EU-LAC ResInfra

D2.1 Report on the criteria, scientific areas and methodology to develop the LAC RI landscape

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement nº 871140. This document reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

Project Acronym	EU-LAC ResInfra
Project Name	Towards a new EU-LAC partnership in Research Infrastructures
Grant Agreement no.	871140
Document type	Deliverable
Deliverable identifier	2.1
Title	Report on the criteria, scientific areas and methodology to develop the LAC RI landscape
Contractual delivery date	31.05.2020
Deliverable type	R (Report)
Dissemination level	CO (Confidential)
Disclaimer: The views and opinions expressed in this document are solely those of the author, not those of the European Commission.	

History of versions				
Version	Date	Created/Modified by	Comments	Approved
1	23.03.2020	Giovanna Sanchez Nieminen (VTT), Heidi Auvinen (VTT), Minna Kulju (VTT)	First draft	
2	27.03.2020	Marilena Rossano (CNR), Kathrin Megerl (DLR), Stephanie Splett (DLR),	Reviews and modifications	
3	06.04.2020	Giovanna Sanchez Nieminen (VTT), Heidi Auvinen (VTT), Minna Kulju (VTT)	Reviewed version	
4	13.05.2020	Heidi Auvinen (VTT)	Final draft	
5	18.06.2020	Inmaculada Figueroa (MICINN), Andres Lopez Lara (ANID)	Reviewed final draft	
6	23.06.2020	Heidi Auvinen (VTT)	Final version	

Contents

Figures

Tables

List of acronyms

AC	Associated Countries
CELAC	Community of Latin American and Caribbean States
CNPq	National Council for Scientific and Technological Development
CF	Core Facilities
EB	Executive Board
EC	European Commission
ERA	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
ERDF	European Regional Development Funds
EU	European Union
EU-CELAC WG RI	EU-CELAC Research Infrastructure Working Group
Finep	Funding Authority for Studies and Projects
GRIs	Global Research Infrastructures
GSO	Group of Senior Officials
ICT	Information and Communication Technology
IPEA	Institute of Applied Economic Research
JIRI	Joint Initiative for Research and Innovation
KPI	Key Performance Indicator
LAC	Latin America and the Caribbean
MS	Member States
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
RFO	Research Funding Organisations
RI	Research infrastructure
SENESCYT	Secretariat of Higher Education, Science, Technology and Innovation
SOM	Senior Officials Meeting

Executive summary

The EU-LAC ResInfra (Towards a new EU-LAC partnership in Research Infrastructures) project is aimed at identifying priorities, funding mechanisms, methods and policies to support Research Infrastructures (RIs) bi-regional cooperation. The project will build on the results of the EU-CELAC Senior Official Meeting on Science and Technology Research Infrastructure Working Group (EU-CELAC WG RI) and EU funded projects relevant to the scope. A Sustainability Plan will be presented to the EU-CELAC WG RI for discussion and endorsement. The plan will recommend specific actions and instruments for co-funding RIs of common interest in order to maximise the impact of the RI collaboration in the construction of the EU-CELAC Common Research Area.

This report presents the results of Task 2.1 devoted to analysing existing LAC RI mappings. The analysis consists in the study and definition of some eligibility criteria to be applied for the inclusion of RIs in the LAC mappings and the scientific areas in which the RI are grouped.

The results of the review of existing RI mappings in Europe and LAC countries show that numerous mapping exercises have been conducted in both regions on the national and regional levels, but there is great variation in mapping methods, processes, scientific areas described and reporting. In Europe, most countries have regularly updated national RI roadmaps, whereas in the LAC countries such systematic practices are new and have only been taken up by frontrunner countries. In Europe, several regional mappings and projects contributing to harmonisation and collaboration exist, and they growingly seek alignment with the well-established ESFRI (European Strategy Forum on Research Infrastructures) activities. Moreover, the first efforts to map the RIs across the LAC countries are so far stand-alone projects of limited scope, even if they offer a good starting point to develop national, regional as well as bi-regional mapping and thus RI collaboration further.

Based on the review work, recommendations on the following topics in further LAC RI mappings are suggested. Firstly, to envisage inclusion criteria, making distinction between prioritised criteria that align well with existing mappings and criteria of secondary or tentative importance that need to be further developed to meet the specific LAC objectives and scope. Secondly, suggestions are given for scientific or thematic groupings of RI, aiming at compatibility with existing mappings. Thirdly, general recommendations to the design of mapping processes for

national, regional as well as bi-regional RI mappings is given, encouraging high-level scientific ambition, transparent and fair methodologies and long-term approach with regular updates.

1. Introduction

Among the aims of EU-LAC ResInfra project is to identify a number of LAC (Latin American and Caribbean) research infrastructures (RIs) that may be considered eligible for the construction of a bi-regional collaboration. This will be carried out through the definition of minimal key requirements these RIs would need to develop in the coming years.

To this aim, the project will build on the prioritisation results of the EU-CELAC SOM WG RI and, more specifically, will take as a reference the mapping exercises developed in previous EU funded projects.

In addition, EU-LAC ResInfra will develop a map of National and Regional Research Infrastructure policies, and their corresponding strategies and plans, included funding mechanisms that might be used to support the construction and operation of future EU-LAC RIs.

Finally, EU-LAC ResInfra will use all the results and information obtained for drafting a Sustainability Plan, which will be presented to the EU-CELAC WG RI for discussion and endorsement. The Plan will include specific actions to support the bi-regional collaboration in a mid-term perspective. The objective is to design specific variable geometry instruments for co-funding RIs of common interest, and to design measures that pursue the strengthening of the bioregional RI cooperation, seeking to maximise the impact of the RI collaboration in the construction of the EU-CELAC Common Research Area.

In parallel, the project aims to show the feasibility of the EU-LAC RI collaboration through existing examples thanks to the development of four pilots in different scientific domains that are linked to some existing Research Infrastructures: INSTRUCT-ERIC, LIFEWATCH-ERIC, E-RIHS and RICAP.

The present report summarises the results of Task 2.1 (Analysing existing LAC RI mappings) of the EU-LAC ResInfra project and it is aimed at reviewing the state of art of RI mapping in EU and LAC countries to provide useful inputs for future activities in this context. The analysis involves the study and definition of the list of the eligibility criteria to be applied for the inclusion of RIs in the LAC mappings and the definition of the scientific areas in which the RI will be grouped. The report is structured as follows: Firstly, the working process, materials and methods are

explained. Secondly, the results of the review of existing RI mappings in Europe and the LAC countries will be presented. Thirdly, findings will be elaborated using gap analysis to provide recommendations for further LAC RI mappings.

2. Working process

The working process consisted of the following three steps:

- **Desktop study to review existing RI mappings in the EU and LAC countries**, focusing mainly on the inclusion criteria and scientific groupings used. Materials used in the study were publicly available reports, websites and other materials by past and on-going mapping projects. In addition, tacit information from EU-LAC ResInfra project partners were used.
- **Gap analysis on LAC RI mappings**, based on the review of step one, in order to identify information gaps relating to e.g. countries or scientific areas covered.
- **Formulation of recommendations** to be presented to the JIRI WG RI on inclusion criteria and scientific groupings to be used in LAC RI mappings, and **drafting a methodology** for deepening the already existing mapping where needed.

For the purpose of the EU-LAC ResInfra project and this report, the following **definition of a research infrastructure** is used, as formulated in Article 2 (6) of Regulation (EU) No 1291/2013 (2013):

> *"'research infrastructures' mean facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, for example for education or public services. They include major scientific equipment or sets of instruments; knowledge-based resources such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieving excellence in research and innovation. Such infrastructures may be 'single-sited', 'virtual' or 'distributed';"*

A number of RI mappings on national and regional levels from the EU and LAC countries were identified, and the most relevant ones were included in the review for full analysis. These mappings represent the most established or advanced examples of regional efforts as well as a

few national examples from LAC countries. The mappings chosen for full analysis are the following:

- **ESFRI** (European Strategy Forum on Research Infrastructures) "Roadmap 2018, Strategy Report on Research Infrastructures"
- **MERIL** (Mapping of the European Research Infrastructure Landscape) portal
- **RISCAPE** (European Research Infrastructures in the International Landscape)
- **CatRIS** (catalogue of Research Infrastructure Services)
- **InRoad** (Synchronizing Research Infrastructure Roadmapping in Europe)
- **EULAC Focus** (Giving focus to the Cultural, Scientific and Social Dimension of EU - CELAC relations)
- **SOM EU-CELAC Research Infrastructures Working Group** (Mapping of Research Infrastructures in CELAC countries)
- National mapping: **Argentina**
- National mapping: **Brazil**
- Brief overviews of national mappings in the **EU** and **LAC** countries.

3. Review of existing RI mappings

3.1. ESFRI roadmap 2018

Project / initiative name and year(s):	The Strategy Report on Research Infrastructures, ESFRI roadmap, 2018
Organisation:	European Strategy Forum on Research Infrastructures, ESFRI
Scope of mapping:	Research Infrastructures of Pan-European importance
References and resources:	ESFRI Roadmap 2018 webpage: http://roadmap2018.esfri.eu ESFRI Roadmap 2018 pdf-file: http://roadmap2018.esfri.eu/media/1066/esfri-roadmap-2018.pdf ESFRI Roadmap 2021 Public Guide: https://www.esfri.eu/sites/default/files/ESFRI_Roadmap2021_Public_Guide_Public.pdf

The European Strategy Forum on Research Infrastructures (ESFRI) was set up in 2002 as an informal Forum composed of representatives of national authorities of the Member States (MS) and Associated Countries (AC) of the EU and the EC. The ESFRI roadmap is an ongoing process. First published in 2006, with 35 projects, it was updated in 2008, 2010, 2016 and 2018 bringing the number of RIs of pan-European relevance to 55. The next roadmap update will be launched 2021.

3.1.1. Mapping, scope and target audience

The ESFRI roadmap is a collective work: as many as 100 individuals from all over Europe were involved in the writing, if counting all Working Groups providing analysis and knowledge, the whole Forum extensively involved in discussing and refining the drafts along with the European Commission Officers and Secretariat, and the editorial team who managed the production of the document.

The roadmap presents the list of 18 ESFRI Projects and 37 ESFRI Landmarks. Each RI is identified by acronym, full name, type of RI, legal status, year of entry in the roadmap, year of expected start of operation and estimated costs.

The **ESFRI Projects** are RIs in their preparation phase, which have been selected for the excellence of their scientific case and for their maturity, according to a sound expectation that the project will enter the implementation phase within the ten-year term. They are included in the roadmap to point out the strategic importance they represent for the European Research Area (ERA) and to support their timely implementation as new RIs or major updates of existing RIs. Each ESFRI project should identify their potential user community, both science and innovation oriented, the outline of a business case and the rationale for the international consortium.

The **ESFRI Landmarks** are RIs that were implemented or reached an advanced implementation phase under the roadmap and that represent major elements of competitiveness of the European Research Area (ERA). The Landmarks can be already delivering science services and granting user access or can be in advanced stage of construction with a clear schedule for the start of the Operation Phase.

3.1.2. Eligibility criteria for inclusion

The following definition for RI from Article 2 (6) of the Regulation (EU) No 1291/2013 of 11th December 2013 on Establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) applies:

- ESFRI RIs are facilities, resources or services of a unique nature, identified by European research communities to conduct and to support top-level research activities in their domains. They include major scientific equipment – or sets of instruments; knowledge-based resources like collections, archives and scientific data; e-Infrastructures, such as data and computing systems and communication networks; and any other tools that are essential to achieve excellence in research and innovation.

- RI are implemented along different organisational models, including central sources and laboratories for experiments and measurement sessions, coordination and management of geographically distributed observatories or laboratories, remotely accessible resources for computing, data banks, physical sample repositories, surveys and longitudinal studies.

While the above definition captures the common features of RI, there are at least three types of RIs:

- **Single-sited research infrastructures** are central facilities geographically localised in a single site or in a few dedicated complementary sites designed for user access, whose governance is European or international. A single-sited RI needs to:

    - have a legal status and a governance structure with clear responsibilities and reporting lines, including international supervisory and relevant external advisory bodies

    - have an access policy and access point for external users facilitating the submission of proposals and a user programme absorbing a considerable fraction of the total capacity of the RI

    - have a user support structure to optimise access to the relevant site, such as users' office, ancillary laboratories, accommodation arrangements and logistics

    - have a data management system providing metadata and data storage, retrieval tools and online/in situ/remote data reduction and analysis

    - identify relevant and measurable Key Performance Indicators (KPI) addressing both excellence of scientific services and sustainability
    - enforce a human resources policy guaranteeing the necessary competences for its operation, users support, education and training by equal opportunity hiring and secondments.

- **Distributed research infrastructures** consists of a Central Hub and interlinked National Nodes. A distributed RI particularly needs to:
    - have a unique specific name, legal status and a governance structure with clear responsibilities and reporting lines, including international supervisory and relevant external advisory bodies
    - have legally binding attributions of coordination competences and resources to the Central Hub
    - have 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
    - have a user programme absorbing a relevant fraction of the total capacity of the RI
    - identify and adopt measurable Key Performance Indicators addressing both excellence of scientific services and sustainability
    - have a human resources policy adequate to guarantee the effective operation of the Central Hub supporting the research, users programme, education and training by equal opportunity hiring and secondments
    - define a joint investment strategy aimed at strengthening the RI through the Nodes and the common/shared facilities.

- **Global research infrastructures** (GRIs), as defined by the Group of Senior Officials (GSO), represent those research infrastructures with a full international dimension to serve common needs of the world scientific community, or the advanced collaboration among existing RIs that share common needs and efforts to pursue challenging upgrades needed for top research. GRI may be single-sited or distributed RI and should

follow the GSO Framework for Global Research Infrastructures approved by the GSO in 2014 and updated in 2017.

The key principles in the ESFRI criteria relate to scientific and technological excellence, socioeconomic impact, and governance and financial management.

3.1.3. Methodology and scientific areas

Member states, associated countries and EIRO forum members were eligible to submit proposals for the ESFRI roadmap 2018. The Executive Board (EB) checked each proposal for eligibility and proposed attribution to the leading Strategy Working Group (SWG). Proposals carrying a prominent impact across multiple domains were attributed also to a second SWG. The submitted proposals were all eligible and underwent the two parallel and independent evaluation processes run by SWGs and Implementation Group (IG), also involving independent external experts. After evaluation, proposals were invited to dedicated hearing sessions during which the Coordinators addressed and discussed the issues identified by SWG and IG. After the hearings, the SWGs and IG reached their conclusions and drafted a joint evaluation report for each project. Harmonisation of the results on scientific excellence and maturity was conducted by Working Group Chairs and EB, after which the EB recommends to the Forum the inclusion of new proposals for roadmap.

According to the lifecycle model, the ESFRI Roadmap Dynamics implies the monitoring of ESFRI projects and pilot periodic review of ESFRI landmarks. Both processes were performed in parallel by the Strategy Working Groups (SWGs) in the Energy (ENE), Environment (ENV), Health & Food (H&F), Physical Sciences & Engineering (PSE), Social & Cultural Innovation (SCI) and Data, Computing and Digital Research Infrastructures (DIGIT) domains for the evaluation of the scientific case, and by the Implementation Group (IG) for the assessment of the maturity aspects.

The scientific areas for grouping in the roadmap are:

- Energy
- Environment
- Health & Food
- Physical Sciences & Engineering
- Social & cultural innovation

- Data, computing and digital RIs.

3.1.4. General remarks

Promotion of global consortia of advanced facilities and novel global research infrastructures (GRIs) are needed to enhance the role of European RIs and science in the global context. In the roadmap, global cooperation between different RI landscapes are described, and in some cases, the cooperation and relationships with LAC countries is also mentioned.

A robust long-term vision is essential to successfully and sustainably develop, construct and operate RIs. ESFRI set up an ad hoc Working Group with the mandate to provide a set of recommendations that would help to strengthen the Long-Term Sustainability of RIs, and to provide ESFRI's input to the dedicated Action Plan to be prepared by the European Commission.

3.2. MERIL - Mapping of the European Research Infrastructure Landscape

Project / initiative name and year(s):	MERIL 2, Mapping of the European Research Infrastructure Landscape, 2016-2019
Organisation:	H2020 project, coordinated by the European Science Foundation (ESF)
Scope of mapping:	Openly accessible research infrastructures (RIs) in Europe
References and resources:	MERIL portal: https://portal.meril.eu/meril MO Forum Report "Research Infrastructures in the European Research Area" (2013)

The MERIL (Mapping of the European Research Infrastructure Landscape) portal provides access to a database that stores information about openly accessible Research Infrastructures (RIs) in Europe, across all scientific domains. The project has received funding from the European Union's Horizon 2020 research and innovation programme.

The MERIL-2 project has ended at end of 2019. The portal will remain online and searchable; however, they are no longer able to process new or updated RI entries.

3.2.1. Mapping, scope and target audience

The MERIL public portal is an open access resource displaying available information that has been collected with input from European Member States and Associated Countries, and the RI scientific community. MERIL data consists of lists of identified, eligible RIs, and a set of data for each individual RI, collected and displayed in a standardised format. The information is quality-checked by the MERIL Team.

The MERIL database will enable:

- Individual research infrastructures to raise their profile and foster a greater sense of partnership across Europe
- Scientists and RI users to access resources and find information about services and facilities offered by research infrastructures they may previously have been unaware of
- RI coordinators to exchange best practices with a view to optimising the operation and exploitation of research infrastructures;
- Policymakers to analyse and optimise the national and European RI funding landscapes by, for example, pinpointing gaps and identifying synergies at the European level.

3.2.2. Eligibility criteria for inclusion

The MERIL project established the following definition of Research Infrastructures:

> *A European Research Infrastructure is a facility or (virtual) platform that provides the scientific community with resources and services to conduct research in their respective fields. These research infrastructures can be single-sited or distributed or an e-infrastructure and can be part of a national or international network of facilities, or of interconnected scientific instrument networks.*

Furthermore:

- RIs offer recognised, established scientific and technological facilities or services;
- RIs permit free access or regulate access through a transparent selection process based on scientific quality and project feasibility;
- RIs are managed according to sustainable principles and have a long-term perspective.

MERIL has established a checklist of questions that define whether a RI is eligible to be included in the MERIL database (Table 1).

Table 1. MERIL eligibility criteria checklist.

MERIL eligibility checklist	YES	NO
1. Does the RI have a policy of providing access to users outside of the country in which it is located or by which it is coordinated?		
2. Does the RI provide clear access rules (for example application forms, open calls and contact information) and an access point for users on a publicly available web page?		
3. Does the RI provide a website in English (including the access rules)?		
4. Does the RI receive national, regional or European public funding?		
5. Does the RI have an appointed contact or manager responsible for the RI?		
Criterion only applicable to RIs that are part of an ESFRI landmark/project as a node: 6. Does the RI offer any services (including providing access to equipment) in addition to those already been offered through the ESFRI landmark/project?		

An RI is considered to be eligible to be included in MERIL if you have answered "yes" to questions 1-5 (and 6 if applicable).

3.2.3. Methodology and scientific areas

MERIL uses a standardised, bottom-up approach, where RI managers, researchers, and national data intermediaries supply information on RIs that are eligible to be included in the database. RI managers provide detailed and up-to-date facts about their RI. Each entry is reviewed by one of MERIL data analysts to ensure it is correct. This level of quality review is one of MERIL's trademarks.

The MERIL project has defined 72 categories of RIs under following scientific domains:

- Biological & medical sciences
- Chemistry & material sciences
- Earth & environmental sciences
- Engineering & energy

- Humanities & arts
- Information science & technology
- Physics, astronomy, astrophysics and mathematics
- Social sciences

In addition, the MERIL has mapped **each RI to its ESFRI domain** that include energy, environment, health and food, physical sciences and engineering, social and cultural innovation, e-Infrastructure (the e-infrastructure label can be used in addition to the other five domains). These both domains are used in MERIL database as a search criterion of RIs.

3.2.4. General remarks

The MERIL portal will help to connect the scientific community by giving researchers access to information on RIs in Europe, their facilities, and areas of research. This will help researchers to pursue new opportunities, partner and collaborate with colleagues across Europe. This will be particularly useful for interdisciplinary teams. The portal will also feature a forum area covering all countries for researchers to engage with each other and share best practice.

Among the functions the portal is expected to serve are the following:

- Improving scientists' access to resources, services and facilities offered by modern Research Infrastructures
- Promoting individual Research Infrastructures by raising their profile and fostering a greater sense of partnership across Europe
- Allowing policy makers to assess the state of Research Infrastructures throughout Europe to pinpoint gaps or duplications and make decisions about where best to direct funding
- Stimulating discussion among policy makers and research funders on RI funding and joint investment, where appropriate
- Supporting the exchange of expertise and best practice among RI coordinators with a view to optimising the operation and exploitation of research infrastructures
- Contributing with this state-of-the-art analysis to the planning for future needs in cooperation with the European Strategy Forum on Research Infrastructures (ESFRI).

RI coordinators can provide information for 21 data fields related to their RI's impact, funding and HR. The collected data portrays the active use of RIs and metrics on RI outputs, which are relevant for European policymakers. This will foster engagement and help demonstrate an RI's positioning within the European RI landscape.

3.3. RISCAPE - European Research Infrastructures in the International Landscape

Project / initiative name and year(s):	RISCAPE (European Research Infrastructures in the International Landscape), 2017-2019
Organisation:	H2020 funded project coordinated by The University of Helsinki
Scope of mapping:	The RISCAPE project provides a systematic, focused, high-quality, comprehensive, consistent and peer-reviewed international landscape analysis report on the position and complementarities of the major European Research Infrastructures in the international Research Infrastructure landscape.
References and resources:	RISCAPE project web page: https://riscape.eu/ RISCAPE final report: https://riscape.eu/riscape-report

The RISCAPE project (funded by H2020) produced a landscape analysis report and a comprehensive overview that describes what kind of major research facilities exist worldwide and how the European facilities position themselves in the comparison.

3.3.1. Mapping, scope and target audience

The goal of the RISCAPE landscape report is to conduct an analysis of the Research Infrastructure landscape outside of Europe, with an European perspective based on the ESFRI infrastructure framework.

The primary user groups identified for the RISCAPE report are the European agencies (national and regional) and research performing organisations funding the Research Infrastructure development, the ESFRI, and international organisations such as OECD.

The secondary user groups are the managers and operators of European and non-European research facilities and infrastructures, who are interested in the service provision, co-operation opportunities, and potential for joint international developments. Although the RISCAPE methodology and data is collected with these two user groups in mind, the data is relatively general and should be widely applicable for other users as well.

3.3.2. Eligibility criteria for inclusion

A RISCAPE Research Infrastructure is a facility, organisation, or network that fulfils the following:

- It has science or scientific research as the main driver of its activities. This requirement comes from the need of finding complementary facilities to the ESFRI (and similar major infrastructures) Europe, which – as science-oriented organisations – are best mirrored by facilities concentrated on the same goals.

- It provides research services to users outside of the organisation itself. This requirement has a similar background as the previous one, but is more fundamentally based on the European view of shared research facilities, and the RI as a service provider.

- It has an operational time horizon longer than the typical research projects in the field in question. This longevity is crucial for the use cases considered, as any short-term projects or initiatives would make the collected information quickly obsolete. Also, as the longevity is typical for the scale of operations required for European ESFRI infrastructures, the identified potential complementarities should be more meaningful.

- It promotes excellence and is of significance for the science field in question. This requirement was needed in order to have some degree of similarity to the European ESFRI landscape facilities, all of which are important at a European (i.e. regional) level. The requirement was, in some science fields, also needed to reduce the number of facilities to analyse. Even if this is criterion introduce a certain degree of subjectivity in evaluating a specific RI, it has been considered acceptable due to the practical requirements.

These four attributes were used to guide the overall methodology and the requirements for facilities to be included in the landscape report. However, during the process it became clear that for some scientific fields the strict use of these criteria leads to very few facilities to analyse.

3.3.3. Methodology and scientific areas

The RISCAPE project team was augmented with a stakeholder panel. This consisted of senior research infrastructure experts with expertise in most of the RISCAPE science fields, with representatives of international funding agencies, international organisations, and regional

European funders, all with knowledge of RIs. The stakeholder panel met in several virtual and physical meetings to consider the targets of the study, the scope of the project, methodology (including the content of questions), and to evaluate the initial results and early conclusions.

The methodology consisted of following:

- **Discovery of potential research infrastructures**; ESFRI; expert panels, special expert consultations and workshops; literature analysis; information collection from international facilities; discussions with country representatives.
- **Desk research**; Domain experts did a rough analysis of the identified RIs based on the RI webpages, discussions with European RI facilities, and on reports and documents.
- **Prioritisation and pre-selection**; Based on the desk research results, the RISCAPE domain experts evaluated each RI. If an RI was characterised as a RISCAPE RI it was included in the landscape analysis.
- **Initial Contact;** After identifying a potential RI, the project partners sent an email invitation to the RI to participate in the survey.
- **Pre-analysis of the facility;** After contacting the facility and preparing an interview (or questionnaire), the RISCAPE partners pre-analysed the facility, using information found in internet websites and reports.
- **Information collection**; Direct interviews with survey respondents.
- **Data analysis, interpretation and write-up;** After the information harvesting, the RISCAPE teams evaluated the answers from the perspective of the domain landscape analysis.
- **Feedback and finalisation;** As the last part of the analysis, the domain report was further discussed by domain experts and with the landscape report editor and the RISCAPE project team.

The main methodology for information collection was a controlled (directed) interview. The questions were built around the following categories:

- Identity of the respondent: name, title, contact information
- General information: facility name(s), website, address, contact, type
- Funding and scale: primary funding, approx. construction and operating costs

- Longevity and plans: statutes, time horizon, business plans, long-term funding
- Mission and goals: mission statement, science orientation, science support, specific goals
- Services: service catalogue, types of services, access methods, accessibility to outside, use of capacity, extent of external use of services, user quotas
- European access: current use of EU researchers, existing agreements with EU countries
- Data: data policy, open licences
- Impact: scientific impact, socio-economic impact, impact reports, altimetric, user statistics, indicators
- Position and future: roadmap status, development plans, geographic coverage, central and secondary facilities, extension plans
- Capabilities and interaction: technical capabilities, service provision to other facilities, dependence on external providers
- Complementarity: comparison to EU facilities, collaboration possibilities, global initiatives.

Scientific areas for grouping RIs in RISCAPE were:

- Environmental RIs
- Health and food RIs
- Physical science RIs
- Energy RIs
- Astronomy and astro-particle RIs
- Social sciences RIs
- Cultural heritage, digital humanities and language RIs
- e-Infrastructures

3.3.4. General remarks

RISCAPE has defined following collaboration between RIs, within CELAC, EU and others:

- **Environmental RIs:** The replies state that cooperation is commonly science driven: the research projects, the scientific quest are the reasons to engage in a cooperation with a partner. Moreover, this type of cooperation is mainly pushed by the scientists themselves, and most of the existing collaborations happen without a formalised agreement, on a researcher-to-researcher and project basis. When agreements are

signed, they are mostly Memoranda of Understanding, the expression of a "common good will".

- **Health and Food RIs:** Almost 75% of the analysed Heath and Food RIs have or had scientific collaboration or exchanges with European organisations (individual institute or university), but less than half have already established collaboration or have signed a collaboration agreement with a European RI in the same field. In rare cases, and surprisingly, respondents did not spontaneously mention or know the European RI existing in their field. This can be explained by the quite recent development of the European RIs and the long-lasting scientific collaboration existing between some organisations.

- **Physical sciences:** Neutron Sources (NS) and Synchrotron Radiation sources (SR) facilities are well spread over the world. Perhaps the most significant result of the analysis of the questionnaires is the International RIs' degree of knowledge of, and interaction with relevant European RIs. In general, strong collaborations and interactions exist between RIs across the globe. A vast majority of RIs that answered the questionnaire already mentioned a European partnership and other collaborations. This is not surprising as modern physical science is essentially international in nature; scientists exchange information regularly with colleagues in other countries, so new collaboration possibilities may be limited. However, new or deeper collaborations remain possible with RIs in Asia, Africa and (probably) Russia.

- **Energy:** Surveyed RIs already partake in collaborations with European researchers and organisations. Some respondents noted international organisations, such as EUREKA and IAEA, as important for developing international partnerships. During the research phase on European RIs, the international alliance on Mission Innovation was also stressed as a key opportunity for strengthened research collaborations in the energy field. It was clear from interviews and research that many Energy RIs outside Europe are proud of their self-developed facilities (for example, in nuclear energy research), which can be served as complementary to the EU facilities. At the same time, they are happy to use technologies from the EU countries while improving their own facilities, and some of the non-EU RIs also attach great importance to the cooperation with the EU RIs.

- **Astronomy and astro-particle:** A majority of the RIs included in the survey have existing collaborations with EU-based research organisations (17 out of 20). The ELT is an RI with similar technology and characteristics currently under construction by Europe (ESO) in Chile. However, there are informal contacts and collaboration between the EU and the US facilities, mainly regarding exchange of know-how and technology development solutions.
- **Social sciences:** The opportunities for collaborative work were appreciated by respondents. Most of the entities were national entities; only one, IPUMS University of Minnesota (US) identified a global reach of its services, however most reported openness to European researchers' access to services. The similarity or difference to European Research Infrastructures and similar initiatives was explicitly probed: some responses indicated clear alignment to European RIs (especially CESSDA (Consortium of European Social Science Data Archives)). The international initiatives reported several partnerships with European bodies; for example, with CESSDA and with ESS ERIC; with national research bodies such as the UK Economic and Social Research Council. Others had arrangements with individual universities in different European countries. IPUMS (US) reported that the great majority of European national statistical agencies participate in IPUMS.
- **E-infrastructure:** The e-infrastructure landscape is quite well connected between the EU and the rest of the world. GÉANT, PRACE, EGI, OpenAIRE have active collaborations worldwide.

The RISCAPE analysis has provided new insights on the global landscape and the operations, services and organisation of RIs globally, but the work faced several challenges. The scoping of the landscape goals led to a concentration on larger, more established research facilities of the same level and general type as ESFRI initiatives. This means that many interesting and potentially relevant, e.g. smaller or commercial facilities are not necessarily covered within this analysis. This concentration enabled the use of more detailed information collection, in the form of an organised interview of RI operators, which revealed a much more complete view of the facilities involved. At the same time, such methods also required direct contact with the RIs, which was not always successful. The analysis also has an intentionally European (and ESFRI RI) viewpoint, which will of course influence the types of facilities involved, and the information

collected. From this perspective, the RISCAPE analysis can be considered internally consistent and indicative, but not a complete view of the global RI landscape.

3.4. CatRIS – Catalogue of Research Infrastructure Services

Project / initiative name and year(s):	Cataloque of Research Infrastructure Services, CatRIS, January 2019 - June 2021
Organisation:	H2020 project, coordinated by European Science Foundation (ESF)
Scope of mapping:	CatRIS will make available information about RI services offered in Europe. Such information will improve visibility of services, foster European and international collaborations, and enhance RI accessibility, usage, and impact.
References and resources:	Project webpage: https://project.catris.eu/

CatRIS started on January 2019 and it is being developed by an international consortium and funded under the H2020 Programme.

CatRIS is an open, trusted and user-friendly portal to a harmonised and aggregated catalogue of services and resources provided by RIs and Core Facilities (CF) across Europe. It is a bottom-up initiative that is meant to be populated and run by RI and CF service providers at European, national, regional and institutional levels. CatRIS will be complementary to and interoperable with the EOSC (European Open Science Cloud) catalogue.

RI owners, managers and funders will be able to use the CatRIS portal as a marketplace to publicise RI services to a large community of users and policy makers, avoiding the drawbacks of generic search engines. The portal will also facilitate the search, exploration, comparison, getting recommendations, rating, reviewing and viewing statistics on RI services. Such possibilities are currently not available to for RI users, since the information on is spread and unstructured throughout the web, or available in fragmented, individual cataloguing initiatives. CatRIS will therefore optimise the accessibility of RI services to users and their promotion by RI owners and managers.

There is not yet much information available on project webpage, e.g. in outcomes and deliverables there is notion “coming soon”.

3.5. Inroad - Synchronising research infrastructure roadmapping in Europe

Project / initiative name and year(s):	Synchronising research infrastructure roadmapping in Europe, Inroad, 1.1.2017-31.12.2018
Organisation:	H2020, coordinated by Swiss National Science Foundation (SNSF)
Scope of mapping:	Seeking to contribute to a better harmonisation and synchronisation of priority-setting, funding and lifecycle management of RIs in Europe.
References and resources:	Project webpage: https://www.inroad.eu/

InRoad is a Horizon 2020 project going towards better synchronisation of priority settings and evaluation mechanisms for RIs beyond national relevance. The InRoad project seeks to contribute to a better harmonisation and synchronisation of priority-setting, funding and lifecycle management of RIs through the exchange of best practices among the main stakeholders of EU Member States (MS), Associated Countries (AC) and also at European level. Additionally, the regional dimension will be considered by integrating Smart Specialisation Strategies in the work conducted.

InRoad does not map the RIs, but mainly focuses on creating recommendations and good practices on roadmapping processes, business planning and funding framework of RIs.

3.5.1. Mapping, scope and target audience

InRoad is 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.

3.5.2. Eligibility criteria for inclusion

InRoad uses European Commission and ESFRI definitions of Research Infrastructure:

> *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).

3.5.3. General remarks

There are several sources of income to fund RIs. Namely European funding through European grants specifically designed for this topic, European Structural and Investment Funds (ESIF) and in particular the European Regional Development Funds (ERDF). Funding raised based on bilateral or multilateral agreements between MS that can be mobilized to different investment objectives, depending on the partnership agreement between the EC and a MS, industry raised or bilateral agreements, national budget and others. Regarding the availability of funds for investment on research infrastructures through ERDF, this is very different depending on the country and there are countries where there is no investment on RI. H2020 investments seems to be more targeted to the RIs that are highlighted by the European Strategic Forum on Research Infrastructure (ESFRI) roadmaps or are already ESFRI landmark, as a way of directing resources to the more emblematic and prominent RIs.

Due to the diversity of the funding instruments, it is difficult to compare investments in RIs across European countries, also because the funding and the involvement of the individual RI funding actors, including the industrial sector and others, changes in time (i.e. during the RI life-cycle). Some RIs are funded mainly externally, others are predominantly industry-funded, others have a complex mixture of incomes from national budgets and private investments, etc. The most common sources of public funding for RI identified by the responding countries are: the National Budgets, Horizon 2020 and Research Funding Organisations (RFO).

3.6. EULAC Focus - Giving focus to the Cultural, Scientific and Social Dimension of EU – CELAC relations

Project / initiative name and year(s):	EULAC Focus (Giving focus to the Cultural, Scientific and Social Dimension of EU – CELAC relations) 2016-2019
Organisation:	H2020 project led by UNIVERSITAT DE BARCELONA
Scope of mapping:	LAC countries RI mapping
References and resources:	Deliverable. D4.2: Research Infrastructures (RI): Analysis on the CELAC landscape of Research Infrastructures. Project webpage: http://eulac-focus.net/

EULAC Focus is a research project funded by the European Commission under H2020 for the period 2016-2019. The project was approached by the European Commission DG RTD with the request to support the bi-regional political dialogue on the topic of RIs by preparing a first overview on existing capacities of RI in LAC that are open for international collaboration. Thus, the Work Package (WP) leader of the scientific dimension, DLR, conducted two surveys in the LAC countries participating in this process in close collaboration with the co-leaders of the WG RI. These surveys provided the basis for developing a LAC regional approach. The information on RIs in LAC gained through the surveys was combined with the results of the activities of the WG RI and desk research conducted by DLR. The European side was covered by making use of the information provided by ESFRI.

The document reports on the national capacities of Research Infrastructures in LAC countries. It summarizes the current political dialogue between the EU and LAC and presents a selection of national and multinational RIs open or ready to be opened for international collaboration.

3.6.1. Mapping, scope and target audience

The aim of EULAC Focus is to promote the EU-LAC Strategic Partnership by reinvigorating and strengthening existing initiatives and proposing new and innovative areas of cooperation between both regions in the cultural, scientific and social dimensions.

3.6.2. Eligibility criteria for inclusion

In 2009, the Organisation of the Ibero-American States for Education, Science and Culture (Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura, OEI),

produced an inventory and an analysis of large scale scientific facilities ("Grandes instalaciones científicas en Iberoamérica") including astrophysical observatories, research vessels, as well as research bases in the Antarctic and in 15 countries in the LAC region.

The term "large scale facilities" is based on the following definition: "*unique or exceptional facilities whose investment and / or maintenance cost is relatively large in relation to (other) Research and Development (R&D) investments in the area where their activity is conducted, and whose importance and strategic nature in R&D justifies their accessibility to all the R&D community and society as a whole*". Following this definition, many of those large scale facilities listed in the report can be classified as RIs. Thus, this report is the first comprehensive compilation of LAC RIs and is an important reference document.

In the survey the RIs answer questions related to the type of RI: single sited, multi sited or virtual; funding sources of the RI (public and/or private; from a ministry or funding institution); services offered by the RI; life cycle of the RI; the thematic areas; special policies for transnational access existing or not; collaboration types of the RI (national, regional, international); types of user groups; user capacity; number of employees; cost structure.

In the 1st round of the survey, recipients were asked to identify three categories of RIs in their country:

- **Category 1:** National Research Infrastructures that are already open to other LAC country users; this category is targeting at RIs that offers access to national and international researchers, mostly focusing on the intraregional cooperation in LAC. The national representatives were asked to give a brief overview on the access conditions for other research teams.

- **Category 2:** Existing RIs that are ready to be open for possible institutional collaboration with other RIs in LAC countries; To identify RIs of regional interest, categories 2 and 3 addressed RIs that are considered of regional interest based on their planned or already existing institutional collaboration with other LAC or international facilities. Therefore, the recipients were asked to briefly describe the objectives of the envisaged collaboration.

- **Category 3**: RIs that already have in place an institutional collaboration with other RI in LAC countries; In line with category 2, this category also addresses RIs that have

established collaborations with LAC and other countries. The recipients were asked to briefly describe the existing partnership.

In the 2nd round of the survey, the objective was to receive more detailed information on the access conditions and policies and the already existing cooperation and to select only those that are or have the potential to be opened for the use of actors from other LAC countries.

The following criteria serve as basis for the selection of regional case studies:

- RI that has formulated access conditions and grant access to researchers from other LAC countries
- RI which has already institutional collaborations with RI from other LAC countries
- RI that offers a high added value to RI from other LAC and European countries
- RI from a thematic area that is of specific relevance for a number of LAC countries.

3.6.3. Methodology and scientific areas

The selection was based on two surveys among the national representatives of the Senior Officials Meeting working group on RI, which served as a starting point for the discussion on political collaboration by presenting suggestions for the future collaboration.

A two-step survey was conducted among all LAC representatives nominated for the WG RI with the objective to create an overview on the national RI landscapes. The survey was focused on RIs that are (planned to be) open for users from other countries or already have collaboration agreements.

The results of the two-step survey were complemented by data from previous inventories (e.g. OEI "Grandes Instalaciones Científicas en Iberoamérica" report 2009, RIS+ Net Survey 2013, RICH 2020 RIs Observatory results).

As important for RI in LAC countries, the areas of Health, Food, Energy and Climate change were identified. Nevertheless, RI from other areas could also be nominated in case there are of interest for promoting the collaboration.

Participants of the survey did not specify further the term Research Infrastructure, which lead to a broad variety of the results. To tackle this challenge, RIs were divided into new grouping categories for the analysis of the results. The following categories were applied for the RIs:

- Type (e.g. facilities, services and resources available for the scientific community)
- Location (e.g. single-sited, distributed or virtual)

- Scale – indicators for this categorization might be the construction and maintenance costs of the RI.

3.6.4. General remarks

In the frame of ESFRI, an analysis among the promoted projects has been undertaken by the European Commission to find out with which countries outside the EU collaborations are underway. With regards to LAC, the analysis showed that only Brazil and Mexico have institutionalized partnerships. But regarding other forms of collaboration, such as Memorandums of Understanding, working arrangements at research institute level or technical assistance, Argentina, Chile and Uruguay are already related to EU RIs (Strategy Report on Research Infrastructures. Roadmap 2018, ESFRI). To foster collaboration between Europe and other regions and countries, the ESFRI serves as a strategic incubator.

Most of the LAC countries consulted in the study have RIs at their disposal, however the countries often lack of a central systematic record of RIs and their access conditions. The availability of this information is crucial to establish interregional collaboration and facilitate the access for foreign researchers.

3.7. Mapping of Research Infrastructures in LAC countries

Project / initiative name and year(s):	Mapping of Research Infrastructures in LAC countries
Organisation:	EU-LAC Working Group on Research Infrastructures (WG RI)
Scope of mapping:	Research Infrastructures in LAC countries
References and resources:	https://celac.d2c2.gub.uy/en/home-page/

The context of the mapping is framed in the 6th Meeting of Senior Officials on Science and Technology (SOM) of the joint EU-LAC initiative on Research and Innovation (JIRI) held in March 2017, where the need to create a EU-LAC Working Group on Research Infrastructures (WG RI) was established. The group is co-lead by the Directorate of Research and Innovation of the European Union (DG-RTD) and Dr. Fernando Amestoy, Executive Director of the Scientific and Technological Park of Pando, Uruguay, nominated by the Presidency of the CELAC, and unanimously supported by member countries to represent them. The objective of the Working

Group is to align and harmonize the coordination of regional policies and share good practices in the development of policies and in the mapping of RIs, in order to make the most of the available infrastructures regionally and abroad.

3.7.1. Mapping, scope and target audience

The regional mapping of Research Infrastructures in LAC countries was developed by the Research Infrastructures Working Group under the joint EU-LAC initiative on Research and Innovation (JIRI).

3.7.2. Eligibility criteria for inclusion

The mapping adopted the following RI definition:

> *"Research infrastructures (RI) are diverse and may include: main scientific equipment, resources such as collections, archives or scientific data, e-infrastructures such as data and computer systems and communication networks. They can be single-location (a single resource in a single location), distributed (a network of distributed resources), or virtual (the service is provided electronically) but with access through a single point of entry. Examples of some well-known RIs can be CERN (a single location), Coordinated Atmospheric Networks (distributed)."* (Retrieved from the RI survey introduction text)

For setting the scope of the mapping, in addition to the adopted definition of RIs, it was agreed by the Working Group that RIs to be included in the mapping must provide a platform for conducting or facilitating excellent research that benefits the country where it is developed. Additionally, RIs must provide access, resources or related services where it is developed, for private or public entities. Finally yet importantly, RIs must have a certain degree of strategy, with national, international, or regional importance.

The mapping is presented as a Georeferenced Map of RIs (Figure 1) and it is publicly available in a digital format at: https://celac.d2c2.gub.uy/en/digital-map/. In the map, RIs can be searched by country or by scientific area.

Only RIs located in the 19 member countries of the EU-CELAC Working Group on Research Infrastructures were considered in this mapping. RIs developed as part of short-term focused projects without long-term sustainability are not included in this study. To be included in the

mapping RIs must fulfil three requirements: 1) be publicly owned infrastructures, 2) unique and 3) open to competitive access.

Figure 1. Digital Map by the Working Group on Research Infrastructures (WG RI).

3.7.3. Methodology and scientific areas

Scientific areas classified according to innovation sectors in which the RI activities could be applied:

- Biodiversity and climate change
- Energy
- Food safety
- Health
- ICT

3.8. Argentina

Project / initiative name and year(s):	Programa de los Sistemas Nacionales de Grandes Instrumentos, Facilidades y Bases de Datos (2008- on-going)
Organisation:	Ministerio de Ciencia, Tecnología e Innovación, Argentina
Scope of mapping:	Argentine national mapping of Research Infrastructures under the National Systems Program of Large Instruments, Facilities and Databases
References and resources:	INFORME SOBRE INFRAESTRUCTURAS DE INVESTIGACIÓN EN ARGENTINA, Año 1 – N°2

The National Systems of Large Instruments, Facilities and Databases emerged in 2008, as an initiative of the Ministry of Science, Technology and Innovation and the Inter-institutional Council of Science and Technology (CICyT), which brings together the highest authorities of Science and Technology (S&T) organisations of the country. The main objective of the Large Instruments, Facilities and Databases programme is to promote the efficient use of resources (large-scale equipment and facilities), better organization and access to scientific databases, existing in the different S&T organizations. To achieve this objective, it established a registry of existing equipment and services in the country, purchased with public funds and/or with assets in a public body of the Argentine National System of Science, Technology and Innovation.

3.8.1. Mapping, scope and target audience

The Argentine National Systems originate from the detection of needs, demands and / or deficits common to S&T organizations that require coordinated solutions in order to optimize efforts and resources around their research infrastructures.

For the mapping of national Research Infrastructures, the Argentine Ministry of Science, Technology and Innovation understands that Research infrastructures are diverse and heterogeneous, which may include core scientific equipment, resources such as collections, archives or scientific data, e-infrastructures such as data and computer systems and communication networks. They can be single-located (a single resource in a single location), distributed (a network of distributed resources), or virtual (the service is provided electronically) but with access through a single entry point. Until 2019, 1,217 equipment, facilities, databases and digital repositories are included in the mapping.

3.8.2. Eligibility criteria for inclusion

Due to the variety of types of RIs, the scope was limited to RIs located in the Argentine territory, which were registered to the National Systems of Large Instruments, Facilities and Databases. To register, it is necessary to provide information about the institution and infrastructure, equipment or data. Moreover, when registered, 20% of the available operating time of the infrastructure should be made available to the community. Concerning their type, RIs registered in the system were classified as belonging to the following groups:

biological data	bioterium	genomic data
microscopy	x-rays	digital repositories
mass spectrometry	High Performance Computing (HPC)	lasers
flow cytometry	magnetic resonance	magnetometry
sea data	advanced network	micro and nano manufacturing

3.8.3. Methodology and scientific areas

The National Systems Programme has the mapping of Argentine RIs as one of its core parts. Organizations and institutions participants had to reply to survey concerning their RI existing capacities, diagnosis of their operability conditions and access criteria to the services provided. Support efforts for the detection of the needs and demands of equipment and services of a strategic nature for scientific-technological development throughout the national territory. In addition to support in the development of common strategies for the acquisition and maintenance of equipment. Thus, organizations and institutions report annually to the National Systems Programme, the quantity and type of new RI acquired and their geographical location, specifying in which province, centre, campus (in case of universities) and/or department.

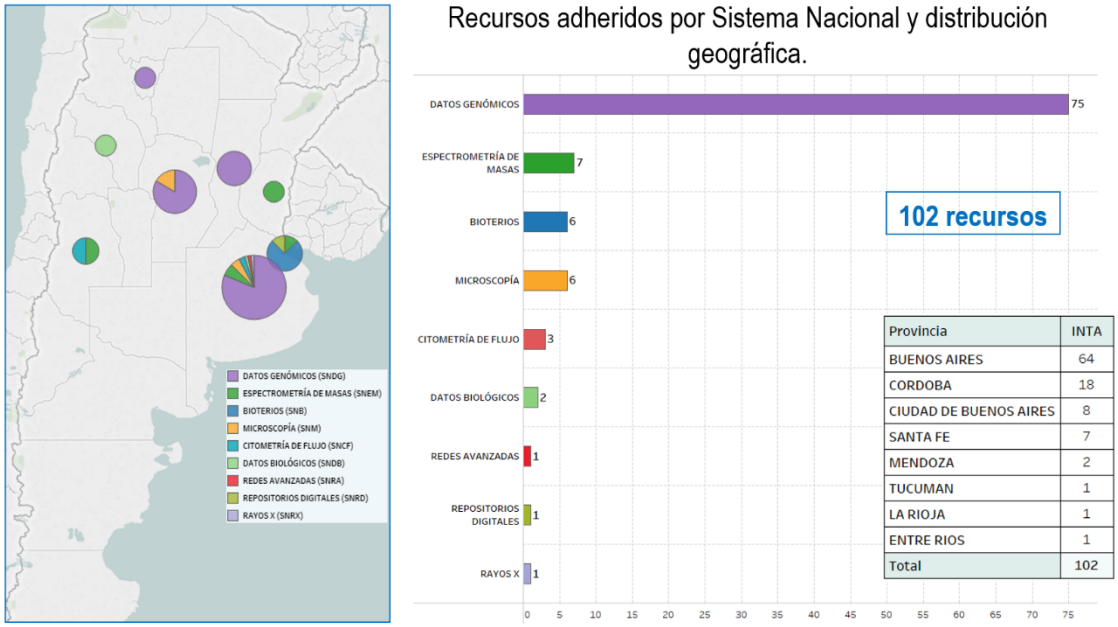

Figure 2. An example of Argentine RI mapping according to the geographical location and type: RIs registered in the National System by the National Agricultural Technology Institute (INTA).

Although RIs were grouped in this mapping according to their type, considering the participating institutions and university departments in which RIs are located, it could be Identified the following scientific areas according to innovation sectors in which the RI activities and services could be applied:

- Defence
- Health
- ICT
- Agriculture
- Energy
- Biodiversity

3.8.4. General remarks

Through the Large Instruments, Facilities and Databases Programme and its National Systems of Large Instruments, Facilities and Databases, the Argentine Ministry of Science, Technology and Innovation and the Inter-institutional Council of Science and Technology (CICyT) created an extensive mapping of national RIs. Through the individual consultation of relevant national organisations and institutions developing research in various scientific areas, it was possible to create individual mappings for each organization and institution after their registration to the

Programme. Thus, detailed information on the existence, conditions and availability of RIs could be made in an extensive manner, covering the entirety of the Argentine territory and various innovation hubs.

3.9. Brazil

Project / initiative name and year(s):	Sistemas Setoriais de Inovação e Infraestrutura de Pesquisa no Brasil, 2016
Organisation:	Institute of Applied Economic Research (IPEA), Brazil
Scope of mapping:	Brazilian national mapping of Research Infrastructures
References and resources:	De Negri, F., de Holanda Schmidt Squeff, F. (2016). O mapeamento da infrastrutura científica e tecnológica no Brasil. Sistemas Setoriais de Inovação e Infraestrutura de Pesquisa no Brasil. (pp. 15-62). Brasilia: ipea. https://www.ipea.gov.br/agencia/images/stories/PDFs/livros/livros/livro_sistema_setoriais_miolo_cap1.pdf

The first systematized study on the location, quantity and situation of the RIs in Brazil was published in 2016 in the form of a book entitled *"Sistemas Setoriais de Inovação e Infraestrutura de Pesquisa no Brasil"*, organised by the Brazilian Institute of Applied Economic Research (IPEA). The aim was to map the infrastructure of scientific and technological institutions, in order to monitor and manage data. Thus, enabling a better understanding of the functioning of innovation systems in Brazil and offer companies and the scientific-technological community access to information on the main laboratories and equipment available.

3.9.1. Mapping, scope and target audience

The Brazilian national mapping of Research Infrastructures adopted the MERIL project RI definition, which includes a broad spectrum of infrastructures varying from facilities to software and databases. The mapping was made by the by the Brazilian Institute of Applied Economic Research (IPEA), in partnership with the Ministry of Science, Technology and Innovation (MCTI), the National Council for Scientific and Technological Development (CNPq) and the Funding Authority for Studies and Projects (Finep).

3.9.2. Eligibility criteria for inclusion

Due to the variety of types of RIs and the pioneering nature of the study, the scope was limited to RIs located in the Brazilian territory, in public or private universities and research institutes, in the areas of engineering, health science, biology, mathematics, statistics, computer science, astronomy and aero-space, physical science, chemistry, geology, oceanography and agricultural science. Moreover, concerning their type, RIs included in the mapping were either a laboratory, monitoring station or network, research ship, floating laboratory, pilot plant or plant.

From the 2,119 RIs that replied to the web-survey questionnaire, only 1,760 were eligible to participate in the study according to the criteria for inclusion.

3.9.3. Methodology and scientific areas

The selection of RIs was based on desk-research and results of a web-survey questionnaire distributed to research directors/coordinators of universities and research institutions located in Brazil. In total, 4,857 RIs were invited to participated in the study, which were located in 185 universities and research institutions. From the 185 institutions invited, 130 effectively participated in the research (70%). Regarding the RIs themselves, 2,119 replied to the web-survey questionnaire (a bit over 40% of the total invited).

The questionnaire was organised in five modules:

- 1st module: general information about the RI (e.g. identification, name of the coordinator, description, research areas and type of RI);
- 2nd module: infrastructure performance (e.g. identification on the main area(s) of knowledge the RI could be utilised, in addition to sub-areas);
- 3rd module: identification of participants (e.g. what is the research team working in the facility, who are the researchers, technicians and students and what kind of work they perform in the RI);
- 4th module: detailed information on equipment and software of the RI, including their type, name, price of acquisition, license and current condition (e.g. only equipment which value was over R$100,000 were considered);
- 5th module: evaluation of the RIs current status (e.g. main developed activities, frequency of its usage for different activities, condition for external users access the existence of any policy regarding its access and procedures for usage, number of external users who utilized the RI in a specific year, types of cooperation and technical-scientific services provided by the infrastructure and current estimated value of the infrastructure).

Scientific areas and sub-areas were classified according to innovation sectors in which the RI activities could be applied:

- Defence
- Health
- Oil and gas
- ICT
- Aeronautics
- Agriculture
- Renewable energy
- Construction

3.9.4. General remarks

The total number of researchers working in the RIs included in the study is 7,090. Which demonstrated a characteristic of the RI scenario in Brazil, the limited size of laboratories. On average, only four researchers were working in a laboratory. Over 88% of these researchers have postgraduate degrees (master's degrees or doctorates), and 72% are doctors.

One of the main objectives of the study was to analyse the relation between RIs and the industry, and how RIs are integrated in the technological development. Thus, one of the questions of the questionnaire was dedicated to investigating if the RI provided technological services to companies, government, other institutions, or researchers. A total of 69% of the participating RIs confirmed to provide services for at least one of the actors mentioned in the question. The percentage drops to 43% when focusing exclusive on services provided to companies.

The study found that the majority of RIs' external users are from Brazil. The RIs are open mostly for post-graduation students (970), researchers from the same institution (957) and researchers from other institutions (814).

The idea of this study was mapping the infrastructure of scientific and technological institutions (ICTs), to monitor and manage data. Thus, making it possible to understand better the functioning of the innovation system in Brazil and to offer companies and the scientific-technological community access to information on the main laboratories and equipment. In

addition to inform governmental bodies on the challenges to improve the competitiveness of the Brazilian science and innovation ecosystem.

Participants of the questionnaire had to answer questions regarding the funding of RIs. The most frequently mentioned funding source was CNPq, state level governmental foundations to support science and research (i.e. known in Brazil as FAPs), funding from the intuitions where the RIs are linked and Capes. Other funding sources relevant in the RIs scenario in Brazil are the Petrobras (Brazilian Petroleum Coorporation) and Finep.

3.10. National mappings

3.10.1. Europe

The European Commission and ESFRI encourage Member States and Associated Countries to develop national roadmaps for Research Infrastructures. Most of the countries have their own RI roadmap, which they also have updated regularly. Some countries have their roadmap in a preparatory phase. The countries that do not have national RI roadmap are Iceland, Latvia, Luxembourg, Malta and Slovak Republic (https://www.esfri.eu/national-roadmaps). The aim of the national roadmaps is to implement national research strategies, identify the research infrastructures and their potential impact for the country as well as creating future policy and vision for RIs.

The InRoad project aiming towards better synchronisation of priority settings and evaluation mechanisms for Research Infrastructures beyond national relevance, 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.

3.10.2. LAC countries

In the LAC countries, studies have been developed to access the number and capacity of existing research centres and scientific grouping has been made to categorize research centres according to the main scientific domains and national R&D priorities. However, the concept of Research Infrastructure mapping is relatively new for most the countries' innovation system.

In 2019, the Ministry of Foreign Affairs from Panama together with the National Secretariat of Science, Technology and Innovation released guidelines for the country diplomatic strategy on science, technology and innovation (Government of Panama, 2019). One of the main objectives established was to promote Panama's scientific cooperation and talent recruitment. Among the suggested actions in the strategy to achieve this objective, is the mapping of scientific and technological centers and facilities.

Examples of actions can be found in other LAC countries. In Chile, although no unique mapping of national RIs has been made, through its national agency ANID, the Chilean government has four funding programs to provide funds for Research Infrastructures in various scientific fields across the country. The funds are: FONDAP, Iniciativa Milenio, PIA and Regional. Each funding programme has their own webpage, in which RIs and related institutions beneficiaries of the fund are listed. Moreover, ANID Chile developed in 2012 a catalogue listing RIs funded by the agency, including those under construction. In the catalogue, detailed description of the scientific areas covered by the RI and examples of researches and innovation developed can be found. In 2018, a similar catalogue was made by CONACyT Mexico, listing the country national RIs which are benefited by the agency funds. The catalogue contains has 26 public research centres and 76 national laboratories).

ANID Chile has developed an online platform open for the public, in which a total of 309 medium scale equipments (e.g. valued between 100.000 euros up to 500.000 euros) are registered. Users can search equipements in the platform through keywords, navigate through a digital map or filter the list of equipments by type, insitituion and location. In 2016, the Ecuadorian Government, through its Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT), released an online interactive platform containing a list of scientific equipments and other Ris across Ecuador, along with the name of resposible instituitions and contact information. The platform known as "Geoportal de Investigación Científica", also

cointain information on on-going research projects financed by SENESCYT and acredited researchers working in various Ecuadorian research institutions.

Furthermore, a similar initiative is currently been developed by CONACyT Mexico. It consists of a website to make publicly available a list of national RIs, their geographical location, services provided, their use policy and the contact person or team responsible. Until now, more than 3,600 equipment distributed in 100 institutions across the country have been registered.

Although no actual mapping of RIs has been made in Colombia, other initiatives have been made by the Ministry of Science, Technology and Innovation (Minciencias), in order to gather knowledge about national resources, facilities and services for research innovation. For instance, in 2006 an inventory of robust equipment was carried out by the Asociación Colombiana de Facultades de Ciencias (ACOFACIEN), which included 246 research groups in 45 universities, and 660 robust equipment was identified. In 2011, the Colombian Science, Technology and Innovation Systems Observatory carried out an exercise to apply a model to characterize Autonomous Research and Technological Development Centers. In Colombia, MinCiencias has the information of the research and technological development centers in a systematized and updated way, with a record of scientific areas, headquarters, research groups, human resources, products, financing, associated projects, articulation with actors and teams.

Considering the LAC countries participating in the EU-LAC ResInfra project consortium, Argentina and Brazil were the only countries, which have made a systematized national mapping on the location, quantity and situation of the national RIs. Under the umbrella of the Large Instruments, Facilities and Databases Programme that started in 2008, the Argentine national mapping is thoroughly and extensive considering the limitation of its scope. Although, only RIs under the responsibility of participant institutions are registered and included in the national mapping, the approach of focusing and mapping RIs of each institution in a micro-scale and thus producing a national mapping, resulted in a highly descriptive and geographically representative mapping.

In Brazil, the first systematized study on national RIs was published in 2016. This first initiative for producing a national mapping of Research Infrastructures had some limitations in its scope, since it focused only on specific types of RIs (laboratory, monitoring station or network, research ship, floating laboratory, pilot plant or plant). However, with the inclusion of both private and public RIs, 4,857 RIs were identified, which were in accordance to the mapping

criteria. Moreover, this was the only national mapping with a publicly available detailed description of its methodology.

As initially reported by the EULAC FOCUS project (v. Knebel & Romano, 2019), during the preparation of this Deliverable, it was confirmed the majority of LAC countries have RIs at their disposal, but often lack any central systematic record of their existence, geographical distribution, access conditions, services provided or structural condition. The organization and accessibility of this kind of information is key to boost international collaboration and opening LAC RIs to foreign researchers.

4. Gap analysis and recommendations

4.1. Inclusion criteria

Based on the reviewed mappings, a list of inclusion criteria could be identified that was practically agreed on in all the mappings. These top-priority inclusion criteria to be used in further mapping exercises include:

- The foundational starting point: The RI complies with the well-established definition of a RI as laid out in Article 2 (6) of Regulation (EU) No 1291/2013 (2013) that has been adopted by most RI mapping projects, including ESFRI. (See the definition in Chapter 2.)
- In alignment with the above definition, the RI may consist of, for example, scientific equipment or instruments, knowledge-based resources, e-infrastructures.
- In alignment with the above definition, the RI may be single-sited, distributed or virtual e-infrastructure.
- The RI functions under an ambitious scientific agenda to perform unique, high-level research of international importance in its field (scientific as well as societal importance).
- The RI operations go beyond its organisational boundaries, i.e. there is a user programme and (transnational) access and data policies to facilitate user access to researchers from other organisations and countries. (These necessitate publicly available information on access rules and contact points as well as transparent selection processes based on a solid scientific foundation.)

In addition, various additional criteria of secondary or tentative importance were identified. The existing mappings had different approaches regarding the issues raised in this list, and the standing of future RI mappings for the LAC countries needs to be further elaborated and enriched with detailed measuring values so that the unique objectives and scope are met. The secondary, tentative inclusion criteria include:

- The operational time horizon, as well as the funding of the RI should be long span (i.e. well beyond the length of a typical research project in the field). The RI also needs to be in a condition of operation, or it should be reported what the level of maturity is or if it is under construction or phased out.
- The importance of the RI (scientific excellence as well as supporting public interests) should (possibly) be manifested by the RI having received public funding on national, regional or international level(s).
- Both publicly and privately owned RI could be included in the mapping, assuming that certain level of openness is apparent according to the top-priority inclusion criteria.
- RIs should be “large-scale” (not only in terms of physical size and scientific importance), i.e. their investment or maintenance costs are large.

4.2. Scientific areas for groupings

Table 2 shows the scientific areas used for grouping the RI under the major RI mappings reviewed. In general, these groupings share many categories, even if small differences exist in their names. There are also categories that only appear in one or few mappings, such as defence, which could reflect the specialisation under a nation or region or the underlying priorities of the mapping exercise. Another type of difference between the mappings is that oftentimes what is categorised as one group in one mapping may be categorised as several groups in another mapping. In such a case, the RIs in the former should be ungrouped to allow grouping according to the latter mapping. Nevertheless, for many individual RIs, it would be fairly easy to find the corresponding categories within different mappings.

Table 2. Scientific groupings in different RI mappings.

ESFRI	MERIL	RISCAPE	EULAC Focus	WG RI	Brazil
• Energy • Environment • Health & Food • Physical Sciences & Engineering • Social & cultural innovation • Data, computing and digital RIs	• Biological & medical sciences • Chemistry & material sciences • Earth & environmental sciences • Engineering & energy • Humanities & arts • Information science & technology • Physics, astronomy, astrophysics and mathematics • Social sciences *Additionally ESFRI groups*	• Environmental RIs • Health and food RIs • Physical science RIs • Energy RIs • Astronomy and astro-particle RIs • Social sciences RIs • Cultural heritage, digital humanities and language RIs • e-Infrastructures	• (Health) • (Food) • (Energy) • (Climate change) • (Other) *Grouping not in full use*	• Biodiversity and climate change • Energy • Food safety • Health • ICT	• Defence • Health • Oil and gas • ICT • Aeronautics • Agriculture • Renewable energy • Construction

To improve scientific groupings for better compatibility, especially regarding new mappings and updates, it would be good to seek alignment between mappings and make use of existing categories. Based on the reviewed mappings, we recommend the following categories and possible combinations (the most important top-level categories are marked in bold, and categories of cross-cutting nature are marked in italics):

- **Energy**
- **Health** (or life sciences; including biological and medical sciences)
- Food (can be together with Health)
- Agriculture (can be together with Food)
- **Environment** (including Ocean)
- Climate change (can be together with Environment)

- **ICT** (including *data*, computing and *e-infrastructures*)
- **Physical sciences** (including physics, chemistry, astronomy and possibly *engineering*)
- **Social sciences** (including culture, humanities and arts).

4.3. Mapping process recommendations

This section provides suggestions and recommendations on how to develop further RI mappings. Most importantly, these recommendations serve the further RI analysis within the EU-LAC ResInfra project and provide information to the EU-CELAC SOM WG RI and thus contribute to bi-regional collaboration. Additionally, the recommendations can also be taken on board, to large extent, to develop national RI mappings by various countries. Several LAC countries have already started mapping their RIs, but as described in Chapter 3 systematic records as well as methods how to collect and maintain data are largely still needed. Lessons learnt and good practices benefit all levels, and certain degree of harmonisation across national and regional levels could be the way in the LAC countries as well as in Europe.

The key gaps that were identified during the review are the following:

- Many LAC countries have not yet started a systematic national mapping of their RIs, although several examples do exist; national mapping is nevertheless a precondition that supports further collaboration.
- RI mappings on national, LAC, EU and global levels vary a lot in terms of mapping methodologies such as inclusion criteria, scientific groupings, eligibility checking and scope.
- Full transparency was not achieved in all mappings, as methodologies, ownership of the mapping initiative or involvement (or non-involvement) of stakeholders was not always clearly communicated. For example, good practices such as recruitment of impartial experts for reviewing, assessing and evaluating RIs (i.e. mapping not relying solely on surveys and self-reporting) or open invitation and inclusion of various RI owners into the mapping was not always followed.
- Many mapping efforts were realised as projects, which can compromise the continuity of the mapping process; long-term plans on how to maintain and update the mapping were often missing or not communicated.

In the following, some recommendations on how the generalised steps of a RI mapping could look like are provided:

1. Clear and transparent methodology for the mappings: mapping process, inclusion and eligibility criteria, scientific scope and groupings, long-term plan, recruitment of expertise and resources, etc. [e.g. a methodology report and guide].
2. Invitation for proposals to include new RIs into the mapping (e.g. self-registering of RIs by RI owners using an online form).
3. Review and evaluation of submitted RI proposals: inclusion criteria, etc. (e.g. review panel of impartial scientific experts).
4. Catalogue of RIs published and kept up-to-date (e.g. a report, an online database and/or a digital map of RIs accepted to the mapping).
5. Periodic updates of RIs: mapping new entries and re-evaluating old entries (e.g. every other year, steps 2-4 repeated to attract new entries and modified steps 2-4 repeated with old entries so that information is up-to-date and outdated RIs exit the map).

References

CatRIS Catalogue of Research Infrastructure Services (2019). Retrieved from: https://project.catris.eu/

CONYCIT (2012). Centros de Investigacíon CONICYT. Retrived from: https://www.conicyt.cl/fondap/files/2012/08/CENTROS_final_.pdf

De Negri, F., de Holanda Schmidt Squeff, F. (2016). O mapeamento da infrastrutura científica e tecnológica no Brasil. Sistemas Setoriais de Inovação e Infraestrutura de Pesquisa no Brasil. (pp. 15-62). Brasilia: ipea.

ESFRI (2018). Strategy Report on Research Infrastructures Roadmap 2018. Retrieved from: http://roadmap2018.esfri.eu/media/1066/esfri-roadmap-2018.pdf

ESFRI (2020). National Roadmaps. Retrieved from: https://www.esfri.eu/national-roadmaps

ESFRI (2020). Strategy Report on Research Infrastructures Roadmap 2021: Public Guide. Retrieved from: https://www.esfri.eu/sites/default/files/ESFRI_Roadmap2021_Public_Guide_Public.pdf

ESFRI Roadmap 2018. (2018) Retrieved from: http://roadmap2018.esfri.eu

EULAC FOCUS: Giving focus to the Cultural, Scientific and Social Dimension of EU - CELAC relations: (2020) Retrieved from: http://eulac-focus.net/

Government of Panama (2019). Lineamientos de la estrategia de diplomacia científica, tecnológica y de innovacíon. Retrived from: https://mire.gob.pa/images/PDF/Lineamientos%20de%20la%20Estrategia%20de%20Diplomacia%20Cientifica%20-%20Rev%2031%20de%20mayo%20de%202019.pdf

Inroad - Synchronising research infrastructure roadmapping in Europe. (2017) Retrieved from: https://www.inroad.eu/

Mapping of Research Infrastructures in CELAC countries. (2019) Retrieved from: https://celac.d2c2.gub.uy/en/home-page/

MERIL – Mapping of the European Research Infrastructure Landscape. (2015) Retrieved from: https://portal.meril.eu/meril

Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC, Article 2 (6).

RISCAPE European Research Infrastructures in the International Landscape (2020). Retrieved from: https://riscape.eu/

RISCAPE European Research Infrastructures in the International Landscape (2020). RISCAPE report: International Research Infrastructure Landscape 2019. Retrieved from: https://riscape.eu/riscape-report/

v. Knebel, S., Romano, C. (2019). Research Infrastructures (RI): Analysis on the CELAC landscape of Research Infrastructures. Deliverable. D4.2. Project: EULAC FOCUS: Giving focus to the Cultural, Scientific and Social Dimension of EU - CELAC relations.

ResInfra
EU-LAC