concretely, the collected insights focused on: the relationship between National RI Roadmapping Procedures (NRIRMP) and funding; the funding instruments used by RIs; insights on lifecycle approaches and decommissioning; feedback from RIs on users and access policy; training and a final overview of the main bottlenecks and recommendations. Hence, the following observations result from the collection of views expressed by the case studies' interviewees. In addition to some general insights, the segments of blue text highlight specific findings.

NRIRMP AND FUNDING

RIs are often the result of a coordinated effort to gain greater scale in a specific scientific area through the aggregation of already existing infrastructures and focal teams, with the goal of scaling-up capabilities and leading to a smart specialisation. As previously mentioned, the funding of these RIs over the course of different lifecycle stages often entails the combination of different funding sources. However, assuring this multisource funding with very lean coordination between bodies is a challenge for the sustainability of RIs. Furthermore, considering the availability of the different funding sources and the funding needs of RIs, the need for prioritisation is well perceived across all RI representatives. In this context, roadmapping processes tend to play a pivotal role (both at national and European level) and their importance was recognised by the interviewees. Nevertheless, the different case studies revealed a significant variety of experiences regarding the inclusion of each RI in the national and ESFRI roadmaps and the implications of such on assuring the funding sustainability of the RI.



Key finding 1. *Although roadmaps are perceived to be a valuable tool, some RI representatives stressed the importance of the specific context of each country that designs and implements it. The success of priority setting exercises seems to highly depend on the ability to set in motion long-term perspectives and commitments. Moreover, from the RI management's perspective, it seems to be important that the roadmapping process is accompanied by a perspective of funding.*

With regard to the implications of the roadmapping processes to secure national funding for RIs, the insights collected also highlighted a wide range of experiences. In some cases, the decision of including a new RI into the national roadmap is simultaneous to the decision of allocating basic public funding (e.g. Ministry of Education, Youth and Sports of the Czech Republic). In those cases, the inclusion on the roadmap implies some national funding commitment. In other cases, although it is a formal condition to apply for funding, the inclusion in the national roadmap does not guarantee access to funding (e.g. France).

Furthermore, other perspectives were identified regarding the importance of roadmapping processes. Whether it is due to the scientific domain, existing relationships with industry, or the national context, for some RIs, being part of a national roadmap is sometimes not perceived as essential or even appropriate.

Nevertheless, in the majority of the case studies, national roadmapping processes were deemed as essential to secure national funding, as well as for international networking. Moreover, during one case study, an interviewee suggested strategically aligning pan-European RIs to EU and global initiatives (e.g. Climate Initiative) as a potential way to further promote coherence among strategies.

During the case studies, some RIs also stressed the influence that ESFRI has on the development of national roadmaps. In cases of absence of a national roadmap, the ESFRI one is sometimes considered to be an important tool to reaffirm the RI's relevance at the national level.

Key finding 2. *The inclusion of a RI in the ESFRI roadmap does not always assure the governmental support for the inclusion in their national RI roadmaps. Being part of a national roadmap often implies that a considerable amount of funding will be provided to the nodes and this implies national commitment. Even though the logic should be that ESFRI includes the RIs put forward by national governments, some distributed RIs see the absence of national nodes in the national roadmaps as a symptom of lack of governmental support. In some cases, letters of support from the Central Hub to the respective national authorities of the RI's nodes can be helpful to describe progression, thereby informing the funding authorities of the importance of the RI.*

Retrospectively, it seems that the ESFRI roadmap has played a crucial role stimulating MS and some AC to develop their own national roadmaps. Yet, the alignment of timelines for national and ESFRI roadmapping processes remains challenging. In regards to this, the RTWs demonstrated that the criteria, timing and processes in national RI roadmaps vary from country to country, creating a domestic regulatory framework that presents weaknesses for European Union-level cooperation and growth. Furthermore, participants commented that updated lists, maps or documents of already existing RIs in EU MS and AC are not always available for online consultation. In this context, as suggested in point 3.5 of the [Report on the RTW](#), "to



the extent possible, the development and update of a list/database of existing national facilities for consultation purposes – including those involved in ESFRI projects or preparatory phases – would help to attain a better idea of the RI landscape in each country”.

FUNDING INSTRUMENTS USED BY RIs

Funding models for RIs across Europe often imply the combination of different funding sources and financial instruments. Consequently, complying with various funding regulatory frameworks and their respective cycles poses a challenge to the financial stability of RIs. This occurs because the different funding schemes often come with different rules and assume different accounting principles, which represents a problem for the RI management. Hence, careful planning is essential to assure a smooth transition from one phase to the other. Overall, the case studies’ interviewees referred the financial instability herewith described as one of the main bottlenecks to their strategic development.

Key finding 3. *Funding fluctuations over the different lifecycle stages are a bottleneck, namely at the level of recruitment and retention of human resources. High performance scientific facilities are in need of constant technological upgrades and of specialised personnel to operate them. It is often the case that these RIs need a major revision of the budget from construction to operation. The prediction of future costs is challenging and the resulting financial uncertainty is something that RIs often have to deal with, which is ultimately a limiting factor in the retention of highly specialised personnel and consequently in productivity.*

Although the case studies revealed a broad range of funding models, the gathering and treatment of information allowed the grouping of well-defined funding sources: regional, national, EU FP, Cohesion Policy instruments and industrial funding.

Regarding the EU FP, overall the interviewed RI representatives acknowledged its role in organizing the scientific communities around strategic societal challenges that go beyond the capabilities of EU MS. On its importance for RI funding, the case studies declared that this is an important source (and probably will maintain its relevance for the following FP periods). Although the absolute volume of funding is low, it appears to be crucial for certain activities and project logistics. More concretely, the interviewees stressed the importance of the EU FP for the development of the financial and legal model for the RI during the preparatory phase, for the implementation of the RI (including training courses and for the coordination of platforms), as well as for the provision of services and tools. Nevertheless, there were also some cases in which RI representatives have stated that the EU FP had not yet been used as a source of funding.

Regarding Cohesion Policy funding, despite differences for instance in the use of ESIF, it was clear that this source of income represents one of the main funding streams for the construction and implementation phases in some countries. Nevertheless, there were also cases where ESIF was not deemed relevant for the RI's funding model, e.g. when a facility is located in an ineligible region or when the corresponding economic or research area is not contemplated in the defined national priorities.

On the topic of national and regional funding, the findings from the case studies reveal that the overall perception is that basic funding of operational phase should be secured straight from the beginning in order to allow preparation of the competitive funding later. As for the RTWs, some participants had stressed that ensuring a transitional period from one phase to



another through investments is important for the financial sustainability of RI. As recognised during the different events, securing the costs associated to the operational phase of RI through the reconfiguration of existing and/or new tailor-made financial mechanisms would be a measure well received by RI managers. Further consideration from national governments should be given to the creation of a dedicated (national, not institutional) funding line to cover operational costs. In this regard, the European Commission should look into its role as facilitator of this process.

Overall, from the RTWs and case studies, it was suggested that the operational budget should still benefit from significant national contributions in later phases, in order to prevent the instability caused by budget fluctuations. In addition to annual budgeting, financial planning for upgrades was also highlighted as important during some interviews.

Key finding 4. *The establishment of national funding mechanisms to cover the operational phase is just one prerequisite for sustainable funding. It is also important to find a coordination model and strategically align the different sources of national and eventually institutional funding. National funding agencies play a pivotal role by supporting construction and operation of RIs, as they guarantee the functioning and excellence of scientific and research services they provide.*

Regarding industrial funding, the answers provided by the RI representatives once again portrayed a broad spectrum of situations. While discussing the relevance of private funding as a source for the operational phase, the different feedback demonstrated that, in general, this source of funding is expected to account for only a small portion of the budget. For the majority of the case studies, cooperation with industry will occur within the frame of the general institutional policy. As a result, private funding will remain a marginal source also in the future. However, in some cases, such linkage to industry is expected to rise. Nevertheless, while having close links to industry and SMEs, these RIs tend to stress that they would rather continue to work under restricted economic models, serving mainly the extension of the knowledge base.

Besides the abovementioned sources, it is also worth noting that some case studies discussed the potential of other funding schemes, such as [INTERREG](#), which promote the cooperation between local, regional and national actors from different EU MS and European Investment Bank (EIB) loans. However, the interviewees who mentioned these also reflected on some of their limitations (e.g. budget availability and suitability for RI funding). Moreover, the Wellcome Trust, the Wallenberg Foundations, the Bill & Melinda Gates Foundation and the Chan Zuckerberg Foundation were also mentioned, as funding sources that have been used or are being considered by some RIs.

One specific subject tackled during some of the RTWs was related to in-kind contributions. As they can help capacitate and the operation of RI through the provision of technical equipment and the secondment of staff, some aspects were mentioned as existing bottlenecks. Besides ownership transfer, tax and legal matters, the determination of the value of certain goods and services was argued to sometimes involve challenging, lengthy processes for the stakeholders involved. A lack of understanding of the specific know-how of a consortium partner can thus have an impact on the provision of suitable resources to an RI. In this context, understanding the capabilities and know-how of the different partners can help to effectively manage and allocate in-kind contributions in international large-scale facilities. Moreover, agreeing on a standard cost equivalent for a good or service provided by a contributor to a RI (irrespective of the real cost of origin or of execution) not only offers a solution to arduous negotia-



tions/calculations on in-kind contributions among international partners, but also helps achieve further convergence among countries.

LIFECYCLE APPROACHES AND DECOMMISSIONING

As it was previously mentioned, the adoption of a lifecycle approach allows to better understand the different needs and targets of RIs throughout their different stages of development. Creating long-term sustainability therefore depends on the implementation of this approach to each RI funding model. More concretely, it entails the understanding of the full continuous RI development process, from concept development until termination and – when relevant – decommissioning of facilities. Concerning long-term sustainability, the importance of considering and calculating all costs from an early stage, including those associated to dismantling the RI (if relevant), had already been highlighted by some workshops participants.

Moreover, as stressed by some interviewees, decommissioning can be much more than the mere planned shut-down or removal of a building, equipment or plant from operation or usage. It can also entail the upgrade of new facilities, with materials that can be re-used for other research purposes. Overall, decommissioning costs vary broadly, depending on the scientific domain and the specific characteristics of the RI.

Key finding 5. *Although some RIs are aware and anticipate the need of predicting the costs of their future decommissioning, it is rarely the case that they have a clear funding plan for it.*

Hence, besides being rarely foreseen by RIs, the existence of a decommissioning plan seems to be highly dependent on the domain in which the RI operates (e.g. RIs in the field of energy are by default more aware of the need for long-term planning). In order to prepare for this phase, some interviewees have stated that the provision for their decommissioning is being anticipated through a saving plan throughout their operational phase in order to smooth the process.

USERS AND ACCESS POLICY

The role that RIs play in the provision of services to a broader network of users, access policy and funding were topics often mentioned by the interviewees. Overall, recognising the usage of their facilities as an indicator of their relevance was an area of concern for many. According to one RI representative, the number of external (meaning international) users could be considered as a key indicator to measure the quality and strategic relevance of the RI.

Regarding access funding, the feedback obtained indicated that access to a RI can depend heavily on the scale of the research projects and level of costs associated.

Key finding 6. *Some RI representatives recognised that open access and its costs should be a part of the RI mission discussion from very early stages on, on the basis of a systemic approach that entails the comprehension of the role that each RI plays in their related scientific, innovation and education systems.*

Nevertheless, some of the interviewees revealed that they do not yet have a concrete policy for user access in place. Moreover, the lack of available funding for operation also seems to cause difficulties in the implementation of a clear, structured and transparent open access policy. Moreover, as already put forward during the RTWs, “*the involvement of users from*



early conceptual stages of the RI can be beneficial for the design of access schemes, as well as for the validation of the fit-for-use and fit-for-purpose of research facilities. Besides this, specific actions aimed at young post docs could help raise awareness of the products and services offered by RIs”.

From the case studies, while still far away from implementing concrete policies for user access, RIs seem to exclude the possibility of having users from public research institutions paying for access to their facilities. For other external entities, the fact that their country is a partner or not of the ERIC is considered as a criteria when assessing their access to the RI.

Overall, the existence of a high demand of RI services by users was deemed crucial to the survival and the long-term sustainability of the RI. As suggested by several RTWs’ participants, improving awareness of RIs and their portfolio of services and products is essential to increase user involvement inside and outside the scientific community. Moreover, some of the RI representatives stressed high expectations for the growing relevance of virtual and remote access. In their view, it is crucial that the forthcoming funding mechanisms also contemplate the support of virtual and remote access to RIs.

Furthermore, on the relationship between RIs and the scientific and education systems, some additional and specific remarks were made by some interviewees.

Key finding 7. *National instruments designed to fund universities are an efficient way to bind universities to the capabilities of large-scale facilities. A recommendation was made for the institutionalisation of a support scheme for transnational access to RIs, in order to bridge the gap between academia and more applied research.*

TRAINING

Some of the previously mentioned bottlenecks and concerns expressed by the RI representatives here described have already highlighted the need to promote training, dialogue and other forms of knowledge exchanges between stakeholders, with regard to the coordination of funding sources. Overall, RI representatives tended to agree that very bureaucratic conditions require at least one Full-Time Equivalent (FTE) administrator, even for mid-size projects, in order to fulfil all requirements. Such an administrator needs appropriate training and this, as recognised by the interviewees, represents a cost to be taken into account in the budget.

To handle extensive information on different funding schemes available, some RI representatives consider that external help and training on how to write applications and apply for funding instruments such as those for interregional cooperation is necessary. In some cases, training courses are offered to users through the RI's training platforms. Also related to this is the shortage of qualified personnel in highly skilled areas such as big data, data mining and modelling that are relevant for RI operation and upgrading, as suggested during one of the rRTWs. Moreover, during the case studies, some RIs discussed the potential of knowledge-exchanges through the mobilisation of staff. In one specific interview, it was suggested that one of the things that would be welcomed in Horizon Europe would be to expand the staff exchange scheme so that industry can be included. Adding to that, one particular suggestion that came from one of the RTW regarded the creation of an ERASMUS-type of scheme for short secondments of public civil servants, working in RI policy and funding. This could contribute to a better understanding of RI and the factors that determine the use and non-use of funding instruments as potential sources for RI funding in different countries. In consequence,



it would enable more informed funding decisions, as well as a stronger funding coordination among countries through the mobility of these civil servants.

Furthermore, some RI representatives also stressed that they are aware of the present expectations to demonstrate short-term economic returns as a result of recent and significant investments made. For this, besides the aforementioned training needs on how to use the different available funding schemes, it has also been suggested that there is a need for external expertise on business planning and business plan drafting.

OTHER MENTIONED TOPICS AND BOTTLENECKS

Throughout the conduction of all 17 in-depth case studies, besides the insights already tackled in this section, different approaches and new topics that are relevant for the subject of RI funding were put forward by the interviewees. Some of them are developed below.

- In order to build up capabilities (comparable to those of China or the United States, for example), multi-national cooperation should be fostered. For this reason, the promotion of mechanisms that combine and allow for different funding sources to be mobilised from different countries would enhance the potential of developing-national projects.
- Funding commitments are not always clear at the start of RI projects. For the operation phase, in particular, the funding of big international facilities should ideally be agreed upon when the project is being defined and not during its course. Complementarily, RIs recognise the importance of being aware of their role in their scientific, social and economic systems and anticipating external changes that require individual adjustment (e.g. foresee pressures for regulatory changes, extra-European competition, etc.).
- Regarding the ERIC status, although considered to be a commitment at the EU MS level, the case studies demonstrated that in terms of funding it is sometimes perceived as a rather weak form, with different interpretations and implications across different countries. Furthermore, feedback from the RTW demonstrated that although there is ample information out there on ERICs, the general perception is that the information is scattered and not always accessible in a concise form to everyone. Moreover, during one of the interviews, it was suggested that some economic activities are deemed to be incompatible or difficult to combine with European treaties (namely, the Euratom) and that it represents a bottleneck. Also, it was stated that it would be welcome to have all countries, adopting a common approach towards the VAT /excise duty.
- Due to insufficient national resources for RI operational costs, some interviewees demonstrated that there is an apparent tendency to substitute the national commitments by European sources, namely ESIF, even in pan-European RIs. However, the applicable financial regulations of ESIF can then become an obstacle for some phases and the planning of future expenditures (e.g. running costs).
- Clear and well-defined set of KPIs are important for transparency in decision processes and allow to set internal principles, which are then easier to be understood and followed. These KPIs could be used both for internal managerial decisions as well as for reporting to the funders. However, some interviewees stressed the importance of telling a narrative, in order to avoid misinterpretations of results. Talking about the stories, alongside the presentation of data, can be a more appropriate way to show the impact of the RI to the funders.



CONCLUSIONS

Following previous steps of data collection and interaction with relevant stakeholders, InRoad carried out the case studies with RI representatives, offering a micro-perspective on the present and past experience of RI on combining different funding schemes throughout their lifecycle stages. In this document, besides the methodology behind the selection of case studies and conduction of interviews, some of the preliminary findings and insights of InRoad regarding the funding of RI were presented.

Through the analysis of the information collected from the 17 in-depth interviews, it is possible to propose three main topics in which InRoad's recommendations on RI funding will focus:

- **Lifecycle approach:** In order to promote the long-term sustainability of RI, a lifecycle approach is needed allowing the improvement of financial predictability and stability across all stages. For this to happen, long term funding commitments, a better integration of RIs in their related scientific, innovation and educational systems as well as a focus on the promotion of access to these facilities are essential;
- **Closer synergies among funding frameworks:** Considering the multi-source funding models of RI and the existing bottlenecks that are inherent to the combination of different funding sources, closer synergies among funding frameworks are needed. For this to happen, both the alignment of priority setting processes and regulatory frameworks are needed;
- **Exchange of knowledge for funding solutions:** Given the diversity within the 'tool box' available for the funding of RIs and the complexity of their regulatory frameworks, there is the need to foster mutual learning and cooperation through the sharing of practices and the common development of funding solutions for RI. Specific budget allocations are needed, in order to allow for the development of activities that promote such goals;
- **Demonstration and communication of RI's scientific and strategic relevance and their broader societal impact:** As there are pressing expectations for RIs to demonstrate their relevance and impact, as well as a need to enhance their role, it is important to create mechanisms to foster the communication between RIs and all the stakeholders (e.g. policy makers, funders, users, society in general). In order to promote this, there is a need to develop appropriate impact measurement standards, not only through KPIs but also through qualitative information.



ANNEX III: REPORT ON BEST PRACTICES FOR BUSINESS PLANS

EXECUTIVE SUMMARY

The aim of the present Annex is to bring together in a concise but comprehensive way the findings of the consultation and case studies carried out by InRoad on business planning practices in European research infrastructures (RIs) and on business plan assessments in national roadmap procedures. The results are based on in-depth case studies of business planning practices in different RIs, as well as a country analysis. Trends, good practices and existing bottlenecks are analysed to produce recommendations on business planning for RIs, and evaluation of business plans in view of RI roadmapping and funding.



ABBREVIATIONS

AC	Associated Countries to Horizon 2020
ANR	French National Research Agency
CNR	Consiglio Nazionale delle Ricerche
EC	European Commission
EIB	European Investment Bank
EPAnEK	Programme Competitiveness, Entrepreneurship and Innovation
ERA	European Research Area
ERDF	European Regional Development Fund
ERIC	European Research Infrastructures Consortium
ESIF	European Structural Investment Funds
ESFRI	European Strategic Forum for Research Infrastructures
EU	European Union
EU FP	EU Framework Programme for Research and Technological Development
FAIR	Findable, Accessible, Interoperable and Reusable
GDPR	EU General Data Protection Legislation
GSRT	General Secretariat for Research and Technology
IPR	Intellectual property rights
KPI	Key Performance Indicator
LIMS	Laboratory Information Management System
MESRI	French Ministry for Higher Education, Research and Innovation
MEYS	Czech Ministry of Education, Youth and Sports
MS	Member States
PNIR	Programma Nazionale per le Infrastrutture di Ricerca
R&D	Research and Development
RCN	Research Council of Norway
RI	Research Infrastructure
RIS3	Research and Innovation Smart Specialisation Strategies
RTW	Regional Technical Workshop
TNA	Transnational access
UHR	Norwegian Association of Higher Education Institutions



INTRODUCTION

The present Annex merges two deliverables corresponding to the InRoad tasks 5.2 ('Collection of information on the business plan evaluation in the national RI roadmapping') and 5.3 ('Synthesis of best practices for business plans and discussion with the Reflection Group') of the project.

The objectives were to investigate on one hand the practices of business planning in European RIs, and on the other, the national procedures of RI business plans assessments.

The task was performed using diverse data collection methods. In a first step, a common questionnaire was developed by InRoad partners, targeted at national policy making organisations involved in the RI roadmapping and funding procedures. The interaction with this target group was done primarily through an online consultation, with some additional insights being obtained through email exchanges. The third part of the questionnaire was dedicated to questions on business plan assessment. The feedback from the [InRoad consultation](#) was then further enriched with information from a desktop study of supplementary documents provided by the consultation respondents.

In the second step of data collection, a set of case studies were produced based on a series of interviews with RI managers and on an analysis of supporting documents provided by interviewees. One of the case studies also included an interview with a national funding organisation (the Research Council of Norway (RCN)) and interviews with the managers of a Norwegian node and of two central hubs of European Research Infrastructures Consortia (ERICs) seated in Norway.

This comprehensive investigation allowed the gathering of detailed information from various RI stakeholders (RI funders, national ministries, and RI managers) and provided a solid background. In this step, the findings from the individual interviews were combined in comprehensive case study analyses, which allowed the drafting of main recommendations regarding best practices for RI business planning and business plan evaluation. The recommendations were discussed with the Reflection Group at the InRoad Validation Workshop, and subsequently refined using feedback from Workshop participants. InRoad policy recommendations on business planning are presented in the third part of the final report.

Some insights regarding RI business plans and associated challenges were obtained during the [regional technical workshops](#) (RTWs). These workshops were dedicated mainly to discussing the issues related to RI funding landscape, to which the question of business planning is closely related.

METHODOLOGY AND DATA COLLECTION

MAIN RESEARCH QUESTIONS

In order to deliver recommendations on best practices for business plan drafting and strengthening RI long-term sustainability, InRoad sought to explore the ongoing processes in several pan-European and national RIs and to gather feedback and recommendations from RI managers (mainly), funders and other stakeholders involved.

A set of questions was prepared in advance, in order to harmonise the interview process and to facilitate the drafting of the report on state-of-the-art business planning.

The main research questions structuring the interview guide are presented below:



1. How are business plans drafted in different types of RIs (pan-European distributed RIs, large European single-sited facilities, national RIs) and how are they used for management and operational activities?
2. How are business plans used by national nodes to manage activities and respond to funder's requirements in the frame of roadmapping and evaluation processes?
3. Which monitoring practices are implemented at the RI?
4. What is the role of business planning in assuring long-term sustainability of the RI?
5. Which support measures from national and European authorities can be put in place to improve business plan drafting and long-term sustainability, and how can they be improved (recommendations from RI managers)?

CONSULTATION

The consultation was carried out by InRoad between March and July 2017, using an online survey tool. The questionnaire included closed- and open-ended questions as well as multiple-choice questions with rating scales, and offered the opportunity to upload additional documents. The invitation to participate in this survey included a description of the InRoad project, the content and objectives of the consultation, as well as contact addresses for technical issues and questions about the content.

In order to get an overview of the current status quo in different countries, the consortium targeted actors responsible for national RI roadmapping in all 46 EU Member States (MS) and Associated Countries to Horizon 2020 (AC). Where the consortium was able to identify relevant people, these were directly addressed. Yet, in cases where this was not possible, the invitation to participate was sent to the respective European Strategy Forum on Research Infrastructures (ESFRI) delegate.

A detailed list of the questions layed out in Section 3 of the consultation 'Business plans for RI' can be found in Deliverable 5.2 – 5.3.

27 out of 46 countries answered the survey. The consultation responses were summarised, allowing InRoad to perform a cross-country analysis presented in the [InRoad Consultation Report](#). Information collected during the consultation that is relevant to business planning practices was also used in the present analysis.

IN-DEPTH AND INDIVIDUAL CASE STUDIES

DEFINING THE CASE

The present study covers business planning as a process in central hubs of pan-European RIs, national nodes and national RI, as well as business plan evaluation in national research infrastructure roadmapping processes (on a country level). Therefore, the focus is not homogeneous in all case studies, since the dialogue was conducted with different actors in the RI ecosystem (though mainly RI managers).

SELECTION OF CASES

The investigation was organised using two approaches. The first approach consisted of a limited number of in-depth case studies, including two ERICs and one country-oriented investigation. Each in-depth case study was then based on findings gathered from different sources, such as desk research and interviews with the central hub and several national nodes of distributed RIs (for the RI-oriented study), and interviews with a national policy-making and



funding organisation, as well as with several RIs whose head office is located in this country (for the country-oriented study).

The second approach included 'individual' case studies, based on one interview and desk research (and/or alternative data collection methods) on national and pan-European RIs.

The only binding criterion for the selection of candidates for this investigation was that the chosen RI had to be on the latest update of the national roadmap of its respective country. The other criteria applied to the selection were:

- recommendations from InRoad's consultation respondents;
- evidence of ongoing or completed business planning from desk research (published business plans or dedicated workpackages of the preparatory phase of projects);
- evidence of good practices and infrastructure maturity from desk research and In-Road's consultation results;
- for the node selection: the recommendation from the central hub was taken into account;
- balanced geographical and scientific field distribution;
- coherence and complementarity among selected case studies and interviews;
- coherence with other InRoad case studies (on roadmapping and funding practices).

Both RIs with and without a business plans were considered for the selection of case studies. However, InRoad partners looked for evidence of good practices through a preliminary desk study.

Regarding the lifecycle of the selected RIs, the selection includes RIs in different stages (preparatory, implementation, operational phases) with a preference for already established and operating facilities. The assumption is that RIs that are already established have verified practices regarding different aspects of business planning, such as monitoring, risk management, financial planning, access and commercial policies. However, taking into account that business planning and support measures for newly established RIs might evolve with time, a RI that is still in the preparatory phase was also included.

RATIONALE FOR THE SELECTION OF THE EMBRC, BBMRI AND NORWAY IN-DEPTH CASE STUDIES

EMBRC ERIC was identified as an interesting case because of its business planning practices, e.g. existence of an initial version of the business plan drafted during the preparatory phase and of a recent update; both versions are readily accessible on EMBRC's [website](#).

BBMRI ERIC, on the other hand, was included in the selection for three reasons: it is an example of an ERIC that has been in operation since 2014, and its business plan, which was drafted during the preparatory phase, is published on its [website](#), and it is considered a highly distributed RI due to the high number of member biobanks spread across European countries.

Both BBMRI and EMBRC are infrastructures that belong to the same research field (Health & Food according to the ESFRI Roadmap). However, they operate in different sub-fields, which led to the assumption that the expected operation strategy and socio-economic impact would be different.

The rationale for choosing Norway as a country-case study is mainly based on the consultation results. InRoad's partners aimed at obtaining the perspective from the national funding and policy making organisation and at exploring the link between this funding body and the RIs located in the country. From the consultation findings, Norway was considered by In-Road's partners to be a country with an interesting system for the evaluation of RI business plans.



METHODS FOR DATA COLLECTION

Three main methods were applied:

1. Review of secondary sources, such as relevant documents provided by study participants prior to the interview and analysed by InRoad partners;
2. Semi-structured and structured expert interviews with all relevant actors based on a common interview guide;
3. Additional data was collected through the presentation of a case during the RTW in Wrocław, supplemented by round-table discussions.

ANALYSIS AND REPORT DRAFTING

All interviews were recorded and then transcribed. Interview reports were then drafted for internal use and subsequently analysed. The analyses produced were used for two types of analysis.

Within-case analysis:

- Draft an in-depth analysis of business planning in central hubs combined with an analysis of the situation in national nodes;
- Country-case: in-depth analysis of the business planning in several RIs (including hubs hosting the statutory seat or country nodes).

These analyses were complemented with information on business plan evaluation in roadmap procedures. The aforementioned case studies were also supplemented by the analyses obtained from the individual case study interviews.

Cross-case analysis: The joint analysis of business plan processes in different RIs across Europe is presented in Deliverable 5.2 – 5.3.

TEMPLATE FOR ANALYSIS – SECTIONS

Each in-depth and individual case analysis was structured as follows:

1. Description of the RI or national node and description of the interview (date, duration, participants, location, etc.);
2. Main topics discussed. These were described in two parts – observations and lessons learnt –, and covered at least:
 - a. Development of business plans and their use as a management tool;
 - b. Internal RI monitoring mechanisms;
 - c. Evaluation of the RI business plan by the funder and link to the roadmapping process;
 - d. Main factors of the long-term sustainability of RI;
 - e. Financial planning and risk management;
 - f. Access and commercial policy;
 - g. Socio-economic impact (the topic was included only in selected case studies);
 - h. Existing and desirable support measures;
 - i. Other topics that might come up in the interviews.
3. Brief summary of the lessons learnt;
4. Recommendations derived from the analysis of the case or directly suggested by the study participants.



IN-DEPTH AND INDIVIDUAL CASE STUDY REPORTS

The in-depth case study reports are based on the analyses of interview findings, supplementary documents, as well as feedback from case study participants. The individual case study reports contain a brief analysis of interviews held with one RI, verified by interview participants. Those documents can be found in InRoad's website (Annexes of Deliverable 5.2 – 5.3).

GOOD PRACTICES

Various good practices are described throughout the InRoad report and Annexes. The present Annex also displays anonymized citations of interviewees, which illustrate good practices identified during data collection and subsequent analyses.

A good practice is a very concrete example of a business plan practice implemented in a European RI. The selection of good practices was based on the cross-case analysis of individual studies, feedback provided by case study participants, and from InRoad Advisory Board and Reflection Group members.

EVALUATION OF RI BUSINESS PLANS IN THE NATIONAL ROADMAP AND FUNDING PROCEDURES

The analysis presented in this chapter places a focus on RI evaluation and monitoring, and are based on the results of InRoad's consultation and case studies.

The chapter covers mostly the countries hosting RI nodes that participated in the in-depth case studies, namely **Czech Republic, France, Greece, Italy, the Netherlands** and **Norway**. Consultation responses from the organisation in charge of the Norwegian RI roadmap, the RCN, were complemented and enriched with the in-depth case study results.

Some additional examples of the national procedures were added to the analysis, highlighting good practices of the RI business plan assessment.

Among the consultation respondents (from 27 countries), 17 national policy making organisations indicated that they assess RI business plans in their roadmapping processes. However, the desk study revealed that RI business plans are not requested as a separate document. Instead, the most important aspects of the RI business plans are, in fact, evaluated in the roadmap and in funding calls for proposals.

Usually, business plan elements are requested using specific templates, some examples of which are provided in Annexes of Deliverable 5.2 – 5.3. The format of such templates, as well as the evaluation methodology, depend on the country's procedure, and also, on the funding source.

FRANCE

In the consultation, the French respondent, the Ministry for Higher education, Research and Innovation (MESRI), indicated that business plans are not requested as part of the national roadmapping process. However, monitoring of RIs is performed by MESRI and is linked to the roadmap update (currently done on a bi-annual basis). The data, which contain the essential elements of the business plan, are collected through a survey (internal document) and an annual total cost calculation exercise. The most important part of the aforementioned survey relates to the user strategy.

In the case of EMBRC France, having an up-to-date central-level business plan was not sufficient to have ready-made answers to the questions of the ministerial survey. National node managers were expected to collect data on the performance indicators at the node level by establishing internal monitoring procedures.



Those performance indicators are also used for reporting purposes to the French National Research Agency (ANR), which is the research funding organisation in France. All RIs funded by ANR through the 'Investments for the Future' scheme undergo a periodic evaluation by the RI Steering Committee in their scientific domain (according to the RI's taxonomy on the national roadmap).

Good practice 1: *EMBRC France was funded under the national call for proposals 'Investments for the Future' for a period spanning July 2011 to December 2019. A mid-term evaluation was performed in 2016 by the Health and Life Sciences Steering Committee. EMBRC France received excellent evaluation marks, with only one recommendation for the operational adjustment, which is 'to transform the federation of three marine stations into a true national RI' with a central management office and dedicated personnel. This recommendation was successfully implemented shortly thereafter.*

EMBRC France managers consider drafting a node's business plan in view of the upcoming renewal of the funding application. They also believe that the business plan requirement will become a criterion of RI evaluation, particularly in the upcoming 'Investments for the Future' call in 2020 (but not necessarily for the national roadmap update).

Regarding the current monitoring practices, EMBRC France commented that ANR does not systematically take into account performance indicators such as the success rate in European Commission (EC) grant applications, for instance through INFRADEV and INFRASUPP calls, and responsibilities associated with leading such projects. The international dimension currently considered by the funder is the existence of a European RI counterpart of the national RI in order to develop international synergies. On the contrary, at the ministerial level, the success rate in EC calls is becoming an important performance indicator. The acknowledgment of the impact of the EU Framework Programme for Research and Technological Development (EU FP) grants on the funding coverage and other operational improvements of the RI came with an annual full cost calculation exercise, performed for the first time in 2017 (based on 2016 costs) and renewed in 2018 (based on 2017 costs).

GREECE

The General Secretariat for Research and Technology (GSRT) of the Ministry of Education, Research and Religious Affairs is in charge of the roadmap process. The roadmap update was initiated in February 2013, and resulted in the establishment of a priority list of 26 RIs and a secondary list of another seven RIs. The roadmap update was followed by a multiannual investment plan for the whole period 2014-2020, which is closely linked to the management of European Structural Investment Funds (ESIF) funds under the operational programme Competitiveness, Entrepreneurship and Innovation (EPAnEK). The first call for proposals for RI funding was launched in 2015 and the second one in 2017.

The Greek national roadmap serves as a reference for the funding of RIs, therefore, RI business plans are not requested for subsequent funding applications.

For RIs that have already received funding during the ESIF 2007-2014 programming period, a performance assessment was undertaken prior to the allocation of new funds. This evaluation was performed in 2015 as a pilot project, involving a review panel consisting of international experts.

In parallel to the funding procedure managed by EPAnEK, the GSRT issued in June 2016 a new call for expressions of interest for the submission of RI proposals, aimed at completing the mapping of RIs and fulfil ESIF conditionality 1.2 'Research & Innovation Infrastructure'. In



particular, this call sought to extend the RI priority list, which was announced in December 2014.

The full list of **evaluation criteria** applicable in this call can be found in the Annexes of Deliverable 5.2 – 5.3. They cover most of the aspects of a RI's strategy and planned operation. The results of this evaluation, thus, provide a good basis for improving an existing RI business case / business plan, or for drafting one.

There is a notable focus placed on the socio-economic impact of RIs and their contribution to Research and Innovation Smart Specialisation Strategies (RIS3) in the Greek procedure, which is related to the main source of RI investments (ESIF) and its specific conditions. Another particularity of the Greek national procedure is that it is important to be related to a larger European network to obtain the funding (mainly, adherence to ESFRI projects).

Good practice 2: *CMBR (which represents a Greek node of EMBRC ERIC) was one of the 20 selected projects and was granted €4M for a period 2018-2020. The Ministry of Education, Research and Religious Affairs had set some specific requirements to all funded RIs, one of them is to use allocated funding to make the RI immediately accessible to Greek users, and not to invest all the funding in the infrastructure development exclusively, meaning that the development of service offer is a priority in their national strategy.*

The consultation respondent from GSRT indicated that all of the RI **monitoring** procedures pertain to the ESIF monitoring framework and are performed by corresponding bodies. While activity reports related to ESIF audit are submitted on an annual basis, cost statements are declared monthly.

ITALY

The Consiglio Nazionale delle Ricerche (CNR) is involved in the creation of a roadmap, and in a next step, RIs on the roadmap are funded through a dedicated call for proposals. The consultation respondent from CNR indicated that the business plan is part of ex-ante indicators included in the proposals.

The CNR reported on several aspects that were assessed in the frame of the Programma Nazionale per le Infrastrutture di Ricerca ([PNIR](#)) update, performed in February 2017. Those aspects are listed in Annex of Deliverable 5.2 – 5.3.

Concerning the **monitoring** practices, it was mentioned that RI performance assessment by CNR is included in the monitoring of their hosting research institutions, and is usually performed on a triannual basis.

CZECH REPUBLIC

The main national component of financial support for large-scale RIs comes from the Ministry of Education, Youth and Sports (MEYS). The MEYS is also responsible for the national research infrastructure roadmapping process. The last roadmap update was published in 2015, for the 2016-2022 period.

While operational costs of large RIs in the Czech Republic are covered with research and development (R&D) state budget expenditures, investment costs for technological development or upgrades are funded predominantly through EU Cohesion Policy instruments.



The national roadmap contains the outcomes of the 2014 comprehensive ex-ante evaluation of RIs in the Czech Republic. It comprises a total of 58 positively assessed RIs with the indicated degree of priority for the public funding (A1, A2, A3 and A4) in direct proportion to the quality-differentiated output of the evaluation. This was a pilot evaluation process that applied newly-developed methodology, prepared within the framework of the Effective System of Evaluation and Funding of Research, Development and Innovation project, financed by the European Regional Development Fund (ERDF).

All the RIs, regardless of their previous main funding source (e.g. R&D state budget expenditures or ERDF) and their current state of development (e.g. preparatory, implementation, operational or decommissioning) were subject to the assessment. A two-stage evaluation was carried out by an international evaluation committee.

Specific documents were requested at each stage of the process.

- A so-called form A was used in stage I of the evaluation which acted as the basis for a brief RI presentation, covering mainly the research focus of the RI, involvement of the RI in national and international research activities, robustness of the RI strategy, etc;
- In the second stage, a form B was requested, which included comparisons to similarly focused research organisations (benchmarking), a detailed budget and specific information enabling a feasibility assessment of the proposed RI;
- In addition, a form C was required, which mostly contains data on users and their feedback from the RI use (for operating RI).

The consultation respondent from the MEYS indicated that business plans are requested in their roadmap procedure, with the following remark “*During the RIs’ evaluation, we are also assessing the sustainable development strategy of RIs. Each RI which is listed on the National RIs’ Roadmap is requested to develop and fulfil its development strategy, including a feasibility strategy*”. The desk investigation of supporting documents showed that **business plan elements** are included mostly in form B, the content of which is described in Annex.

An international peer-review evaluation of existing RIs was performed subsequently in 2017 and is considered an interim evaluation, followed by MEYS 2018-2022 funding commitment. For new RI projects, an ex-ante evaluation was conducted in 2017, based on the methodology published in 2014. A ‘consensus report’ was produced for each evaluated RI and sent to RI managers (confidential documents).

Good practice 3: *The consensus reports are also accompanied by recommendations from MEYS. One of those recommendations for improvement provided to BBMRI Cz after the 2017 interim evaluation was to augment industrial collaborations. Currently, these collaborations account for 7% of the node’s activities and the maximum allowed by State Aid rules is 20%. The major bottlenecks for increasing collaborations with industry, as indicated by RI managers, is the lack of major pharma or diagnostic companies located in the region, and the complex regulations for industrial collaborations applied to public institutions.*

The evaluation rounds will be renewed every three to five years. The next one is planned for 2019. One of MEYS’s future objectives, as stated in the latest roadmap update, is to create a **stable pool of experts** for the evaluation of the RIs over a longer period, so that the Scientific Boards are aware of the previous development of RIs and thus able to observe how their previous recommendations were reflected in the operation of the facilities.

This approach could be considered a good practice and recommended for adoption in other national procedures.



Concerning monitoring practices, the annual progress report concerns only those RIs that are funded by MEYS (i.e. all listed in the national RIs roadmap). This annual progress report is rather brief and related mostly to ongoing activities and the financial framework.

THE NETHERLANDS

NWO is responsible for designing the national roadmap, and in a second step selected RIs are funded through a specific [Call for proposals](#) launched biannually. Only the facilities included on the [roadmap](#) are eligible for NWO funding (16 of them are individual facilities and 17 are clusters).

The consultation respondent from NWO answered that the business plan is a requirement in roadmapping processes.

The desk study of supporting documents showed that **business plan elements** are to be included in the 'Technical, business and management case', that RI submit as part of their proposal, and not a full-format business plan.

The RI assessment criteria applied at the subsequent funding stage in the **Dutch** procedure can be found in the Annexes of Deliverable 5.2 – 5.3.

Furthermore, the consultation respondent indicated that roadmap updates are planned every four-years, and the re-assessment of the strategic importance of the RIs is done at this step. When it comes to **monitoring** practices, NWO reviews the annual outputs requested.

The updated and detailed RI roadmap and funding procedures in **the Netherlands** and the **Czech Republic**, as well as the description of the national embedment and actors involved, can be found in InRoad's Deliverable D.3.3, as those countries' national RI systems were subjects of comprehensive case studies.

NORWAY

The roadmap process is guided by the Research Council of Norway (RCN) through the [INFRASTRUKTUR](#) call, for which all documents can be found on the RCN website. The first Norwegian RI roadmap was initially published in 2010, based on the first call for RI proposals launched in 2009, and subsequently updated every second year, in 2014, 2016 and lastly in [2018](#). The consultation analysis was based on the previous (2016) version of the roadmap update and the corresponding call for proposals documentation.

Only RIs of national importance are funded through the INFRASTRUKTUR call, those that:

- have a broad national interest;
- are found in one or few places in the country (as a rule);
- create a foundation for international leading research;
- are made available to relevant research communities and industries.

Funding commitments last at least five years, so RIs do not reapply every two years.

The evaluation procedure involves both an assessment of the **scientific case** and the ranking of project proposals, made by international expert panels, who are classified according to different research areas and also reflect Norwegian research priorities. It is then followed by a second step, which includes an (in-house) administrative evaluation that assesses strategic, national importance and cooperation, as well as the **business case**.

When composing the international expert panels, especially for certain research areas, RCN places a special focus on reviewers' experience in RI implementation. The administrative evaluation panels consist of RCN permanent staff working in different scientific areas.



The main parts of the RI application template requested in the INFRASTRUKTUR call by the Research Council of Norway can be found in the Annexes of Deliverable 5.2 – 5.3.

Good practice 4: *In the assessment of RI proposals, criteria are not weighted beforehand. Some criteria are more important for proposals in certain research areas. An example of this is 'relevance to industry', which has more weight in the fields of energy, nanotechnology, bio-technology, etc. The relative importance of a criterion also depends on whether certain aspects of the RI strategy are highlighted in the proposal or not. Lastly, current national priorities have an impact on the weight of the criteria. This is a good example of a flexible approach to the RI project evaluation in a national procedure, which was positively perceived by RI managers during InRoad's RTWs.*

The second (administrative) round of RI proposal evaluation results is a ranking list with those candidates that have the highest priority for funding. The last step before the grant allocation is a meeting of RCN-staff with the RI project leader and the leader of the host institution, to explain RCN's decision and negotiate the grant-contract.

Multiple aspects of RI business planning are found in the RCN-INFRASTRUKTUR's application form and its annexes, the fulfilment of which requires detailed inputs. Specific guidelines and requirements concerning the number of pages and aspects covered in each part of the application form are provided by RCN. This comprehensive approach prevents the science case being put forward more strongly than the business case.

The use of business plans for RI management in the implementation and operation phases is also actively encouraged by RCN.

RCN also requests an **annual progress report** from all funded RIs, as a part of monitoring. A template is provided, and it mostly contains questions on the use and management of the RI. In addition, RCN monitors also some specific performance indicators that have been agreed with each of the funded RI.

The formal procedure for monitoring of funded RIs also includes a direct contact with all running projects, as part of RCN's quality assurance system. RCN's RI department aims at maintaining a **close dialogue** with RI managers because it is also in the Research Council's interest that infrastructure projects are successfully implemented.

OTHER RELEVANT EXAMPLES

In some national processes, other strategic documents than business plans are requested for a roadmap evaluation. A good example of this is an RI Strategic plan evaluated in the **Spanish** roadmapping process (c.f. ['Map of Unique Scientific & Technical Infrastructures \(ICTS\)'](#)) which is requested as a stand-alone document in a specified format and with recommended content.

In addition to the strategic plan of each individual RI, Infrastructure networks are requested to submit a joint Strategic plan. As for distributed RIs, these present a single joint Strategic plan that includes the contributions of all involved partner institutions.

To complete their dossier, RIs are also requested to provide an Excel file (in a specified format) listing performance indicators and other factual data. Performance indicators for the construction / implementation phases are to be included if the RI is not yet operational. The description of the data collected is provided in the guideline for applicants.



Having a quadrennial Strategic plan is one of the criteria for RI evaluation in the roadmap update. The full list of criteria can be found in the aforementioned [guiding document](#), some parameters of which are listed in Annex of Deliverable 5.2 – 5.3.

Even though comprehensive data on RI projects are collected through different documents in the application procedure, the request for a Strategic plan as a single document could be considered as a good practice. Furthermore, this document provides a solid basis for drafting a full-format business plan (please, refer to **recommendation 8**) because it helps to establish RI objectives and strategies, and align them with existing and planned resources.

One of the requirements in the aforementioned examples includes the drafting and submission of documents in English language to allow its evaluation by international experts. Inviting an international expert panel to perform the evaluation of RI projects is already an established practice in those countries. An idea worth further exploring would be the creation of a permanent body at the EU level that not only benefits from the rich experience and expertise of its reviewers, but also contributes to the improvement of the evaluation methodology and alignment of national procedures.

Such alignment of the evaluation criteria is especially important for distributed European RIs, which are subject to discrepancies in the periodicity and methodology of the nodes' evaluation, creating an additional hurdle for the distributed infrastructure.

DEVELOPMENT OF THE BUSINESS PLAN

BUSINESS PLAN CONCEPTION, CONTENT, AND TEMPLATES USED FOR DRAFTING

Case study findings show that in most cases, especially the ERICs, business plans are drafted during the preparatory phase. However, there are exceptions to this, where memoranda of understanding, statutes and other relevant documents covering relevant aspects like mission, objectives, activities, innovation, standards, access, dissemination and optimization are prepared in accordance with ERIC and national regulations and practices. Furthermore, it has also been reported that when a specific item was not requested for the ERIC application (e.g. value proposition), some RI managers (e.g. CESSDA) would cover this gap using widely available strategic management tools like the business model canvas from Osterwalder (see for example [Osterwalder 2004](#)).

In addition to the example in the previous paragraph, there are others where nodes from a specific pan-European distributed RI also developed their own business plan. In such cases, the business plan was different yet coherent with the central one, focusing on aspects like the facility's offerings and the improvement of user services. In relation to this, one of the interviewees stated that, as activities became increasingly centralised over time and synergies with other relevant scientific initiatives were forged on a national and European level, having a business plan at the node level was seen as helpful to improve coordination of activities among all those involved, avoid the duplication of efforts and build upon existing efforts.

As regard to the content, the business plans examined during the case studies included sections on governance structure and operational framework (i.e. access policy, dissemination and exploitation, funding, data management plan, education and training and the implementation plan). According to one of the interviewees, one of the most challenging parts of the drafting process was agreeing on the governance structure and the right level of detail for the business plan, as some partners wanted to cover every eventuality, while others believed that a shorter and more concise version would be best.

The above example reflects the complexity of the decision-making process.



Another issue that added to the complexity of the process was the fact that during the preparatory phase, several interviewees indicated that not enough templates and guidelines were available to lead the process confidently. In one particular case, a template designed specifically by the European Investment Bank (EIB)¹⁸ for European RIs was used. Furthermore, another interviewee emphasised that in addition to the success stories, failure can also be of value to newcomers. The problem with failure, according to this manager, is that these cases are not well known, as people share their successes but are reluctant to discuss their failures.

Besides the lack of available templates and guidelines, some interviewees made remarks on the length of the business plan. As a matter of fact, some of the business plans examined in the case studies are quite extensive, with up to 88 pages. Furthermore, on several occasions the interviewees pointed out that a shorter and more concise business plan would be useful to improve its use as a living management tool.

"We are using the model provided by the EC with the business guidelines for the ERIC (the last version) but I also asked for different templates. I have one elaborated by the European Investment Bank. The problem here is the lack of models because not many models are available around, even though 17 ERICs have already been established."

INVOLVEMENT OF STAKEHOLDERS (CONSULTATION, FEEDBACK AND APPROVAL)

Based on the information gathered, two approaches have been identified to draft RI business plans: the first one involves the joint work of the consortium partners in the preparatory phase (i.e. ministries, funding agencies and research performing organisations) and the second one entrusting the drafting of the business plan to external consultants. The experience using this last option has been satisfactory so far, as pointed out by some of the interviewees, since the whole process can be carried out professionally and quickly. In both cases, exchanges among different parties were needed. These exchanges happened through direct dialogue and meetings for the most part, and through consultations with users via survey or alternative means at later stages, to improve services and increase user engagement. In general, exchanges among stakeholders have been productive to gather feedback, direction and commitment. Besides this, some interviewees mentioned that having people on board with previous professional experience in other state-of-the-art facilities and European initiatives facilitated the process, as they shared their knowledge and experience with RI, management and business concepts, which came in handy for the drafting process.

Good practice 5: *The involvement of relevant stakeholder communities has provided in a number of cases a balanced and comprehensive approach to the development of business plans, by transferring their experience and expertise to the project. Some examples include but are not limited to patient organisations, insurance companies and research performing organisations.*

IMPLEMENTATION, REVISION AND UPDATE OF BUSINESS PLANS

Several elements have been reported on business plan updating and implementation. While in some cases business plans have not been updated since the date of publication (e.g. six years ago), others have been reviewed and amended after two years. In the second case, updates were done to specific sections like strategy, investments and key performance indicators

¹⁸ This template is not a public document.



(KPIs). These modifications were then presented to the General Assembly for approval. The governance section, on the other hand, was one of the sections that remained untouched, since it was an area that was considered to be clear. According to another interviewee, although the process proved to be beneficial, it turned out to be so complex and labour-intensive (taking almost up to one year), that in his opinion, updates should only be done every five years. Furthermore, as mentioned earlier, the extensive length of the business plan in some cases is seen as a hurdle for further updates. Conversely, in cases where no updates have been made, an annual work programme that acts as a roadmap, setting out the goals, activities and funding was used at the central and node levels, and a vision paper with an outline of the prospects and challenges for the next five years was sometimes used.

“Even though it is not formally updated, we are using the different parts of the business plan for the daily work of operations and purposes of the day to day management and for future development purposes.”

Besides issues related to the length of the document, some remarks on the evaluation of the business plan were also made by interviewees. For instance, in one specific case, the RI manager pointed out that there were some discrepancies between the ESFRI Evaluation Committee and the consortium involved in the drafting of the business plan, on the role and objectives of the RI. While one party considered that the business plan model should be targeted at short-term economic benefits, the other placed the focus on making the most of research facilities in Europe, maximising the benefits of partnership, and on increasing operational efficiency.

The implementation of business plans is reported to be diverse among and within RIs. Even within the same distributed RI, nodes will use business plans in various ways and for different purposes. For example, whereas some nodes consider these to be useful for the implementation and operational strategy, others either do not have one in place at the node level, or do not use them to run the facility. At the central level, on the other hand, the business plan is seen as an excellent tool to communicate with stakeholders, as stated by one Director General. In fact, while the statutes and the rules of procedure are more rigorous and static documents, the business plan serves as a tool to present the internal strategy to RI managers and to the stakeholder community.

USE OF BUSINESS PLANS AS A MANAGEMENT TOOL FOR INTERNAL RI MONITORING AND OPERATIONAL PERFORMANCE

Based on the feedback obtained from the case studies, the use of business plans and other strategic documents for internal monitoring and operational performance varies between RIs. For instance, in one case, an interviewee reported that the strategy of one of the nodes was reviewed every three years and then reflected in the strategic plan. In other cases, an action plan had been set up annually outlining the specific tasks, timeline and resources to reach the goals.

When it comes to **KPIs**, a number of things have been observed. First, KPI monitoring appears to be a recent thing for the majority of the RIs interviewed. Second, KPIs are used at different levels (node and central) and for various purposes. In some cases, they are used to measure short-term objectives (such as number of visits and number of projects) and in other cases they are being developed to measure long-term performance.

Good practice 6: *Monitoring practices depend strongly on the type of RI and their operational specificities. For example, Biobank Norway (BBMRI national node) reports to RCN on behalf of the national partnership on*



contractually agreed KPIs. Furthermore, Biobank Norway collects information for the yearly report from different work packages and institutions, representing the participating biobanks, and in addition, reports on the common services of the national hub level.

The biobanks in Norway are embedded in universities, health organisations and hospitals, and report on their activities through the host institutions as well.

Examples of the KPIs collected by Biobank Norway for reporting to the Research Council are:

- *total number of users;*
- *total number of samples;*
- *number of researchers making use of the samples;*
- *number of researchers from industry;*
- *number of projects with international funding (e.g. EU projects);*
- *number of projects with external national funding, with co-financing from health institutions;*
- *number of projects financed by industry.*

Also included are KPIs on outputs (publications from the biobank-based research), meetings and conferences hosted and attended, etc. This report also highlights the RI input to the quality standards improvement, e.g. on the data management and LIMS (Laboratory Information Management System).

There are also cases in which different nodes from the same pan-European distributed RIs follow diverging approaches. For instance, while one node might not be tracking KPIs, another one will be collecting information on relevant parameters to the country where it is located, such as contribution to education and training. Yet, regardless of this, most interviewees appear to agree that KPI monitoring and benchmarking are important in view of providing quality services. To this end, some preliminary actions have already been taken within the H2020 project EMBRIC, e.g. gathering feedback during meetings targeted at users. Moreover, quality of services is said to have improved significantly as a result of these exercises, and staff exchange programmes between different nodes have led to an improvement in staff's competency, impacting the overall organisation of the node.

However, most interviewees agree that there are certain challenges associated to the use of KPIs. From an operational point of view, collecting the feedback provided by the nodes on a regular basis to assess the volume of activity is not always straightforward. Another interviewee added that time and not having enough people to track KPIs are barriers to maintaining the quality system. Regardless of this, several central hub representatives highlighted their desire to engage with consortium partners on a more day-to-day basis.

Another point raised during some of the interviews concerns the adaptation of the central hub's KPIs to the node's needs. But things get even more complex, as one of the interviewed nodes mentioned that they were also gathering data for the national funding agency, which had its limitations as some of the indicators used were quite general.

There are other cases, however, where progress in earlier stages was monitored by one of the internal committees on a rolling basis without the use of KPIs. In one specific case, milestones were used instead to keep track of events, activities and resources. Furthermore, several governance bodies were set up to monitor and assess performance through meetings, in some cases up to 10 times per year.

Other internal management tools used include reports sent from the central hub to all nodes (with a general update on the key accomplishments, the obstacles encountered and the next



steps to follow), teleconferences between the director general of the ERIC and the node directors, to enquire on progress made and the challenges faced, management committees, composed of national node directors, that meet around three times per year to discuss strategy and progress.

"KPIs were introduced about 1.5 year ago as a useful tool to report on the central activities, and it was thought logical to report on the same KPIs as we do on the national level. Trying to harmonize this was a difficult and extensive discussion at the ERIC-level, also based on what people were able to provide."

LONG-TERM SUSTAINABILITY OF RESEARCH INFRASTRUCTURES AND ITS LINK TO THE BUSINESS PLAN

Achieving long-term sustainability of the RI is one of the main reasons for drafting a business plan. In the business planning exercise, RIs relate their mission to value creation, develop a strategy and plan their activities, estimate the cost and income for the short-term as well as the long-term, for the different phases of the lifecycle of RIs, for investments, operations and, finally, for closing down. It is crucial for the success of this exercise that RI managers identify and address in their business plan the main risks, and reflect on the success factors and challenges that affect the long-term sustainability of the RI in its specific environment.

Besides the importance of adequate and stable long-term funding, the 'question of RIs' long-term sustainability goes well beyond the funding only, and is touching upon several dimensions such as scientific excellence, socio-economic impact or innovation' as is underlined in the EC's 'Sustainable European Research Infrastructures – A call for action' [report](#) and supported by InRoad's findings.

The following topics, related to business planning and RI long-term sustainability, served as the basis for InRoad's interviews:

- key factors influencing the long-term sustainability and the RI's ability to respond to important challenges and manage risks;
- full lifecycle costs of RIs, financial planning;
- requirements for RIs to ensure their long-term sustainability (i.e. next phases of their lifecycle, including operations, maintenance, upgrades, termination).

In the cases studied, several critical factors for the success of RI long-term sustainability were highlighted by RIs managers. The success and risk factors are important topics to be considered in RI business planning, either in the business plan itself or when drafting other operational documents, e.g. the financial plan, stakeholder engagement strategy and communication, user strategy, access policy and data-management plan.

MAIN SUCCESS FACTORS, CHALLENGES AND RISKS

Important success factors that impact the long-term sustainability of the RIs that were highlighted by RI managers in the case studies, are related to:

- **financial planning and funding framework** (e.g. adequate, stable funding perspective, that allows adjusting for growth, future investments for upgrades – also at the node-level –, calculation of the full lifecycle costs, continuation of regional funding, development of a sustainable business model combining different sources of income);
- **societal and economic impact** (e.g. the energy challenge, blue economy, health);
- **stakeholder engagement** (e.g. widening the partnership, industrial relations);



- **user strategy and access policy** (e.g. accessibility of the facilities, user satisfaction);
- **data management** (e.g. quality assurance, trust, costs, unifying data in certain types of facilities);
- **communication and outreach** (e.g. visibility of the RI, communication strategy);
- **implementation and monitoring** (e.g. alignment of strategies between central hub and nodes, professionalisation of management, using external business planning expertise).

In the view of the interviewees, **user engagement and user satisfaction** are important pillars of RIs sustainability. A strong brand of the RI may bring short-term political support and initial funding, but it won't automatically bring in the users. It is therefore not surprising that **making the use of RI attractive and visible** is a main factor of success reported by all RIs. A major challenge from the operational point of view is to have all the facilities fully used and receive feedback on the usage, to enable the RI to show existing and future members or partners the benefit of their commitment to the RI. Hence, an important work in the business planning has to be done about user strategy and stakeholder engagement, and translated into more operational plans, like on access, monitoring and communication.

The **commitment of stakeholders** is a general pillar of RIs sustainability. At the national level of distributed RIs, **regional investment** is also important for the financial stability. For some RIs, an important area is to find the best way to interact with local industry, since engaging with industry will then benefit to the RI in the form of regional investment or contribute in another way to reaching the RIs societal or innovation goals. Policymakers – both at EU and national level – could support improving the visibility and accessibility of RIs on European and international scales by implementing measures that would favour the use of RIs. This could mean, for example, providing more financial incentives to researchers to actually use RIs, but also highlighting RIs in the national research agendas, and performing educational work by explaining why RI's use may be more beneficial than buying specialised equipment and performing the research in-house only.

For some RIs, developing a **commercial strategy** is important not only as a way to bring in financial resources, but also for delivering the mission of the RI, especially with regards to societal and economic impact, including the growth of innovation ecosystems. In some national RI funding procedures, making RIs accessible not only to researchers but also to industries is a requirement to be met. Niches in terms of services provision to the industry can be identified through a market analysis in the business plan and used to develop RI services in that direction. In the case of distributed RIs, this service development has to be tailored to the territories and their resources.

Good practice 7: *In one of EMBRC's national nodes, EMBRC-FR, RI managers are using a flexible approach when providing the assistance to industrial users who are not familiar with the facilities (marine stations). In terms of the service offer development for industry, this issue is tackled specifically within the EMBRIC¹⁹ project through the creation of a service pipeline between the involved research infrastructures (EMBRC, ELIXIR, EU-OPENSCREEN and MIRRI) and two Integrating Activity projects (AQUAEXCEL and RISIS) in order to foster innovation in marine biotechnologies.*

¹⁹ European Marine Biological Research Infrastructure Cluster, H2020 project funded under the call for proposals INFRADEV-1-2014



As part of the engagement strategy on innovation in the business plan, RIs have different ways to establish closer relations with industry. Some RIs have an industry advisory group or a committee in their governance structure and can also be involved in advising on RI's business planning. In some cases, the RIs engage with industrial stakeholders through a partnership or an associate membership. In other examples, some RIs engage with industry via the establishment of an industry platform or develop specific tools to facilitate industrial collaboration.

Good practice 8: *As part of its strategy to engage with industry, the Norwegian node of BBMRI has established a working group with representatives from pharmaceutical industries, biobanks and universities. One concrete idea that this group is working on is the development of tools to make biobanks ready for industrial collaboration. This involves the establishment of an industry compliant standard enabling biobanks to act more swiftly when approached by industry.*

For some RIs, ties with industry will remain minimum, like in the case of the European XFEL, since they are mostly designed to perform fundamental research. Therefore, these elements need to be related back to the mission of the RI.

Related to the aforementioned topics and examples, it is clear that an important success factor for the long-term sustainability of RIs is the **visibility of the RI**, to show how they fulfil their role. RIs' communication strategies and outreach plans target specific stakeholders and how to approach them. Using only traditional media has its limitations, as was stated by one of the interviewed RI managers; although impact is not always guaranteed, a communication strategy combining both traditional and modern media is more likely to increase the facility's visibility.

Good practice 9: *In the case of the Norwegian node of BBMRI, the name BBMRI.NO was seen as meaningless for the general public in Norway. Therefore the national node has also been operated under the alias 'Biobank Norway' or 'Biobank Norge' since 2010.*

Support of an external professional (e.g. a commercial communication company) can help the RI to develop a communication strategy. In the case of CESSDA, the RI's main office hired external services to develop a communication strategy targeted to the RI's stakeholders (members, service providers, users of data, producers of data) and for advising the RI how to restructure the website and how to reach out to new members.

Finally, a **weak link between the headquarters and the nodes' strategy** can also be a risk for the long-term sustainability of any distributed RI. The alignment of strategies can be improved through joint business planning. If each node has its own strategy for development separate from the ERIC strategy, they may still function successfully as individual facilities. However, there is a great risk that the nodes' activities will drift apart. A solution, as proposed by a RI manager, is to put in place a 'quality system' for the strategy, such as labelling the node as 'compliant with ERIC strategy' or not. It can be called alternatively **the power of a brand**, when the nodes' governance would trust the RI's central brand and respect their recommendations.

FINANCIAL PLANNING AND FUNDING STRATEGY

In their financial plan, RIs describe present and foreseen funding sources, including members financial and in-kind contributions, cohesion funds (if applicable), project funding, income



from user fees and from other parties (private or public). This plan is used for the provision of funds, for initial and planned investments, for the calculation and funding of operational costs of the RI within a given timeframe, on the short- and long-term during its lifecycle. The development and regular updates of the financial plan and funding model, with adjustments according to changes encountered, are important elements of the business plan and a key factor of success for RIs' long-term sustainability, as is a suitable funding. This was supported by the findings from the case studies.

RIs in our case studies experience several financial risks or challenges related, for instance, to the risk of lack of funds/failure to secure financial contributions, to not having a contingency budget to cover potential financial risks, to the imbalance in members' contributions, and also to the difficulty of calculating the cost of the use of the facilities.

Another challenge reported is when the RI's funding model doesn't bring additional budget for the central hub's activities when new members join in; the fixed total budget will in such cases lower the other members' mandatory contributions but won't bring new monetary contributions to the RI.

RIs financial strategies are bound by their mission, value proposition and the rules and regulations that they need to comply with to guarantee their funding. RIs that apply for roadmap funding are required to provide their financial plan and funding model with defined or estimated costs and income for a certain period ahead. A practice from the Norway case study shows the requirement for roadmap applicants to make separate financial plans for the establishment phase and the operational phase. The RCN's call for proposals requires RIs to plan their (estimated) costs and income for a period of 10 years of operations ahead and to fill in a mandatory Spreadsheet for Costs and Income with a quite detailed estimation of the contributions to cover operational costs for a period of 10 years ahead.

Basic costs for operations of RIs are normally not covered by the funding for RIs in Norway, as is outlined in the national [strategy](#) regarding RIs by the RCN (2018a, p. 11):

"Since the National Financing Initiative for Research Infrastructures primarily targets the renewal of Norwegian research infrastructure, the Research Council has a restrictive policy concerning funding of operating costs of research infrastructures. Instead, the operating costs of research infrastructure are as far as possible to be covered by the projects that use it. Thus, the Research Council requires applicants seeking funding to establish research infrastructure to include plans for how to achieve sustainable operation of the infrastructure. User fees from the R&D projects using the infrastructure should ideally be an integral part of financing its operation. Expenses related to the use of research infrastructure are therefore approved costs in all applications for research funding from the various Research Council programmes and funding schemes."

Distributed pan-European RIs are dependent on members' contributions to the central services and their national nodes – mainly on national funding decisions (e.g. investment grants, basic funding from hosting institutions). Practices from the case study show that working with different procedures and timelines for the various income streams is a challenge for the financial planning by the RI Central hub.

Good practice 10: *The financial plan of EMBRC ERIC is described in the 2017 business plan with all the revenue streams and cost categories. The planning is made for 6 years and in two phases: start-up phase (2017-2019) and full regime operation (2020-2022). The financial planning of the EMBRC nodes included in the case study (FR, GR, IT) ranges from a 2-year*



financial period (GR) to a 3 year planning basis (FR) to a 5 years one (IT), and is dependent from the national funding schemes.

In many cases, contributions to the central hub's costs and services are minor compared to the funding (including in-kind contributions) of the national node facilities. An example of **combining funds from different sources**, mainly from national grants and funding by host institutions, but also through engaging with the regions and private sector, is provided below.

Good practice 11: *The basic funding of the French node of EMBRC (EMBRC-FR) consists of a grant obtained in 2010 from the French national research agency in the frame of a programme 'Investments for the Future' (PIA-I), which spanned 10 years. Supportive funding allocated to solving specific challenges was obtained through H2020 projects targeted at RI development. EMBRC-FR is also working in close collaboration with the regions, which allows them to be eligible for the regional structural funds for the continuous development of the infrastructure. Furthermore, EMBRC France continues to improve its visibility and attractiveness to the private sector by working on joint projects, developing services for them, and developing sector-specific training courses to meet the needs of the regional industries. This will improve the annual revenue of the RI and help to cover the operational costs.*

When updating the RI's strategy, planning for a sustainable financial situation could lead a revision of **the existing business model**²⁰ and to the development of new sources for future additional income. This could lead the RI to engage with new stakeholders, widening the group of users or looking for a pricing mechanism in addition to the agreed and fixed income by members' contributions or basic funding by the host institution.

FULL COST CALCULATION AND PLANNING FULL LIFECYCLE COSTS

Case study findings show that calculating annual full costs is a challenge for RIs and not a common practice. And this is also the case for the planning of the full lifecycle costs. For some of the distributed RIs, the calculation of the node's full lifecycle costs falls under the responsibility of its respective national host institutions.

Good practice 12: *EMBRC ERIC considers that the estimation for the termination cost should be done locally, at the institutional level. Headquarters can only encourage performing these estimations, but cannot go beyond simple recommendations.*

For single-sited facilities, European and national, it seems a more common practice to plan the costs for the full lifecycle of the RI, and to include a provision for the costs of termination.

Guidelines for RIs on the cost calculation for use of the facilities (e.g. to have some principles agreed in Europe on how to categorize a few different types of access, and on how to calculate the costs for each type) could be beneficial, whether they are issued by the EC, RIs central hubs or the national governments, however they should be coherent.

²⁰ Abstract representation of an organisation, which includes all core interrelated architectural, co-operational and financial arrangements designed and developed by an organisation (presently and in the future), as well as core products or services the organisation offers or will offer to achieve its strategic goals. ([OECD 2017](#))



Regarding the annual full cost calculations, some distributed RIs headquarters are trying to gather the data from the nodes or facilities by sending them templates to fill in. Still, a big challenge is to have comparable inputs because they are all legal entities with their own accounting practices. Another big challenge is to draw a financial and accounting border between the RI activities as a national node and its other institutional research activities.

In France, the RI annual full cost calculation by RIs was fostered by the MESRI and concerned every RI on the national roadmap.

Good practice 13: *Support measures aimed at implementing RI annual full cost calculations were initiated in 2011 by the MESRI through a pilot project involving several large RIs, which was carried out in collaboration with a consulting agency. The methodology for cost calculation was optimised subsequently, and since 2016 this annual full cost calculation is part of the roadmap update. Consequently, all RIs included in the national roadmap are expected to submit such calculations. An interviewed RI (EMBRIC France) confirmed that this exercise was very beneficial for their financial planning.*

In Norway, a [methodology](#) for the calculation of full costs associated with RIs for the academic institutions was developed by the Norwegian Association of Higher Education Institutions (UHR) in 2014. This is a methodology for declaring the costs and pricing for the use of RIs in externally funded projects. Though this calculation cost model is developed mainly for non-economic activity (research practice in universities and colleges), it provides also a guideline for price calculation for economic activity.

IN-KIND CONTRIBUTIONS

European RIs rely to a large extent on in-kind contributions, which are accounted for at different levels.

Regarding the contribution of members to pan-European distributed RIs, monetary contributions are necessary to assure the central office's financial sustainability in the mid-term. In case in-kind contributions are offered as a substitution to monetary, this requires an approval by the governance of the RI.

However, there are still quite substantial differences between RI funding models concerning in-kind contributions. There are distributed RIs that accept in-kind only as a voluntary addition to the compulsory monetary contributions. In others, in-kind contributions are accepted and valued, for example in the form of staff secondment or by involving local staff in the development of common services and activities. Some distributed European RIs rely mostly on the in-kind contributions from EU MS, and for them, having a reliable in-kind contribution valuation methodology is crucial.

In case of single-sited European RIs, in-kind contributions in the form of instrumentation can be a very important component of their funding model in the construction phase. Some EU MS have a possibility to use ESIF funds to construct state-of-the-art instruments in their country and to deliver it to the single-sited RI as a part of their contribution.

RI managers confirmed that costs calculations, which include the in-kind valuation, are a quite complex exercise.

At the level of national facilities constituting the nodes of European distributed RIs, in-kind contributions from the host organisations are in many cases implicit to their functioning. Biobanks infrastructures, for instance, are constituted of multiple highly distributed facilities.



The majority of those facilities are embedded in hospitals and research institutes. The state-of-the-art equipment and qualified personnel provided by the host organisation is therefore crucial for an efficient functioning of the biobanks.

Apart from the challenges for sustainable in-kind provision, for some RIs the issue arises when comparable data on the in-kind contributions need to be collected across all national operators. One of the interviewed pan-European RIs confirmed that they are currently in the process of collecting detailed information from all national nodes on the volume of work and the staff commitment associated with the service provision at the national and ERIC levels, as well as the contribution of the nodes' staff to the development of common activities and centralised platforms.

Taking into account the abovementioned findings, InRoad recommends that in-kind contributions be better accounted for when drafting RI business plans at the level of central hubs of distributed RIs, as well as at the level of national nodes.

USER STRATEGY AND ACCESS POLICY

CONSULTATION OUTLOOK

Open excellence-driven access is regarded as important, and is one of the main criteria for eligibility for the roadmap.

In many national processes, open access also means receiving a substantial part of users that are not affiliated with the host institutions. Oftentimes, a description of the access policy for industrial users is requested in addition to the access policy for academic researchers. In the Czech roadmap process, for example, RIs are also required to develop an access strategy for other users, who are utilising the RI's capacities for collaborative and/or contractual R&D projects beyond the open access mode.

70% of the consultation respondents stated that they request additional information related to **services and support for users**, and 67% on the **RI user capacity**, in particular the capacity for welcoming external users.

Good practice 14: *In the Czech ex-ante evaluation methodology (form B) a complete user analysis is required: "Describe the current user community of RI, its development over the last 5 years or since the establishment of RI (relevant for the RIs established later) and future outlook. Indicate number of users and their affiliation to research institutions, including the country of origin"*

Multiple parameters for measuring RI capacity and efficiency of usage are requested in the MESRI evaluation survey, and include among others the total rates of usage, percentage of usage by internal/external projects, national/international teams, industry/academia; full list of equipments and associated services, including data storage and transmission services; specific services targeted at industrial users, etc.

The capacity for training at the RI facilities is included as a criterion in the Slovenian procedure.

The above examples show that user analysis and user segmentation are important criteria in the roadmap evaluation procedures.

Only half of the consultation respondents confirmed that they include data management plan and intellectual property rights (IPR) management as assessment criteria in their roadmap procedures. Examination of the supporting documents shows that **data management and**



IPR are usually both addressed under the access policy. One interesting example of data collection is the roadmap survey in the French national process, where those two aspects are elaborated as separate paragraphs, and the part of the survey related to data is well developed. Similarly, in the Norwegian RI application form, data management is a separate category.

One important term that was not initially included in the InRoad consultation, but stood out during the consultation analysis is the **critical mass** of users. In particular, the term was employed in Romanian, Greek and Israeli processes.

ACCESS POLICY DOCUMENTS AND ACCESS PROCEDURES

User strategy, which also includes access policy, is one of the main parts of a business plan, and is tightly linked to the RI mission and value proposition.

The access policy is often defined during the preparatory phase, along with the business plan drafting, and refined in the implementation phase. In addition to the description of access procedures for users, the access policy document also contains guidelines and requirements addressed to the participating facilities, for instance, the recommendations on how to report on provided services (types of access, number of access units, costs and fees, projections for the following years, etc).

RIs involved in the present study are using the [European Charter for Access to Research Infrastructures](#) (2016) as a guiding document for establishing their access policy. In case of distributed RIs, individual facilities' operators refer to the guidelines provided by their central management offices. Regarding the detailed access procedures and pricing, the individual operators/national nodes are responsible for establishing the latter at the local level.

Good practice 15: *The managers of the Italian node of EMBRC indicated that the access policies developed at the ERIC central hub level have to be validated by the Board of directors of the partner institutions prior to being translated into the node's policies.*

In the mean time, the procedures and rules for access must be transparent and visible for users across the whole distributed RI. In pan-European RIs, the access is oftentimes provided either through the central access point (e.g. ERIC) or through the national RI; the latter also includes the use of facilities by researchers of the host institution.

One of the study participants stated that *"the added value [of an ERIC] is to provide the unifying force to overcome differences in cultural, technical, geographical/political and methodological settings and to bring the principles into every day practice"*.

Good practice 16: *EMBRC ERIC strives to make the 'user experience' similar across all involved service providers. The respect of common access procedures and the implementation of a central user access point – consisting of a services catalogue with a human-assisted interface – are the main contributors to it.*

One of the central principles of the access to European RIs is an *open access*, which is widely supported by the national and European policymakers.

Good practice 17: *An interesting example of support for the principle of open access comes from the Greek national RI evaluation procedure. The funder of RIs in Greece, the Ministry of Research and Education, imposed the rule that a minimum of 20% of the RI's access capacity should be de-*



voted to external users (researchers who are not affiliated to host institutions).

However, the infrastructures that produce and store sensitive data have more rigid ethical and legal frameworks for access. In RIs dealing with human biological samples, the access policy must be compliant with the current national and European legislations on the patient data protection contained in the EU General Data Protection Legislation (GDPR). “*New GDPR regulation could play a role in harmonising access requirements in the future, as it might help get informed consent in a more generalised way*”, as was stated by one of the study participant.

COST OF ACCESS AND USER FEES

User fees can form a substantial part of the RI revenue. It is illustrated by a study involving a RI that has just entered its operational phase: the revenue from service delivery is expected to gradually increase to 25% of the operation costs when fully operational, while the transnational access funding will account for an additional 15%.

Access cost calculation, however, may differ considerably depending on a RI organisation. When RI investments are covered at 100% by public funds, access fees are usually used to cover as much as possible the facilities running costs. When a distributed RI includes privately funded facilities, investment costs are included in the access fee.

In any case, establishing the prices for products and the fees for services is not a trivial task, since the value proposition of RIs relies on providing unique services at the local and European levels.

***Good practice 18:** An important pilot project was initiated by the French node of BBMRI and supported by other partner biobanks regarding the calculation of the access costs. The work was published in a journal, Science Translational Medicine (Clément et al. 2014), and displays an estimation grid developed by an international expert group. This grid was tested across biobanks in six countries in order to validate a tool for setting specimen-access prices that are transparently related to biobank costs.*

Independently of the source used to cover access fees, it is desirable that RI users be aware of the actual costs associated with requested services.

***Good practice 19:** One of the RI involved in a case study issues to all non-paying users (for instance, when the access fees are covered by a transnational access scheme) a pro-forma invoice. It allows users to get familiar with the pricing details, and this information can be used in future grant applications, where the access shall be covered by different funding sources.*

On the contrary to physical access, in data-driven RIs charging fees for the access to data is not expected to be a sustainable funding model, as the costs for data storage in the archive are mostly fixed costs and the costs of providing access to data is marginal. Business opportunities arise rather in providing tools and expertise, which is the added value of data RIs.



DATA MANAGEMENT

In the opinion of one of the RI directors, the most challenging issue about the access policy is not to define the access procedure, but to establish the rules for the use of the knowledge and protection of the intellectual property generated by this access.

In 2016, the '[FAIR Guiding Principles for scientific data management and stewardship](#)' (Wilkinson et al.) were published. Shortly after, the [guidelines](#) on FAIR (Findable, Accessible, Interoperable and Reusable) data management for the H2020 programme were published by the EC (2016). This aspect of data management is tackled also by RIs, especially the ones that provide data-driven services. ELIXIR has published its [position paper](#) on FAIR data management in life sciences in 2017; and CESSDA prepared [guidelines](#) and published a 'Data Management Expert Guide' on its website, to accompany social science researchers in making their research data FAIR.

Good practice 20: *One of the interview participants (ERIC director) confirmed that the implementation of the FAIR principles is an important issue included in their current activity plan, and that an upcoming project under H2020 INFRAEOSC-04-2018 call aims at refining those issues and at helping RIs to adapt their data management plans.*

The GDPR regulation that came into force on 25 May 2018 also represents a challenge for RIs, especially those that produce sensitive data (such as patient data). One of the national node's director commented that GDPR implementation might bear risks which are difficult to forecast. At the same time, European RIs prepare their users and stakeholders by organising [webinars](#) and publishing other training materials.

InRoad recommends that all the relevant development in the national, European and international legislation be properly addressed in RI business plans, in order to be better prepared to transition and operational adjustments.

SOCIO-ECONOMIC IMPACT

Socio-economic impact is an important but complex area. According to one of the RI managers interviewed, the quantification of impact is a problem for all RIs, but at the same time there is an awareness that measuring impact successfully would allow the RI to have much better leveraging power with policymakers. Socio-economic data can demonstrate the relationship and impact that the RI services have on the region, the European Research Area (ERA), etc. In a specific case, an interviewee stated that a special budget had been allocated during the preparatory phase to hire the services of a professional firm in order to track this data.

ACCOUNTING PRACTICES

When asked about accounting practices, the representative from one ERIC explained that one of the challenges they face is drawing a line between the RI activities conducted as the RI node from those of the institution. Yet, the biggest challenge concerns the comparability of inputs especially when nodes are bound to their host institutions accounting practices. Having guidelines on cost calculations would be extremely beneficial, whether these are issued by the EC, ERIC, RI's central hub or by the national government agencies. However, these should be coherent.

Another interesting point raised concerns auditing practices. According to one interviewee, while cost calculation methods at the institutional level follow the usual cost categories ap-



plied at the institutional level (e.g. personnel, equipment, travel, consumables and overheads), accounting rules for structural funds' audits comply with specific rules from the common procurement vocabulary.

Accounting standards at the central hub are often applied in compliance with the national law of the country where the statutory seat is located, having consequences for filing, auditing and publication of accounts. In other RIs, International Public-Sector Accounting Standards are used. In the latter case, the RI representative highlighted that even though it takes time for the partners to get used to this international system, it was their auditors who advised them to do so. Furthermore, according to the interviewee, accounting standards are linked to national laws, which might mean nothing to another country. For this reason, the consortium decided that it would be better to have international accounting standards, so that regardless of who joined, even from outside of Europe, it would be easier for them to interpret the information.

"We, for example, have international accounting standards because we believe that independently of who reads the balance they should be able to interpret them. If we use national accounting standards it would be very challenging for all countries. This is a decision we made, which has been questioned by some countries because they are not used to using international accounting standards but this is the easiest thing for everyone. It is like speaking English, it is a decision that we made at a certain point."

SUPPORT MEASURES FOR RI BUSINESS PLANNING

CONSULTATION OUTLOOK

Only 7 national policy making organisations out of 27 (26%) confirmed that they provide support measures to improve RI business planning. In some cases, despite the negative answer from the consultation respondent, relevant support measures were identified by investigating supportive documents (e.g. national roadmaps or guidelines for applicants in RI calls).

Support measures pointed out by survey respondents include: allocation of advisors to help with the drafting of RI business plans or identifying relevant business models; offering guidance to applicants per email, phone, direct discussion, or by publishing clear and detailed guidelines; specific topical meetings at national levels organised by the responsible Ministry and major research performing organisations.

Several consulted countries place a particular focus on the *support* of the RI operational viability, which is done using various methods, such as the development of detailed cost calculation guidelines.

PERSPECTIVE OF CASE STUDY PARTICIPANTS

When asked about support measures to improve business planning and long-term sustainability, RI managers confirmed that it would be very beneficial to have more exchanges with other infrastructures, especially for RIs that are in the preparatory phase, e.g. on the experience of setting up an ERIC. Having a formal way to exchange templates of the main standard documents would be also very helpful to avoid the situation that every emerging RI experiences in setting up its own procedures. The meetings targeted at the exchange of experience of RI managerial staff, such as RItrain or the ERIC forum, are very useful at all stages of the RI lifecycle and should be further encouraged.

Other interviewees highlighted that one way to help address the RI long-term sustainability issue could be through improvement of internal expertise in business planning.



Furthermore, propositions such as putting more focus on the RI value creation for the research and society in the national strategic agendas were made. Interviewees mentioned the **visibility** of RIs as one of the main issues, emphasising that more support is needed to facilitate an efficient exploitation of the RI service capacity, e.g. financial or other incentives from the funders to foster the RI use by the national research projects.

"This incentivisation should come specifically from the policymakers. RIs should not be left alone to advertise their services."

Transnational access (TNA) schemes, in particular, have been named as a great promoter of a more efficient use of facilities.

InRoad's case studies also show that EU FP projects, dedicated to the support for RI development, have substantial impact on the elaboration of common access standards across RI communities.

Good practice 21: *An example of joint efforts aimed at improving the access standards is an ASSEMBLE+ project, funded under a H2020 INFRAIA call, which activities focus on the Transnational Access (TNA) and Virtual Access (VA) to marine biological stations. The managers of one of the national nodes involved indicated that their participation in such project helped them to establish a benchmark for service provision and considerably improve the skills of RI personnel, which was mainly done through staff exchange schemes and workshops.*

Other support measures relating to the improvement of business plan drafting expertise have been offered by ministries in certain countries, and include the provision of external professional services targeted at RIs, for instance in areas that affect the business sector. Furthermore, a continuous dialogue with the ministry/funding agency and the EC is regarded as important for feedback and guidance in areas like Horizon 2020, funding and links with industry. The [Blue Economy](#) meeting organised in March 2018 at the European Union Parliament provides a good example of such dialogue. These actions should be encouraged and facilitated, as stated by one of the interviewees.



CONCLUSION

This Annex has presented current business plan practices in European RIs. The case studies, desk research and InRoad consultation aimed to assess three main issues with regards to business planning: the extent to which managers in the selected facilities use business plans for their daily operations; the degree to which these are required in national RI roadmap and funding procedures across Europe; and the identification of those components that are advised to be an integral part of a RI's business plan.

The findings gathered throughout these past 24 months show that although business planning is seen as challenging by case study participants, national funding organisations and RI managers consider them instrumental for different purposes. From the RI manager's perspective, business planning can make RIs more transparent, efficient, effective and accountable, and from the funding organisation's perspective they can improve decision-making in national competitive roadmapping and funding processes. Considering the complexity associated to the design and implementation of business plans throughout the entire RI lifecycle, it can be concluded that additional support measures targeted at providing guidance on business plan drafting and implementation (both, at national and European level) to current and future RI managers is vital to ensure the long-term sustainability of European RIs.

Considering the above, InRoad proposes the following recommendations to help accomplish the RI's objectives successfully along the different stages of their lifecycle.

1. InRoad recommends all RIs to develop a business plan in order to align their strategy, resources and goals and to connect their mission with national and international strategic agendas.
 - The inclusion of a set of minimal components in a RI's business plan;
 - Short- and long-term financial forecasting for robust RI growth;
 - The alignment of central-level and node business plans to reflect coherent strategies in distributed pan-European RIs;
 - The professionalization of business plan drafting and implementation.
2. InRoad recommends the use of the business plan as a management tool, in the form of a living document aimed at ensuring the long-term sustainability of the RI.
 - Using the business plan as a reference for the development of other more operational documents;
 - Using and periodically updating the business plan throughout the entire RI lifecycle.
3. InRoad recommends early and continuous stakeholder involvement for the development, implementation and updating of a sound business plan.
 - Using business plans as a requirement in national RI roadmap and funding applications and as an evaluation criterion;
 - The development of training schemes, exchange of practices and mutual learning exercises.

In today's competitive world, RIs not only depend on stable and predictable funding frameworks to excel, but also on effective management systems to execute their strategy and maximise their growth and impact. Professional business planning, therefore, provides a reliable framework to accomplish these objectives successfully.



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Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen
Forschung (SNSF), SWITZERLAND – Coordinator



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Science Foundation Ireland (SFI), IRELAND



Université de Lausanne (UNIL), SWITZERLAND



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InRoad has been funded by the
European Union's Horizon 2020
Research and Innovation programme
under grant agreement No 730928.

