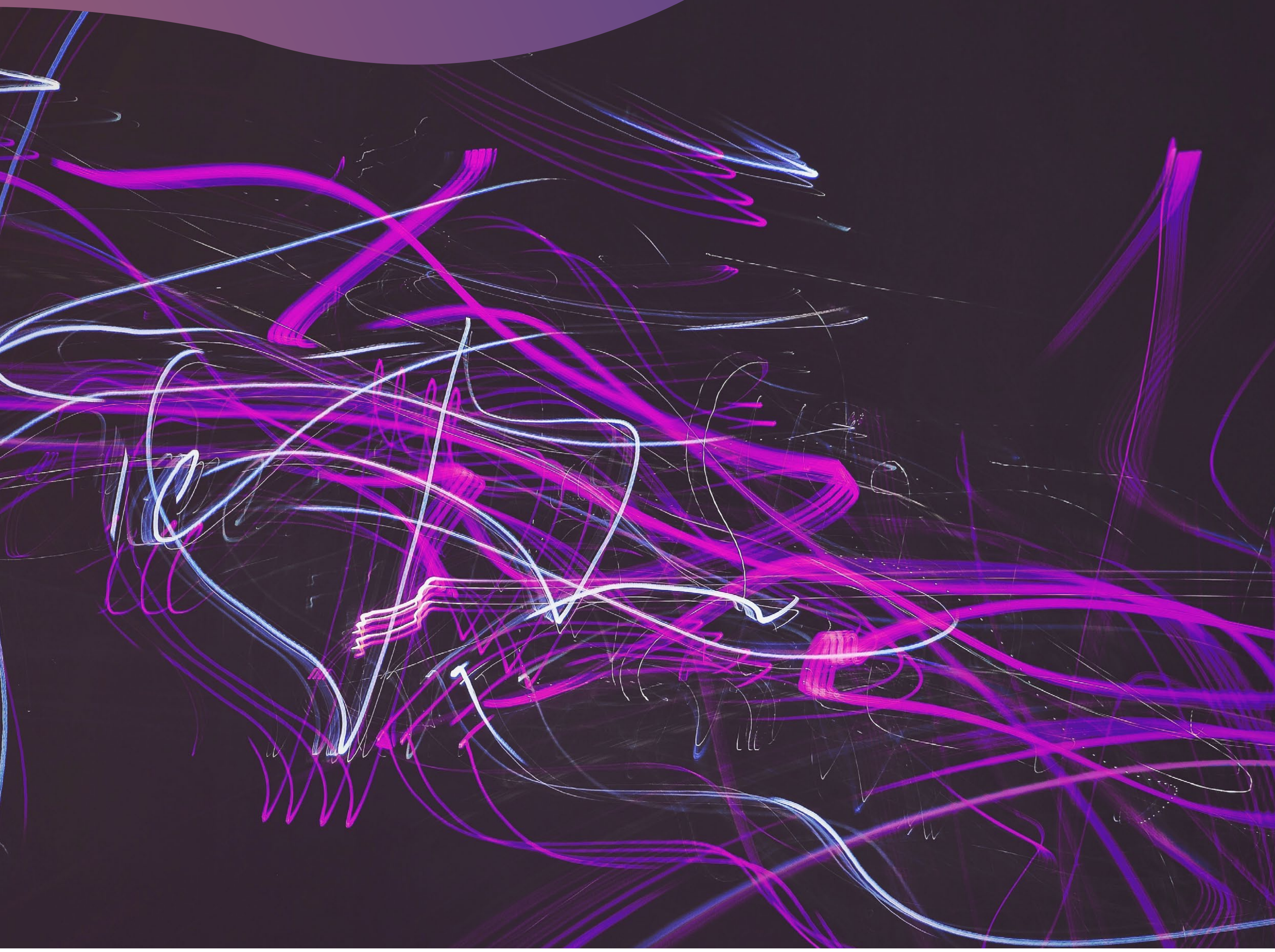
GUIDEBOOK
FOR SOCIO-ECONOMIC IMPACT ASSESSMENT OF RESEARCH INFRASTRUCTURES



RI PATHS
Research Infrastructure imPact Assessment paTHwayS

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Credit

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1. About this Guidebook

Socio-economic impact assessment of Research Infrastructures (RIs) is a fast-growing field. It generates a lot of interest. But it also poses many questions, thus making it a complex topic. We have developed this Guidebook to take you on a journey of socio-economic impact assessment (IA) of Research Infrastructures. We introduce you to the language of impact assessment, give you a glimpse into the topic, present useful examples and help you make important strategic choices.

Who should use this Guidebook?

Why was this Guidebook produced?

What does it include?

Who should use this Guidebook?

- Are you an operations manager, a member of the board or a communication expert at a Research Infrastructure and often having to report on your organisations' socio-economic impact?
- Are you a policy maker deciding on which Research Infrastructures to fund given budget constraints within public funding? Are you wondering what is the whole picture of all possible benefits that investing in Research Infrastructures brings?
- Are you a professional working in the field of impact assessment and/or research and innovation policy and want to develop your knowledge on the topic of socio-economic impact assessment of Research Infrastructures?

Regardless of where you work, if you are interested in the variety of benefits that Research Infrastructures bring to society and the economy this Guidebook is for you.

Why was this Guidebook produced?

Given the large amounts of public money spent on research facilities, there is growing interest in how this investment benefits and effects society and the economy. However, there is no common framework or unified methodology to scope out and measure the socio-economic impact of Research Infrastructures. More and more commonly, policy makers and experts ask:

How can we assess the critical contributions of Research Infrastructures to society and the economy beyond the advancement of science?

Our project **R**esearch **I**nfrastructure im**P**act **A**ssessment pa**TH**ways (RI-PATHS) has been addressing this gap. Funded by the EU Framework Programme for Research and Innovation programme, Horizon 2020, we set out to develop a framework describing the pathways of and towards the socio-economic impacts of Research Infrastructures. We wanted to develop it in a way that could be adapted to a broad range of scientific domains and types of Research Infrastructures. This framework is an outcome of collaborative co-design work carried out together with a wide range of Research Infrastructures, their funders and policy makers. We see the RI-PATHS framework as a first mapping of the complex underlying processes showing how Research Infrastructures bring benefits to society and the economy. It is a work in progress, and we hope all your practical experience in the future will help to shape and further improve our common understanding of this topic.

We would love to hear your thoughts on this Guidebook. E-mail us at contact@ri-paths.eu

What does this Guidebook provide?

- It is a **Guide**: This Guidebook helps you get your bearings in the complex world of socio-economic impact assessments, and how they are applied to Research Infrastructures. It outlines the main impact assessment principles and introduces key concepts. Read this Guidebook as a narrative of the logic you can follow for addressing your IA needs.
- It is a **Flexible Tool**: It helps you to define, scope out, and choose your impact assessment strategy. You do not have to follow all instructions meticulously but let the ideas and proposed approaches inspire your own strategies tailored to your Research Infrastructure's needs and mission. The Guidebook is accompanied by an online toolkit, where you can access further information in an interactive manner.
- It is a **Glossary**: This Guidebook goes to great lengths to avoid jargon so that everything is simple, clear and easy to follow for all types of users. A Glossary of terms is enclosed to help you speak the same language and shape a more common understanding among Research Infrastructure managers, funders, policy makers and evaluation professionals.
- It is a **Helpdesk**: Better understanding how to think about impact is your first step toward measuring it. You should not shy away from requesting specialist help, but everyone should be able to master the basic logic of impact pathways. To deepen your understanding, read the examples, tips and good practices in this Guidebook. Where relevant, check the links for further information.
- It supports **Team Work**: Defining the impact areas and constructing key impact pathways for your Research Infrastructure is a team effort. Engaging your staff and the main stakeholders in a co-creative process helps to achieve internal ownership of and support for your impact (assessment) strategy.

Online toolkit Home page

2. Socio-economic impact of research infrastructures

2.1 Key notions and concepts

"Research Infrastructures are facilities that provide resources and services for research communities to conduct research and foster innovation. They can be used beyond research e.g. for education or public services and they may be single-sited, distributed, or virtual."

What is a 'Research Infrastructure'?

What is 'an impact'?

What is 'an impact pathway'?

Research Infrastructures include:

- Major equipment or group(s) of instruments used for research purposes
- Permanently attached instruments, managed by the facility operator for the benefit of researchers, industrial partners and society in general
- Knowledge-based resources such as collections, archives, structured information or systems related to data management, used in scientific research
- Enabling information and communication technology-based (ICT) or 'e-infrastructures' such as grid, computing, and software communications
- Other entities of a unique nature that are used for scientific research.

European Commission's definition

While Research Infrastructures are designed for research needs, the impact of these facilities reaches far beyond science. The funders and governing bodies of Research Infrastructures and various players in the wider economy and society have become more and more interested in these wider impacts.

But what is ‘an impact’?

“Impact is the extent to which the intervention has generated or is expected to generate positive or negative, intended or unintended, higher-level effects.”

OECD definition

“The term impact describes all the changes which are expected to happen due to the implementation and application of a given policy option/intervention [such as investment in a Research Infrastructure and its activities]. Such impacts may occur over different timescales, affect different actors and be relevant at different scales (local, regional, national and EU).”

European Commission’s definition

What this means in simple terms is that the activities carried out at your Research Infrastructure will lead to effects relevant to its different users, a wider community of stakeholders, economy and society at large. Whether you plan for it or not, all activities will generate an impact; if not in the short term (say, in one or two years) then at a later stage.

How can we understand what impacts a Research Infrastructure generates or will generate?

To help you navigate this complex topic, the RI-PATHS team suggests using an **‘impact pathways’** approach. Its logic is simple but not simplistic.

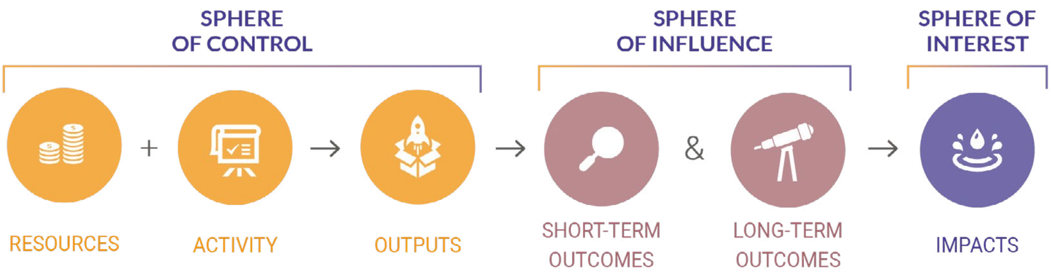
The resources you invest or use allow for (or prompt) an activity to happen. This activity generates some direct results (so-called outputs) that can lead to certain short- or long-term effects (so-called outcomes). Finally, certain impacts emerge.

Figure 1: Example of an impact pathway from communication and public outreach activities

Source: RI-PATHS project

Some of these elements fall under the control of Research Infrastructure managers who implement and steer various activities. On others – although outside their direct control – Research Infrastructures still have indirect influence. When it comes to the final stage – impacts – these are neither under the direct control nor influence of Research Infrastructures. Yet impacts are, no doubt, of high interest to funders, policy makers and hence RI managers as well.

Figure 2: Impact pathway logic



Source: RI-PATHS project

+ **Sphere of control** covers everything that the Research Infrastructure's team can control and for which it is fully responsible. It includes activities and the direct outputs from these activities.

+ **Sphere of influence** covers effects outside the direct control of the Research Infrastructure's team which depend on how RI users or stakeholders react to the results produced. However, they remain at arm's length as the Research Infrastructure interacts directly with the user and stakeholder groups in question and can seek to influence their behaviour.

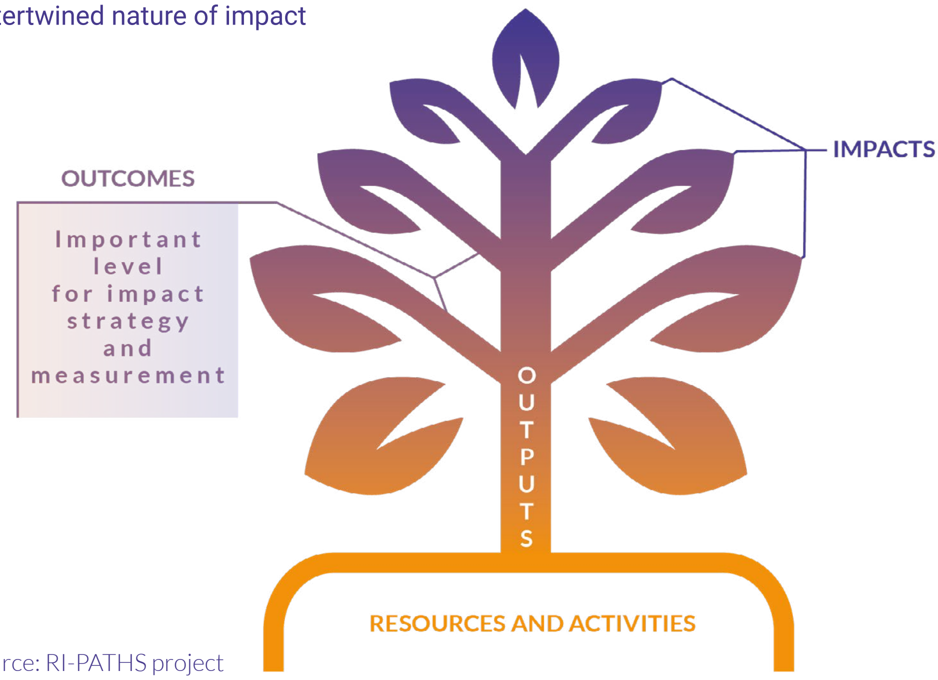
+ **Sphere of interest** covers the lasting impacts and structural changes manifesting in the economy and society. Socio-economic impacts are highly context-driven and hence outside the direct control of the Research Infrastructure, yet this sphere is exactly the main focus of an impact assessment.

In reality, impact pathways are not linear. They should be imagined as a web of causes and effects that grow over time. A parallel can be drawn with a tree that has solid roots (resources and activities) which help to grow a trunk (outputs) with many stronger and weaker, longer and shorter branches (outcomes). Branches are decorated with leaves and blossoms (impacts) giving us the complete picture of a tree.

Impact pathways: a web of causes and effects that grow over time (...)

There is no one-to-one relationship between activities and various impacts. Activities can lead to many types of impacts. They intertwine, accumulate over time and are highly dependent also on external circumstances and context, just as foliage is dependent on the season and the prevailing weather. There can be no tree without a trunk and no impact without the necessary contribution of pertinent outputs and outcomes. That said, we draw your attention to the fact that before talking about impact, we need to consider outputs and outcomes as the main level that Research Infrastructure managers can directly affect by their strategic decisions.

Figure 3: Intertwined nature of impact



Source: RI-PATHS project

2.2 Areas of socio-economic impact

Research Infrastructures generate a wide variety of socio-economic impacts. Some of these impacts are already well articulated and measured; others have received less attention up to now, both in terms of their definition and indicators for measurement them.

Through a series of dedicated participatory workshops, the RI-PATHS project engaged a broad range of Research Infrastructures in a co-creative exercise to identify their most important socio-economic impact areas. The aim of this iterative activity was to compose a shared understanding and more common terms for talking about the socio-economic impacts of Research Infrastructures.

What types of socio-economic impacts are there?

We concluded that all socio-economic impacts can be grouped under four major impact areas:

1. Impact on human resources
2. Impact on economy and innovation
3. Impact on society
4. Impact on policy

Scientific impacts deliberately do not appear on this list as the focus of the RI-PATHS project has been on the socio-economic angle of all benefits. Science is considered as being part of all four major categories as it underpins human resources, economy and innovation, as well as societal and policy developments, which means its impacts are embedded.

Figure 4 outlines the most common socio-economic impacts under each of these categories. This list of impact areas is not intended to be exhaustive but rather provide guidance for and inspiration from the identified benefits that Research Infrastructures bring to the economy and society. Please note that some of the listed impact areas are closely connected or may be dependent on each other.

More detailed examples of each impact area can be explored in the online toolkit. If you find other relevant angles of impacts missing, do not hesitate to leave your comments in the feedback section.

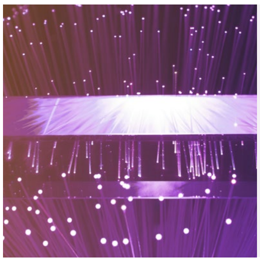
Online toolkit
Impact areas

Figure 4 : Areas of socio-economic impacts of Research Infrastructures

Impact on Human Resources

+ Research jobs and career development
+ Skills development for non-scientific staff and users
+ Relationship capital and international collaboration
+ Better working conditions
+ Wider effects of concentrating new competences

Impact on Economy and Innovation



+ Business and industry
+ Labour market and productivity
+ Technology transfer and innovation
+ Impact on local and regional economy

Impact on Society

+ New solutions, technologies, open access data and software for societal use
+ Knowledge benefits for society in different domains
+ Public awareness and engagement
+ Cultural impact
+ Social inclusion
+ Environmental impact

Impact on Policy

+ Policy, regulations and standards
+ Science diplomacy
+ Co-funding and sustainability
+ Ethics and trust in science

Source: RI-PATHS project

2.3 Impacts of different types of Research Infrastructures

The RI-PATHS project team also investigated if there are certain characteristics of Research Infrastructures that are pertinent to specific socio-economic effects. We concluded that the vast majority of impact pathways are relevant for all types of Research Infrastructures, yet the degree of emphasis may differ.

Background work on this topic can be accessed here

What do we need to keep in mind about differences between Research Infrastructures?

We make three important distinctions in the wealth of the existing Research Infrastructure typologies that bear relevance to socio-economic impact:

1. **The distinction between physical and virtual Research Infrastructures**

Physical Research Infrastructures have more notable impacts on regional economies through improved job opportunities and increased economic activity in a specific location, including as an incentive to tourism.

Virtual Research Infrastructures are predominately oriented towards providing data-related services. The type of data access (e.g. open or restricted) determines to a great extent the abilities to trace the impacts that stem from the data use. Efficiency gains are among the biggest benefits that virtual Research Infrastructures generate.

2. **The difference between single-sited and distributed Research Infrastructures**

The distinction between single-sited and distributed Research Infrastructures lies in the scale of analysis, geographical coverage and context (diverse locations and nodes). In contrast to single-sited facilities, distributed Research Infrastructures operate across different national and regional contexts. Nodes may collect the monitoring data for the same socio-economic benefits in slightly different ways due to the divergence in interpretation. Diverse experiences in various contexts of the distributed facilities also enable significant learning opportunities across the nodes if Research Infrastructures promote the formation of strong scientific communities, as well as the creation of user networks.

3. **The difference between Research Infrastructures in social sciences, humanities and arts, and in natural sciences and engineering**

While all Research Infrastructures could potentially have different socio-economic benefits, it is evident that facilities supporting social sciences, humanities and arts have a stronger relative focus on direct contributions to policy making. These Research Infrastructures are also more likely to have more nuanced benefits in such areas as culture and social inclusion.

For distributed data infrastructures in social sciences, humanities and arts there are also less obvious benefits following from the construction and operation of the facilities than from traditional large-scale facilities in the natural sciences.

3. RI-PATHS Impact Assessment Toolkit

3.1 Exploring RI-PATHS Impact Assessment Toolkit

Online toolkit Home page

All key information that feeds the RI-PATHS framework is presented in an online Impact Assessment Toolkit. The interactive nature of the Toolkit helps users to navigate through the information and find material most relevant to their specific needs. This web-based function is built in an open-source environment allowing for modifications and additions of new information in the future.

To continue the dialogue and productive co-creation of shared meanings, we kindly invite you to use the in-built feedback functions.

The Toolkit can be explored in various ways. In a bottom-up approach, users can navigate through the sections and tailor the display to their interests and needs. The Impact Pathway page is the best place to begin your journey. For Research Infrastructure managers with little previous experience in scoping socio-economic benefits we suggest you 'Get Started' by answering some guiding questions, which will point towards the most relevant impact pathways for your specific case.

Research Infrastructure managers will in most cases want to select a combination of what they need to demonstrate (e.g. 'Impact on Society') and related activities worth further consideration or intensification (e.g. 'Outreach'). Policy makers may well be content with the selection of a single impact area seeking to – as a first step – identify all related pathways. It is not obligatory to answer all initial questions and look through all impact pathways; users may choose to focus their attention on specific components.

The RI-PATHS Toolkit comprises:

+ **Descriptions of 13 generic impact pathways** on how Research Infrastructure activities lead to various socio-economic impacts. All pathways are grouped into three major categories according to the high-level functions of Research Infrastructures.
+ **Lists of the most frequently used indicators** to track activities, outcomes and impacts along each pathway. The user can choose either to see only the 'most relevant' indicators (10-20 per pathway) or to browse all 'potentially relevant' indicators. Thus, it accommodates the needs of users with different levels of prior knowledge and expertise. All lists of indicators can be downloaded in Excel format for more convenient use and modifications offline.
+ **'Get started' section with six guiding questions** helping users to prioritise the most important impact pathways applicable to their Research Infrastructure. Upon selecting the priorities in the guiding questions, all relevant impact pathways are activated for further exploration. Pathways are colour-coded according to the three high-level functions of Research Infrastructures.
+ **Examples of suitable monitoring and reporting tools/methodologies** that can be applied for impact measurement. The Toolkit does not provide a 'recipe' for connecting indicators to specific methodologies. Likewise, it does not provide a timeline for the duration of specific analysis. Nonetheless, it gives a basic overview that clearly distinguishes between indicators for which information can be collected swiftly and those that involve more complex analysis that may require additional resources and skills to carry out.

- **Option to browse, search and retrieve all frequently used indicators.** This function provides users with the opportunity to search for specific indicators, for example, to see which pathways and areas of impact they have become associated with in the RI-PATHS framework or whether they have been classified as 'activity', 'outcome' or 'impact' indicators.
- **Glossary of terms/definitions** to support user learning and promote the use of more shared language across the community of interested stakeholders.

3.2 Constructing impact pathways

Here, we present the descriptions of the most frequent high-level impact pathways that depict how Research Infrastructure activities lead to various impacts on society and the economy. We also include guidance on how this information can be used by RIs to construct impact pathways tailored to their specificities.

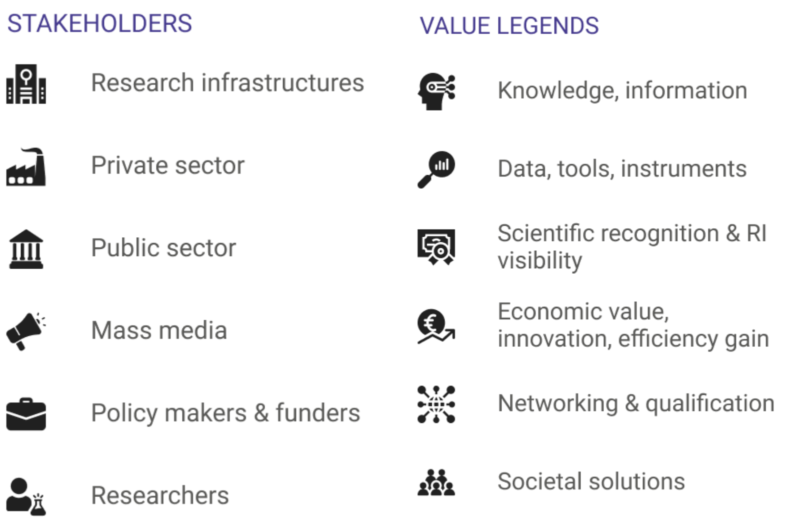
3.2.1 High-level impact pathways

An impact pathway is a simplified causal chain of events – 'productive interactions' – that connects the activities carried out on or in a Research Infrastructure to identifiable effects on the economy and wider society. Through dedicated participatory workshops with a broad variety of Research Infrastructures, the RI-PATHS team identified 13 distinct impact pathways that were grouped across three high-level functions:

1. Impacts as a result of Research Infrastructures pursuing their primary mission – **enabling science**
2. Impacts as a result of Research Infrastructures interacting for **problem-solving**
3. Impacts through Research Infrastructures shaping the fabric of **science and society**

Below, we describe the consolidated list of identified pathways, including visualisations depicting the schematic logic of the causal chains in a simplified form. Explore the legend of visuals and their meanings below.

Figure 5: Legend of impact pathway icons



1. Impacts as a result of RIs pursuing their primary mission – enabling science

- **P1 – Publication-citation-recognition:** This pathway follows the traditional idea of 'knowledge push' where RIs generate scientific publications (either directly or via users). These are, in turn, cited by others and eventually become part of a new body of knowledge. That body of knowledge later finds (conscious or unconscious) recognition within a broader research community and society. Final recipients of the knowledge generated by the RI may further translate it into economic benefits or apply it to societal problem-solving efforts. This pathway may therefore connect to P3, P7 and P8.

Figure 6: Visualisation of the pathway – Publication-citation-recognition

- **P2 – Employment, operations and standardised procurement:** This pathway investigates the effects of the existence of the RI as an economic actor in terms of jobs, wages, local spending, running costs and the procurement of goods and services related to the standard operations of the RI. It may be of particular relevance to large-scale physical infrastructures and/or those that employ high numbers of staff and/or have high operational costs.

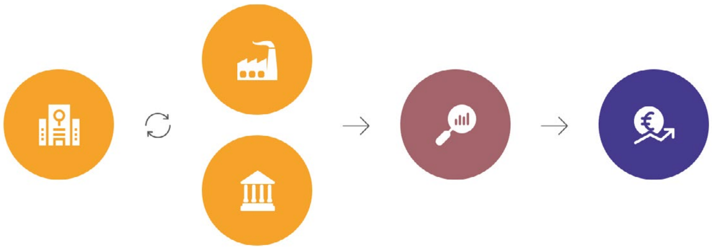
Figure 7: Visualisation of the pathway – Employment, operations and standardised procurement

- **P3 – Technology transfer and licensing:** This pathway expands on the traditional 'knowledge push' idea by adding the element of a proactive approach by the RI to communicate, sell or license results and findings of its research activities to suitable recipients. In cases where the end recipients are from the private sector and the developed technology or knowledge is of interest to industry, this pathway links to P7.

Figure 8: Visualisation of the pathway – Technology transfer and licensing

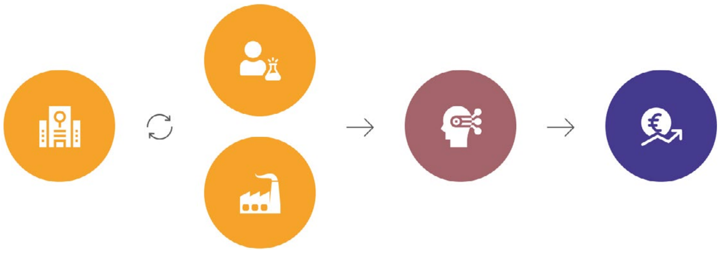
- **P4 – Learning and training through joint development of instruments and tools:** This pathway explores impacts related to activities that involve the RI and external, public or private entities that jointly develop tools, instruments, processes, solutions, etc. The notion of specialised procurement is included as it relates to the commissioning of specific products and solutions that are not readily available on the market (as in P1). This pathway is expected to follow closely innovation activities around the RI and may be of particular importance to RIs that are in the design, construction or upgrading phase of their lifecycle.

Figure 9: Visualisation of the pathway – Learning and training through joint development of instruments and tools



- **P5 – Learning and training by using RI facilities and services:** This pathway focuses on the impacts that originate from the fact that an RI engages directly or indirectly with its users. In particular, it covers aspects related to user training i.e. transmission of knowledge and know-how from RI staff to users, training on the usage of specific equipment, tools, processes, methods, etc., allowing them to (independently) access and benefit from the RI's resources. It may also include feedback loops from users to RI managers and operators, to improve internal processes and expand the service offering and delivery based on user needs.

Figure 10: Visualisation of the pathway – Learning and training by using RI facilities and services



- **P6 – Training and higher education cooperation:** This pathway recognises the importance of the RIs in delivering training to (young) researchers, PhDs, post-docs and students. This may be achieved through specific training courses, internships, scientific visits as well as participation in defining and implementing academic curricula. The cooperation of RIs with research-performing and higher-education institutions/ universities is articulated by analysing how RIs achieve impacts in the area of human capital development.

Figure 11: Visualisation of the pathway – Training and higher education cooperation

2. Impacts as a result of RIs interacting for problem-solving

- **P7 – Interactive problem-solving for the private sector (industry):** This pathway connects RIs directly to impacts through a stream of demands articulated by users that come from the private sector. These may be either large companies or SMEs. Specifically, the interaction allows RIs to provide solutions to a problem that responds to users' needs and follows defined specifications.

Figure 12: Visualisation of the pathway – Interactive problem-solving for the private sector (industry)

- **P8 – Addressing societal and public-sector challenges:** This pathway connects RIs directly to impacts through a stream of demands articulated by users from public authorities (governments, ministries, agencies, etc.) either directly or indirectly through the definition of specific (societal) challenges or priorities to be addressed by the research community in general, or RIs more specifically. The challenges are issued, for example, by national, European or international bodies. We note that societal challenges may also be addressed by the private sector (under P7).

Figure 13: Visualisation of the pathway – Addressing societal and public-sector challenges

- **P9 – Provision of specifically curated/edited data:** The creation and deployment of RIs that produce or provide research data enables the research community, public and private entities to exploit these (digital) resources for their R&D or other purposes. As RIs across all fields of research provide curated, pre-processed data – often organised in databases – these become a valuable resource to further develop products, innovations, studies, policies, etc. This pathway branches out into several different directions depending on how data is provided and by whom. It becomes especially relevant where virtual infrastructures pool information from different sources. Through such central provision and standardisation, relevant data becomes not only more visible but also much easier to use productively.

Figure 14: Visualisation of the pathway – Provision of specifically curated/edited data

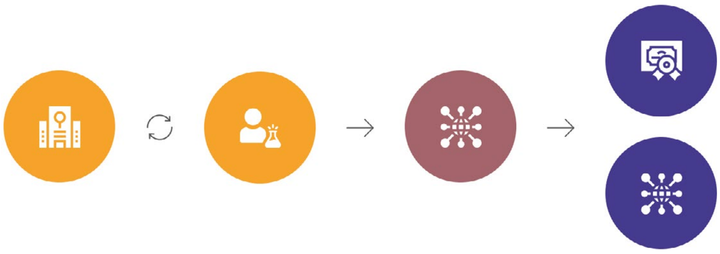
3. Impacts through shaping the fabric of science and society

- **P10 – Changing fundamentals of research practice:** This pathway looks into how RIs change the ways science is being done and how they open up possibilities for new approaches to research both in a cognitive and methodological sense. This subsequently affects – and arguably strengthens – all existing impacts of science. Thanks to their critical mass (in terms of users or the respective research community) RIs have the opportunity to define how (empirical) science is conducted in their field, outline new formal standards, common operational frameworks (rules, processes, toolkits, procedures, codes of conduct) and improve methodologies which eventually lead to better, more reliable, valid and broadly accepted outcomes with greater effects on policy, society and the economy. This pathway is of particular relevance to distributed and data-based RIs and it may connect to P11.

Figure 15: Visualisation of the pathway – Changing fundamentals of research practice

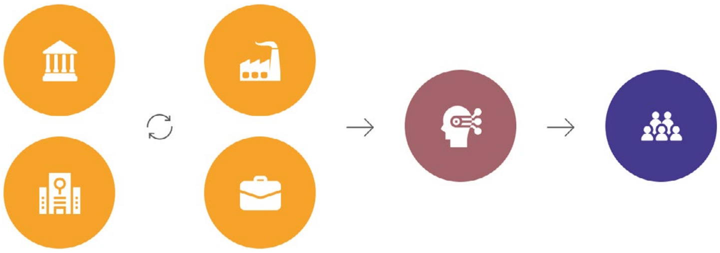
- **P11 – Creating and shaping scientific networks and communities:** This pathway addresses how RIs contribute to the creation of networks among researchers, and how the effects generated by these interactions bring societal and economic impacts. In particular, distributed RIs create 'communities of practice' by providing staff and user-training opportunities. Exchange of experiences and practices among staff members who cooperate on concrete issues and find solutions to common challenges, serving as an 'eye-opener' function for problems that would either not occur or could not be solved in traditional, single-site operations. RIs also induce further networking effects among their user communities whether they are single-sited or distributed.

Figure 16: Visualisation of the pathway – Creating and shaping scientific networks and communities



+ **P12 – Promoting engagement between science, society and policy:** RIs broaden access and active usage of scientific outputs and information beyond the research community, to address a wider group of stakeholders, policy makers, private actors, NGOs and the general public who may have different ability levels and motives for engaging in RI activities. This pathway looks into how RIs can engage in dialogue and cooperation with these groups in exploring new, qualitatively different avenues of data interpretation – which may boost the legitimacy of research efforts and the credibility of the RIs themselves. Such interaction may also help solving some previously unresolved research challenges. Activities related to citizen science, public access to research data (in addition to Open access), provision of scientific, evidence-based advice for policy are included in this pathway.

Figure 17 : Visualisation of the pathway – Promoting engagement between science, society and policy



+ **P13 – Communication and outreach:** Science communication raises awareness of science, with secondary effects achieved in understanding the services RIs provide to the public and private sectors, and more generally RIs' contributions to society. This pathway is primarily directed toward society and it may include, broadly, dissemination activities that target the media, and any other communication channels that would increase RIs' visibility and position in the political, societal and economic context.

Figure 18: Visualisation of the pathway – Communication and outreach

3.2.2 Get started by answering the guiding questions

Online toolkit 'Get started' page

To help users orientate themselves through this long list of pathways, we have designed a set of six guiding questions. These help the user to prioritise relevant high-level pathways and modify them based on the responses provided, thus working as signposts for exploring further information.

The questions are designed to direct a user towards one or more pathways that are related to the Research Infrastructure's main activity/focus, the purpose of the IA itself, training opportunities offered, the availability or production of specific data, interactions with different stakeholders, or the communication and dissemination activities. The user is given an opportunity to reflect on the main priorities by filling out this concise 'self-assessment exercise'.

The activation of specific answers in the 'Get Started' section is by no means prescriptive. The proposed pathways simply serve as inspiration to help users think through the causal links and modify the pathways according to the needs and priorities of the specific Research Infrastructure.

3.2.3 Tailoring impact pathways

The underlying logic of the Impact Assessment Toolkit is to provide users with concrete instruments and inspiration enabling them to combine and adapt impact pathways, their associated sets of indicators and methodological approaches to the needs, and the requirements and settings of specific Research Infrastructures.

A concise way to tailor new pathways involves the following steps:

1. **List the strategic objectives of your Research Infrastructure** or the areas/activities to be assessed
2. **Identify the scope and target audience** of the impact assessment exercise
3. After reading their definitions, **select those high-level impact pathways that better match the needs** of your Research Infrastructure
4. **Refine and specify the causal links** described in high-level impact pathways by identifying specific activities, their outputs and foreseen outcomes and impacts that are generated along the timeline
5. **Identify a suitable title(s) for the tailored pathway(s)** that better reflects the Research Infrastructure's needs and that is relevant to the IA's target audience

Work on defining the focus of an impact assessment and charting tailored impact pathways is a real team effort. Hence, the involvement of and communication with the relevant stakeholder groups is particularly important to ensure the IA efforts are well understood and accepted internally and externally. In the following table, we highlight possible ways of involving and communicating with typical Research Infrastructure stakeholders.

Table 1: Who to involve and who to communicate with

RI managers	RI managers define the purpose of an impact assessment by drafting the existing and future objectives of the RI and signposting the potential impact areas. Likewise, RI managers have an opportunity to put forward specific areas of interest where an impact assessment may be useful in order to improve internal strategic processes in the future. They are also likely to have knowledge of impact-related data collection practices and the feasibility of gathering new data.
RI staff	RI staff (academic, technical, administrative) collaborate in the construction of impact pathways by describing the activities they perform on a daily basis and by visualising respective outcomes and impacts from their perspective and experience. The aims of an impact assessment should be well understood by RI staff to ensure internal buy-in and dedicated contribution.
Industry	Industry, service providers and other private-sector stakeholders can participate in the exchange of ideas about outcomes arising from interactions with RIs, helping to delineate pathways that exploit the outcomes of research collaborations. Industry representatives should receive feedback about the main findings and impacts on industry and innovation.
Research and higher-education institutions	Representatives from research and higher-education institutions, such as research centres, universities, and vocational schools, can contribute by providing insights on the outputs and impacts emerging from diverse agreements on service use or training programmes together with the RI. Research and higher-education representatives should receive feedback about the main findings and impacts on human resources and skills.
Policy makers	Policy makers are in charge of setting high-level requirements for an impact assessment. They are also most interested to learn about the overall results of an IA. It is essential that RI managers provide clear communication on the impact pathway logic and key evidence on the scope of assessed impacts. Policy makers can also help to identify potential areas of impact by providing insights from a public perspective on interactions with RIs.
Funding agencies	Funding agencies may be keen to signpost prime impact areas for further investments in the sector. Their participation in the pathways tailoring phase may be of special interest to align expectations from third parties with the RI's own impact strategy.

3.3 Selecting indicators

The RI-PATHS Impact Assessment Toolkit allows users to explore frequently used indicators along each of the impact pathways. We differentiate between 'activity', 'outcome' and 'impact' indicators.

Activity indicators are those that capture the extent and nature of actions taken at the beginning of all impact pathways. They relate to activities that are conducted by – or at least safely under the control of – Research Infrastructures and can be directly influenced by their management ('sphere of control'). In principle, activity indicators are measures that can be made part of internal reporting within Research Infrastructures. However, the main question is whether the organisation is 'impact conscious' enough to actually do so.

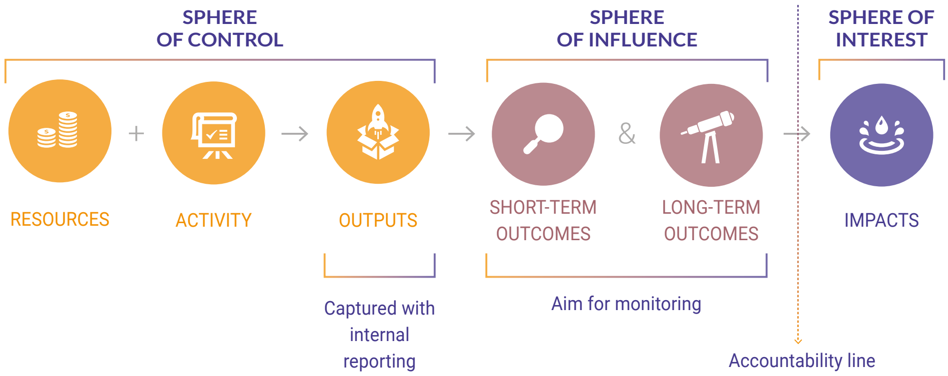
Outcome indicators are those that reflect activities one step further down the impact pathway, documenting the result of the first productive interactions. That being so, the organisations at which these outcomes materialise (i.e. they have acquired knowledge) remain within most RIs' reach or 'sphere of influence'. Typically, they need to reach out to third parties via surveys, external reporting or other means to obtain all necessary information for outcome indicators. Of course, RI managers need to be weigh-up the 'cost-benefit' of gathering large amounts of monitoring data and ensure time and resources for data collection and management contribute effectively to tracking impacts.

Impact indicators are those reflecting the extent and nature of actual effects in the economy and wider society that eventually result from Research Infrastructure activities. Since many pathways are clear in origin, yet complex and diverse in orientation, there is usually no way to document and quantify them in detail. Accordingly, assumptions have to be taken and modelling techniques applied to arrive at meaningful values. With few exceptions, impact indicators are estimations.

(...) Since many pathways are clear in origin, yet complex and diverse in orientation, there is usually no way to document and quantify them in detail.(...)

Figure 19: Logic of impact pathway monitoring

A central finding to be kept in mind is that all pathways have a clear origin defined by one activity (or a few related activities) under the control of internal RI management. The further you move down the impact pathways, the more chains of causation branch out into different intended and unintended directions and trigger effects in different areas. Thus, impacts result from manifold sources in all domains.



Against this background, there needs to be a clear choice of indicator types, depending on the purpose of the planned analysis. Activity indicators allow RIs to assess **whether they do the right things** while outcome indicators allow RIs to assess **whether doing these right things matters**. Both are thus highly relevant from a managerial perspective. Impact indicators allow RIs to assess **how big the overall added value of all these activities may actually be** – making them relevant for external communication and policy purposes.

3.4 Determining data collection and reporting tools

For each selected indicator, it is crucial to set up and implement an efficient and effective data-collection system and reporting tools. The RI-PATHS Impact Assessment Toolkit provides an overview of data-collection approaches and tools for each of the four broad impact areas. These examples can be used to design and structure a data-collection system dedicated to socio-economic impact assessment. The list broadly entails three types of activities:

1. **Keeping track of RI activity and outcomes** including, for instance, *the number of scientific publications, procurement contracts, patents and other innovation output, visitors and doctoral students, social media output and other dissemination products, participation in relevant discussion with policy makers, downloads of open data and software, etc.* This systematic tracking is the basis for the assessment of impacts. It is usually performed by the RI staff as part of internal reporting.

2. **Performing regular surveys** of stakeholders interacting with the RIs, such as *former students, supplier companies, users, citizens, etc.* This activity helps to grasp useful insights in the way outcomes and impacts materialise and the way to maximise them. These surveys can be launched directly by RI staff as part of their monitoring activity (e.g. periodic survey of former students, supplier companies or users) or commissioned to external consultants (e.g. survey of citizens to assess their willingness to pay for RIs).

3. **Carrying out various qualitative analyses and case studies** to report on some intangible impacts, such as the contribution of RIs to *gender balance, social inclusion, environmental issues, sustainability, public security challenges, etc.*

When designing the data collection plan, a relevant issue to consider is data protection, which requires a proper assessment and a management plan to ensure no infringement of existing legislation (GDPR, etc.) takes place.

Beyond a dedicated data-collection approach, RIs need systematic reporting of the information they collect. This activity is usually performed by the RI staff as part of their periodic (e.g. monthly, quarterly, yearly) reporting to RI managers, boards, advisory council members, etc. of the activities and outcomes achieved (e.g. monitoring reports on key performance indicators, KPIs).

Some good practices in terms of data collection and reporting tools can be drawn by the pilot impact assessment exercises which have contributed to the development of the RI-PATHS framework.

Online toolkit
Reporting and analysis page

Cases: ALBA and DESY

A survey sent to users was designed to investigate the impact pathways that lead from experiments to the development of innovations. The survey design investigated how much time is needed, which additional activities are required, which stakeholders are involved (e.g. specialised companies, etc.) to produce an innovation using the knowledge generated in an experiment. These impact pathways cannot be identified by looking at traditional KPIs, such as the number of publications or patents associated with the RI. Systematic user surveys – after some time has elapsed since they

Further information on this pilot exercise can be accessed here and here

accessed/used the Research Infrastructure, beyond routine follow-up questionnaires – can help to trace long impact pathways. More detail on how the survey has been structured and managed as well as lessons learnt are summarised in ALBA and DESY pilot reports.

Case: CERN

A year-long survey of visitors to CERN revealed a discernible economic value in 'science tourism'. It clearly showed that learning more about CERN's core scientific mission, to explore the inner workings of the Universe, is one of the main motivations for visitors travelling to the facility and the area. The study also revealed that each visitor spends, on average, between CHF600 and CHF 900 during their stay, and that continuous sampling of actual spending is required to capture the economic effects and clearly verify the impact of any measures taken to further expand visitor facilities and opportunities for science tourism. These findings reaffirm the role of 'big science' and large-scale research infrastructures, such as CERN, in offering educational but also entertaining activities that complement classic 'holiday' activities during the tourist season, which extends from autumn to spring according to the survey findings.

Case: ELIXIR

Adjustment of post-event surveys, internal reporting and templates to include impact-relevant questions are part of a package of quantitative and qualitative data collection undertaken by ELIXIR. With more intangible impacts like relationship capital it was noted that even manual benefit-tracking (e.g. maintaining a simple list of examples) can be useful when there was an initial effort to categorise and systematise identified benefits. It was concluded that sound and structured impact narratives are the best way to collect and report on most of the intangible impacts of a distributed RI.

Case: EATRIS

A follow-up survey was designed to collect systematic feedback from participants concerning the impact of EATRIS training activities on their work and careers. This pilot paved the way for a career-tracking tool to monitor the long-term effects of EATRIS educational and training activities on researchers' careers, achievements (in terms of projects), products or other professional outputs. To illustrate the impact, interviews and storytelling techniques were also used.

Case: Global BioImaging (GBI)

In this pilot exercise the following data collection tools were identified: i) study (survey/semi-structured key interviews) to further evaluate the impact of the network on local communities, focusing on motivations, inspiration and engagement processes (how and why); ii) a follow-up instrument to collect data about the capacity-building programme, and the impact on the network growth and RI development around the world; iii) a 'success' storytelling tool to show the development of the GBI international network over time.

3.5 Choosing methodologies for impact measurement

Currently, a variety of methods are used in socio-economic impact assessment of RIs depending on the scope of the analysis, the type of impacts that are assessed and the target users. The methods range from quantitative approaches, such as macroeconomic modelling or cost-benefit analysis, to more qualitative approaches like narratives and case studies. None of the existing methods provides a comprehensive and satisfactory answer to all the questions that a socio-economic impact assessment addresses. Therefore, **a smart and rigorous combination of these methods is needed.**

Online toolkit
Reporting and analysis page

Building on the stream of knowledge acquired during this project, examples of how to use existing methodological approaches in addressing the different impact areas are provided in the Impact Assessment Toolkit. More details on their validity, accuracy, reliability, the cost-time needed, and relevance to RIs and policy makers are provided in the RI-PATHS literature review report.

Further information can be accessed here

It is worth pointing out that some analytical methods can be carried out internally by RI staff while others require a joint effort between RIs and external consultants.

Case: ALBA

In addition to the above-mentioned survey, an analysis on patent citations was also performed – in the framework of this pilot exercise – with a view to grasping the full picture of ALBA's innovation pathways. Specifically, the analysis assessed the extent to which innovations have been triggered by the knowledge disseminated through ALBA publications. In other words, it looked at the extent to which ALBA publications are cited in patent documents and, therefore, contributed to innovation outputs, thus assessing the link between science and technology. This kind of analysis requires a joint effort between the RI, which in principle should track and store structured data about publications related to its activities, and the consultant who provides the skills (e.g. use of bibliometric techniques to examine the wealth of patent citation information) as well as access to relevant sources of information (e.g. patent databases) for carrying out the analysis. More details on the process of tracking 'innovation outputs' stemming from ALBA publications, along with results achieved thanks to this analysis, are described in the ALBA pilot case study report.

Further information can be accessed here

For instance, case studies can be carried out by RI staff to obtain a deeper understanding of the benefits accruing to a specific target of stakeholders (e.g. information can be collected through the use of a survey or feedback forms, etc.). Also, approaches based on multiple partial indicators can be used by RI staff to monitor impacts on human resources, policy, society and the economy.

Other approaches include cost-benefit analysis, theory-based investigation, knowledge production/function methods, and input-output analyses/tables, as well as impact multipliers to estimate the effect of human resources on the economy (e.g. skilled researchers with high salaries and disposable income stimulate the local economy). Relevant data have to be collected by RI staff but some analytical skills provided by external specialists are also needed.

Some examples of socio-economic impact assessments of Research Infrastructures – relying on these methodologies – are provided in the box below.

- Cost-benefit analysis of the Large Hadron Collider and HL-LHC programme at CERN
- Cost-benefit analysis and socio-economic impact assessment of E-RIHS
- Quantitative and qualitative analysis of EMBL-EBI services
- Socio-economic assessment of SKA Phase 1 in South Africa
- Socio-economic impact assessment of ESS during construction and operations
- Economic impact of Fermi National Accelerator Laboratory
- NASA socio-economic impact
- Socio-economic impact of Copernicus in the EU
- The economic impact of open data
- Space contribution to the global economy

To highlight the main results of an impact assessment for reporting to decision-makers, we suggest employing well-constructed and evidence-based impact narratives that can be complemented with insights from in-depth case studies. Storytelling can meaningfully capture 'lived experiences' and share impact findings in a highly engaging manner, providing a good cultural understanding while promoting positive attitudes.

To employ storytelling techniques in a sound and robust manner for impact assessment purposes, Research Infrastructure staff can reflect on the following questions:

- What message does the RI intend to disseminate with the impact assessment?
- Who is the final audience of the impact assessment?
- Which were the triggers, obstacles, challenges for a concrete impact pathway?
- How could concrete experiences, outcomes and impacts found during the assessment exercise be shown in a tangible and engaging way?

4. Use of Research Infrastructures' impact assessment in the full policy cycle

The initial investment in a Research Infrastructure and a large part of on-going operating costs and funding for projects are commonly sourced through government budgets (regional, national and European levels). Research Infrastructures are one form of intervention in an overall 'policy mix' that governments implement to achieve a defined set of objectives. As such, RI impact assessment is part of the policy toolbox of government ministries and research funding agencies. As noted above, policy makers and/

or funding agencies (depending on the governance structures in a country) are in charge of setting high-level requirements and the policy frameworks within which RIs operate and IA exercises are conducted.

In a majority of the EU Member States and at the EU level, investment in RIs is conducted within at least three planning frameworks:

1. National and European multiannual budgetary or programming periods (commonly between four and seven years) during which specific investments may be selected for funding
2. National or European Research Infrastructure Roadmaps (ESFRI) that prioritise investments in new RI or the upgrading of existing RIs, which public (and sometimes charitable foundations or industry) agree to fund
3. The lifecycle of a Research Infrastructure or part of a Research Infrastructure (major facility, large-scale equipment or instruments, etc.) – this may vary depending on the scale of the RI and complexity of the investment from anywhere between several years to a decade or more

These planning frameworks all fall within what is commonly termed the policy cycle. Howlett and Ramesh's 2003 policy cycle model[1] identifies five stages: **agenda setting, policy formulation, adoption (or decision-making), implementation and evaluation.**

Figure 20 : Policy cycle tailored to the RI investment cycle

Source: Adapted by RI-PATHS project

We adopt a variant on this model, adding a governance component at the core of the policy cycle, to explore how IA can support public policy interventions in favour of research RI investments. Research Infrastructures, especially large – or international-scale infrastructures, are generally based on a multi-actor partnership involving stakeholders ranging from scientists to governments, to industrial users and even citizen scientists, etc. Governance of RIs individually but also of the entire road-mapping process is thus a critical success factor and needs to be taken into account in the IA process.

[1] Howlett, M. & Ramesh, M. (2003). Studying public policy: Policy cycles and policy subsystems. Toronto, ON: Oxford University Press Canada

Who are the results of the IA being addressed to?
What types of impacts are most relevant to which stakeholders?

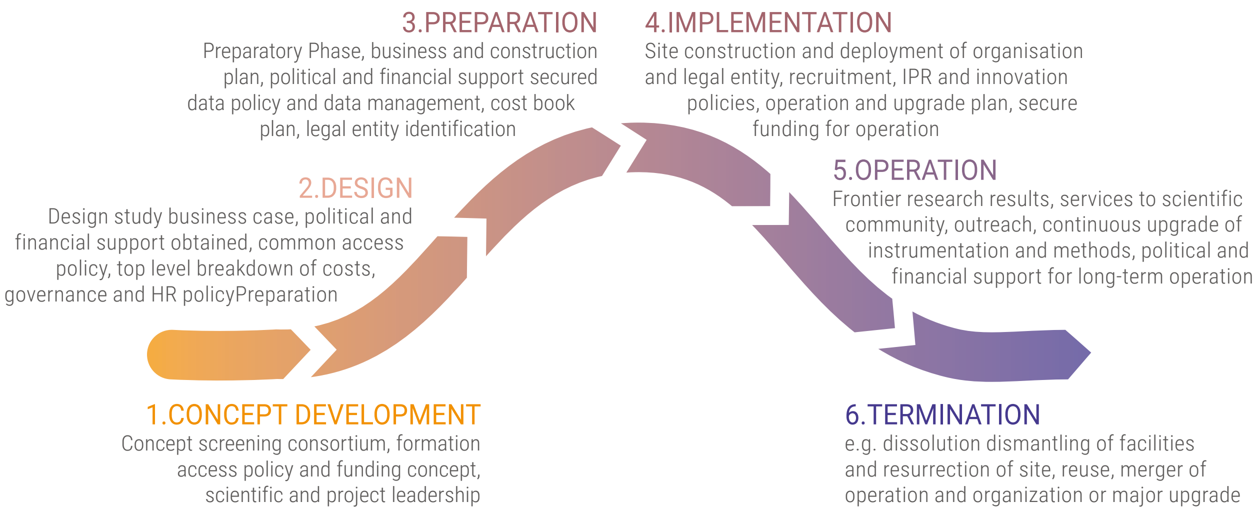
Not all IA and evaluations lead to significant policy adjustments (either at the level of government policy or an RI's strategy) unless the results are fed back into future policy design and priority-setting. Hence, a 'feedback loop' should be an inherent part of the policy cycle.

While socio-economic impact assessment can be considered as forming an element of the fifth step in the process, evidence from IA can potentially feed, to a greater or lesser extent, all stages of the policy cycle.

Placing governance at the core of the policy cycle also underlines that RI policies, roadmaps, projects and investments are not designed only by a handful of technical specialists. Indeed, in the context of RIs, different stakeholders will be involved at different steps from the scientific community, industrial partners, charitable foundations, funding agencies, national and regional public administrations, city authorities, etc.

It is instructive to relate the stages of the policy cycle with the lifecycle approach to a Research Infrastructure.

Figure 21: Life cycle of a Research Infrastructure



Source: ESFRI

Considering the policy and lifecycle stages, the table below summarises the potential contribution of the RI IA process to the various stages.

Table 2: Potential contribution of RI IA to various stages of the policy cycle

Policy cycle stage	RI lifecycle stages	RI impact assessment
Agenda setting	Concept development	Based on past evidence, the types of RIs contributing to specific policy objectives or 'policy missions' can be reasonably assigned to RIs
Strategy/policy formulation	Design	Source evidence to draw up business cases (RI level) and inform roadmap processes (policy level)
Priority setting	Preparation	Learning from past or on-going IA in order to set and define operational targets, etc.
Implementation (policy mix)	Implementation	Using impact pathways to guide implementation with a view to managing and optimising different types of impact (human resource, procurement, economic, etc.)
Monitoring and evaluation	Operation	Establishing and monitoring KPIs with a view to both supporting on-going management of the RI and providing an evidence base for future IA Designing data- and evidence-gathering procedures from an early stage to enable future IAs Establishing an evaluation plan for the RI including general or specific (thematic) IA
Feedback	Upgrade-termination	Evidence from IA should be used to help redefine the mission, objectives, etc. of the RI for future investment rounds

The advantage of placing the RI IA concept within the policy cycle is it signals what needs to be done at each step of the cycle to be able to monitor and assess RI impacts at appropriate moments. It enables an early and on-going reflection on the types of quantitative (data) and qualitative information that should be collected, and how it should be codified so the impact pathways feed into and optimise RI management (from concept to construction to operation).

The RI-PATHS IA framework provides a set of complementary tools and methods that can be combined with existing advice, guidance indicators and evaluation processes that have been developed at various levels (RIs, national funding agencies, EU funding programmes, etc.). For instance, ESFRI has published a guidance document on KPIs, and the OECD has published a set of impact indicators. At European level, the European Commission's Regional Policy Directorate-General (DG) publishes guidance on impact assessment and evaluation of different types of interventions funded in the framework of the European Structural and Investment Funds.

A key advantage of the RI IA framework proposed is that it provides a set of tools and methods that can inform ministries and funding agencies at different stages of the policy cycle. In particular, the RI-PATHS project has fostered thinking and learning on the types of impacts and the way they can inform policy making and decisions for future rounds of investment. The project has fostered an exchange within an international 'community of practice' bringing together policy makers, funders and RI managers interested in improving the IA process. It will be important to maintain and develop the collaboration within strategic policy networks (ESFRI, ERICs, DG R&I and REGIO, third-country organisations, etc.), notably with respect to potential activities for strengthening capacity-building in RI IA (training modules and webinars, uptake of results by champion RIs and lead RI networks).

We hope you enjoyed reading this Guidebook and found some inspiration and useful information for designing socio-economic impact pathways for your Research Infrastructure or bringing the topic on the agenda at your organisation or country. We hope that all your practical experiences in the future will help us to shape and further improve our common understanding of the socio-economic impacts of Research Infrastructures. We would love to hear your thoughts about this Guidebook and your experiences. Stay in touch and contact us at contact@ri-paths.eu.

5. Glossary of terms

+ **Activity** – Initiatives and endeavours undertaken using the resources of a Research Infrastructure or work performed by Research Infrastructure staff.

+ **Activity indicator** – Indicators that capture the scale and nature of a Research Infrastructure's activities; a measure that should form part of internal reporting.

+ **Economic impact** – Monetary and fiscal effects induced in the regional, national and international production and entrepreneurial system; it includes effects in the domains of technological development and innovation.

+ **Human resource impact** – Effects on the development of scientific, technical and non-scientific personnel, as well as changes in the level of new competences and skills in wider society.

+ **Impact** – Intended and unintended long-term effects of activities using the resources of a Research Infrastructure or work performed by Research Infrastructure staff.

+ **Impact assessment** – Systematic, evidence-based evaluation of effects caused by an intervention, such as funding the construction or extension of a Research Infrastructure.

+ **Impact framework** – A conceptual reference tool to help structure thinking about impact and shepherd audiences toward adopting shared language, terms and meanings.

+ **Impact indicator** – An indicator that reflects the extent and nature of generated effects in the economy and wider society; with few exceptions, impact indicators are estimations.

+ **Impact pathway** – A simplified causal chain of events ('productive interactions') that connects a Research Infrastructure's activities to identifiable effects on the economy and wider society.

+ **Key performance indicator (KPI)** – Project-management tools used to monitor the performance vis-à-vis objectives, and to ensure the efficient use of resources.

+ **Monitoring** – Tracking the progress and keeping a systematic overview of the scope and quality of activities and outcomes over a certain period of time.

+ **Outcome** – Longer-term effects that stem from the stakeholder uptake of or interaction with Research Infrastructure outputs.

+ **Outcome indicator** – Indicators that document the result of the first productive interactions; collecting data by reaching out to involved stakeholders, e.g. via a survey, interview, external reporting or other data-gathering means.

+ **Output** – Immediate direct effects and products attributable to an activity performed on a Research Infrastructure or by Research Infrastructure staff.

+ **Policy impact** – Effects and changes in the area of regulations, standards, institutions and science diplomacy, among other policy-related domains.

+ **Productive interaction** – Exchange and engagement between research facilities, researchers and stakeholders which results in new or different ways of doing things.

+ **Research Infrastructure (RI)** – Facilities that provide resources and services for research communities to conduct research and foster innovation; RIs can be used beyond research, e.g. for education or public services, and they may be single-sited, distributed, or virtual.

+ **Social impact** – Refers to the effects on society; the well-being of individuals and communities, and how well societal challenges like climate change, sustainability, inclusion, and science literacy are addressed.

+ **Socio-economic impact** – Effects on or changes to society and the economy that Research Infrastructures generate beyond contributions to academic knowledge.

+ **Stakeholder** – An individual or community of individuals interested in, or concerned about, an issue; Research Infrastructure stakeholders, among others, comprise facility managers, staff, various governing bodies, scientific and non-scientific users, industry and private-sector providers, research and higher-education institutions, specialised agencies and institutions like hospitals and vocational schools, policy makers and funders.

+ **Qualitative indicator** – Narrated information based on meanings, perceptions and representations of people about a specific outcome or effect collected through, for example, case studies, surveys and in-depth interviews.

+ **Quantitative indicator** – Measure of quantities or amount (number, index, percentage or ratio) based on available monitoring data.

Acknowledgements

european future
innovation system
centre

The European Future Innovation System (EFIS) Centre is a Brussels-based policy research lab. EFIS' mission is to support transformative public policies that address societal challenges. The Centre seeks to develop, in cooperation with a network of partners, innovative concepts, methods and techniques that are directly applicable by relevant policy communities. EFIS' work concentrates on opening up pathways to systemic innovations that contribute to social, environmental and economic resilience.

Csil
CENTRE FOR INDUSTRIAL STUDIES

CSIL is specialised in applied economic research. CSIL experts are able to provide a full range of studies, technical assistance and training services in different EU policy areas (cohesion policy, small business economics, RDI, infrastructure, ICT). They combine advanced technical background with a depth of 'real world' experience in policy design and evaluation, stakeholder engagement, feasibility studies, cost-benefit analyses, economic and social impact assessments. The team has worked with different EU institutions and has an extensive understanding of the EU institutional framework and decision-making processes.

European Science Foundation

Established in 1974, the European Science Foundation (ESF) is as an independent, non-governmental, non-profit organisation committed to promoting the highest quality science in Europe and to driving progress in research and innovation. ESF works closely with its members, sharing its expertise and scientific support, and aiming to increase the quality and effectiveness of their science-related activities. Science Connect allows ESF to provide consulting services on an open-market basis. As ESF's Expert Services division, its mission is to partner with members and clients in leading successful projects and facilitating informed decision-making through a broad range of scientific support services.

Fraunhofer ISI

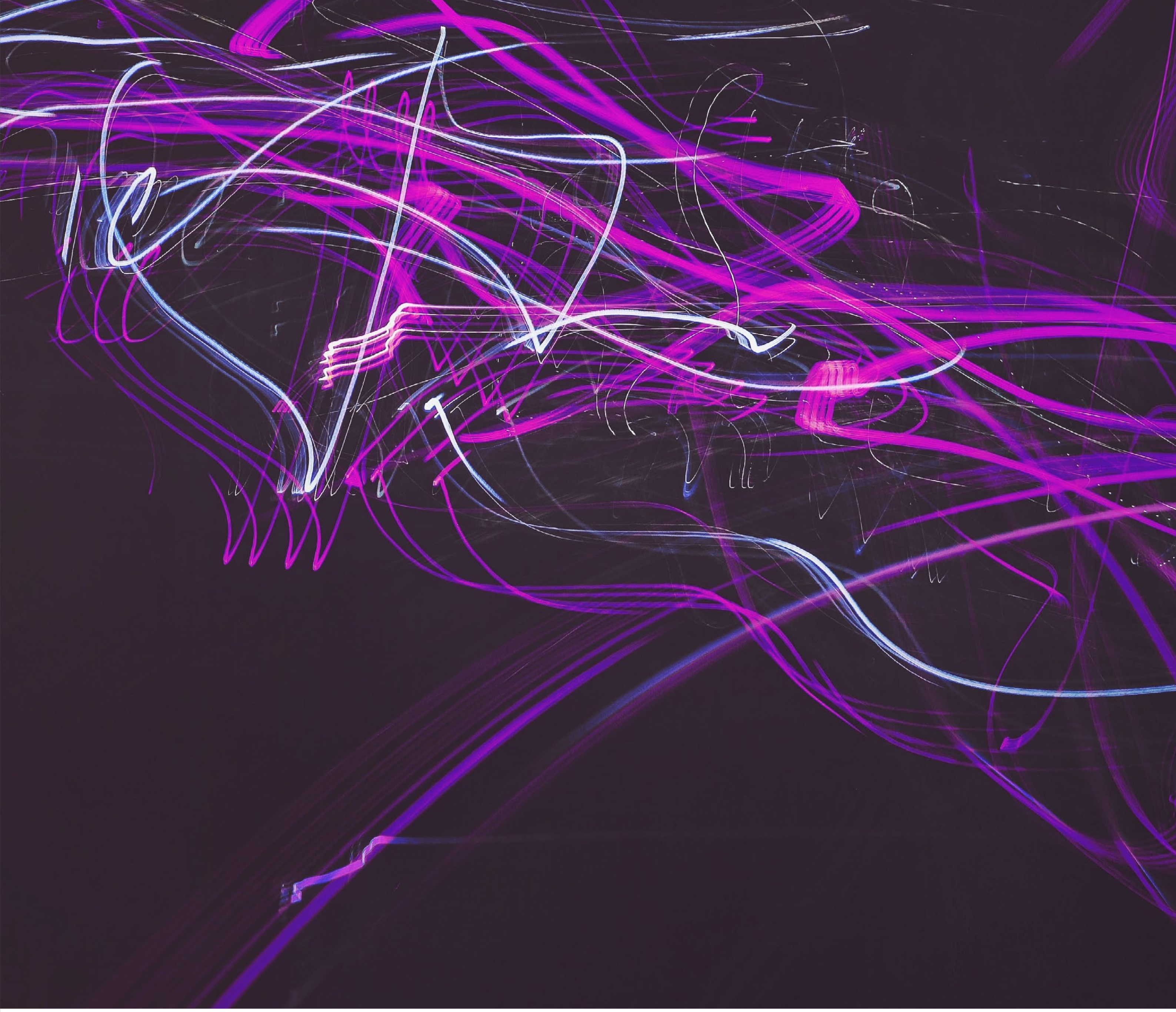
Fraunhofer ISI sees itself as an independent think-tank for society, politics and industry. Its expertise in the area of innovation research draws on a synergy of technical, economic and social science knowledge. Its researchers apply a broad spectrum of advanced scientific theories, models, methods and measurements, and continually develop them further, utilising the empirical findings from the research projects conducted. Its Competence Centre Innovation and Knowledge Economy explores the working principles of research and innovation systems at the supranational, national, regional and sectoral level. Using the latest theoretical approaches, indicators, benchmarks and evaluation concepts it advises clients on the design of new support instruments and funding programmes.

ELIXIR unites Europe's leading life-science organisations in managing and safeguarding the massive amounts of data being generated in publicly funded research. It coordinates, integrates and sustains bioinformatics resources across its members, and enables users in academia and industry to freely access vital data, tools, standards, computing and training services for their research. The application areas supported by ELIXIR are broad and cover all life-science disciplines (health, food, environment). ELIXIR has 21 member countries (acting as country nodes), plus the European Molecular Biology Laboratory hosting the European Node of ELIXIR (EMBL-European Bioinformatics Institute).

At CERN, the European Organization for Nuclear Research, physicists and engineers are probing the fundamental structure of the universe. They use the world's largest and most complex scientific instruments to study the basic constituents of matter – the fundamental particles. Founded in 1954, CERN laboratory sits astride the Franco-Swiss border near Geneva. It was one of Europe's first joint ventures and now has 22 member states.

ALBA is a Third-Generation Synchrotron Radiation facility located in Cerdanyola del Vallès, Barcelona (Spain), operated by the CELLS Public Consortium. It is jointly owned and financed by the national and regional governments. The facility consists of the accelerator systems providing three GeV electron beam and eight full operational beamlines, with photon energies currently ranging from infrared up to hard X-rays of tens of KeV. Different synchrotron radiation techniques are available including diffraction, spectroscopies and imaging. Five more beamlines are in construction.

DESY is a German research centre for high-energy physics, synchrotron light and FEL physics. As one of the world's leading centres for the study of the structure of matter, DESY has many years of experience in the development and operation of accelerators. DESY builds, operates and exploits large-scale RIs with international open access in photon science, astroparticle and particle physics. Its accelerators, detectors and observatories are unique research tools and a magnet for more than 3,000 international guest researchers every year. DESY cooperates with industry and SMEs to promote new technologies that will benefit society and encourage innovations.



Socio-economic impact assessment of Research Infrastructures is a fast-growing field. It generates a lot of interest. But it also poses many questions, thus making it a complex topic. This Guidebook is developed for Research Infrastructure managers and staff, policy makers and funders, as well as other professionals who want to develop knowledge on this topic. The Guidebook introduces the language of impact assessment, gives a glimpse into pathways how Research Infrastructures' activities lead to broader effects on society and the economy, provides useful examples and helps making important strategic choices.