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Contents

List of figures

List of tables

List of boxes

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Abbreviations and acronyms

API	Application Programming Interface
ARWU	Academic Ranking of World Universities
CCSI	Committee for Coordination of Smart Specialization
CCDI	Advisory Councils for Research, Development and Innovation
CIS	community innovation survey
CNCS	National Council for Scientific Research
CSC	Science Information Technology Center
DGEEC	Directorate General for Education and Science Statistics
DPSCDITT	Directorate of Policies and Strategies for RDI and Technological Transfer (Direcția Politici și Strategii CDI, Inovare și Transfer Tehnologic)
EC	European Commission
EERTIS	Engage in the European Research and Technology Infrastructure System
EOSC	European Open Science Cloud
EPO	European Patent Office
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
ETIS	Estonian Research Information System
EU	European Union
GBARD	Government budget allocations for R&D
GDP	gross domestic product
GDPR	General Data Protection Regulation
GERD	gross domestic expenditure on R&D
GII	Global Innovation Index
GSG	General Secretariat of the Government
HEIs	higher education institutions
INS	National Institute of Statistics (Institutul Național de Statistică)
IT	Information technology
KPI	key performance indicator
M&E	Monitoring and Evaluation
MADR	Ministry of Agriculture and Rural Development (Ministerului Agriculturii şi Dezvoltării Rurale)
MCID	Ministry of Research, Innovation, and Digitalization (Ministerul Cercetarii, Inovarii și Digitalizării)
MEDU	Ministry of Education
MEET	Ministry of Economy, Entrepreneurship and Tourism
MIPE	Ministry of European Investments and Projects (Ministerul Investițiilor și Proiectelor Europene)
MoF	Ministry of Finance
MoH	Ministry of Health
NACE	Nomenclature of Economic Activities

NESTI	Working Party of National Experts on Science and Technology Indicators
NRRP	National Recovery and Resilience Plan
NSO	National Statistical Offices
OCyt	Colombian Observatory of Science and Technology
OECD	Organisation for Economic Co-operation and Development
OPCyT	Science, Technology and Innovation Observatory of Panama
ORCID	Open Researcher and Contributor ID
OST	Observatory of Science and Technics
PCT	Patent Cooperation Treaty
PER STI	Policy Effectiveness Review of Science, Technology, and Innovation
POCIDIF	Smart Growth, Digitalization and Financial Instruments Program
PDIA	Problem-Driven, Iterative Adaptation
Ph.D.	Doctor of Philosophy
PNCDI	National RDI Plan
PNIM	the National Integrated Monitoring Platform
PSF	Policy Support Facility
R&D	Research and Development
R&I	Research and Innovation
RAS	Reimbursable Advisory Services
RDA	Regional Development Agency
RDI	Research, Development, and Innovation
RelCO	Research and Innovation Careers Observatory
ReNITT	National Registry of Innovation and Technology Transfer Entities
RIO	Research and Innovation Observatory
RIS3	Research and Innovation Strategy for Smart Specialisation
RO-NOSCI	Romanian national Open Science Cloud Initiatives
RO-RIO	Romanian Research and Innovation Observatory
S3	Smart Specialisation Strategy
SDGs	Sustainable Development Goals
SENACYT	National Secretariat of Science, Technology and Innovation
SMEs	Small and medium-sized enterprises
SNCISI	National Strategy for Research, Innovation and Smart Specialization
STI	Science, Technology and Innovation
TBD	to be determined
ToC	Theory of Change
UEFISCDI	Executive Agency for Higher Education and R&I Funding
VC	Venture capital

Executive summary

About this report

The objective of this report is to offer information and recommendations that the Government of Romania could use to establish a Research and Innovation Observatory (RIO). This report aims to guide the Ministry of Research, Innovation and Digitalization (MCID) in the establishment of a Romanian RIO (RO-RIO) by offering recommendations based on a domestic review and institutional needs assessment (including interviews with representatives of 12 R&I governance agencies) and international best practices (including the review of 23 institutions' websites and 13 in-depth interviews). The proposed framework includes a proposed mission, core services (Section 2), success factors (Section 3), institutional requirements (Section 4), and a workplan for its implementation (Section 5).

A Research and Innovation Observatory for Romania

Romania needs to improve evidence-based decision-making on research and innovation (R&I) to sustain its productivity. Despite rapid economic growth, Romania's innovation performance remains modest. Limited investments in R&I pose a threat to the sustainability of the country's productivity. To enhance R&I performance, improved practices in R&I instrument design, implementation, and coordination are essential.

A RIO could help Romania improve evidence-based decision-making and thereby sustain its productivity. A RIO fills information gaps on R&I trends, actors, and funding. A RIO performs three primary functions, (i) R&I data centralization – including data on innovation within firms and on productivity, (ii) analysis of the performance of the R&I system, and (iii) dissemination of knowledge and information on R&I. By performing these functions, a RIO provides stakeholders with better access to relevant data on information gaps on R&I trends, actors, funding, and performance. This access to data better equips stakeholders to use evidence that can guide decisions on budget allocation and sector prioritization. A RIO also provides benefits that enhance the R&I landscape: breaking silos of information and funding for R&I, providing better guidance for future investments in R&I, and improving the visibility and take-up of R&I funds. Furthermore, access to information can help R&I performers (e.g., researchers, research organizations, innovative firms) and citizens earn greater trust. These benefits ultimately accrue to R&I funders, governance agencies, performers, enablers (e.g., innovation and technology transfer entities, innovation hubs, accelerators), and citizens. This initiative also aligns with Romania's commitment to fulfilling 80% of the recommendations of the Policy Support Facility (PSF) panel, which include establishing a RIO.

RO-RIO's mission

RO-RIO's mission expands upon PSF's recommendation by directly addressing Romania's needs for evidence on R&I, ultimately contributing to a more productive economy and high quality jobs. RO-RIO should provide a rigorous evidence base and promote its use in policy decision-making in R&I by performing the functions of (i) centralizing, (ii) analyzing, and (iii) disseminating statistical data from national and international databases and information on R&I and productivity. The dissemination function includes building the

capacities of R&I stakeholders. RO-RIO will identify Romania's areas of excellence in R&I, which can guide investments in R&I and Romania's internationalization strategy.

RO-RIO's core services

RO-RIO could provide seven core services that would together perform the three primary functions of a RIO: (i) "centralize information and data", (ii) "research and analysis", and (iii) "disseminate knowledge and information". The proposed core services of RO-RIO, informed by the domestic review and institutional needs assessment, and international good practices, build on existing national and international platforms and data on R&I factors, performance and outcomes (including productivity). Over time, RO-RIO could gradually expand the coverage of these services and include additional ones.

RO-RIO's first suggested function, "Centralize information and data", could encompass two core services: SERVICE 1 "Overview of the R&I system" and SERVICE 2 "Mapping of available R&I instruments". The objective of this function is to provide a comprehensive overview of Romanian R&I actors and policies, simplify information access, and enhance transparency.

- SERVICE 1 could be provided through a webpage with four tabs, providing summary information on: (i) R&I governance, (ii) R&I performers, (iii) R&I enablers, and (iv) R&I infrastructure. In the short term (first year of RO-RIO's implementation), both services require establishing data sharing agreements and implementing automation techniques. Initially, SERVICE 1 would feature a tabular overview of R&I governance agencies, emphasizing their roles and responsibilities. Additionally, stakeholders highlighted the importance of including information on enablers and research infrastructure. Therefore, a short-term version of SERVICE 1 should also incorporate an initial overview of services provided by R&I enablers and research infrastructure to support collaboration and strategic investment planning.
- SERVICE 2 would present a graphical mapping of R&I instruments listed in the National Strategy for Research, Innovation and Smart Specialization[1] (SNCISI) and funding channeled through complementary policies. It would use an international taxonomy (for example, the World Bank's methodology for grouping R&I instruments in Policy Effectiveness Reviews in Science, Technology, and Innovation (PER STI) or a national taxonomy (by SNCISI's specific objectives). SERVICE 2 implementation would start with instruments managed by MCID, expanding its coverage over time. This service would provide information about the topic of each instrument, the total budget, the funder, and calls for proposals. It could inform both the design of the portfolio of R&I programs and the design of instruments, enhancing synergies and complementarities between instruments.

RO-RIO's second suggested function, "Research and analysis", could include two core services: SERVICE 3 "Visual analysis of Romanian R&I and productivity performance" and SERVICE 4 "Annual reports and in-depth studies on selected topics." This function aims to identify strengths and weaknesses in Romanian R&I through the analysis of four main dimensions of R&I based on international benchmarking: (i) resource analysis for R&I, covering expenditure, personnel, and research infrastructure (R&I levers) – including the monitoring of the application of national and European provisions regarding to the recruitment, placement and promotion of RDI personnel, (ii) analysis of enabling factors of R&I (R&I

[1] Governmental decision no. 933/2022 on the approval of SNCISI.

structural conditions), (iii) analysis of R&I performance (R&I performance), and (iv) understanding the role of R&I investments in the economy – including on productivity, and society (R&I outcomes).

- SERVICE 3 would provide an interactive indicator dashboard for international comparison of key indicators. Initially, it could prioritize indicators aligned with Vision 2030's targets, with expanding coverage over time. This report provides detailed guidance for the implementation of an indicator dashboard, including information on the principles of dashboards, available software, and guidance for visualization options (Appendix 7).
- SERVICE 4 involves comprehensive analyses covering the above aspects. Key findings can be summarized in annual reports guiding the Romanian R&I Coordination Councils' operational activities and in knowledge products addressing varying needs of analysis depth. In the short term, RO-RIO can enable the generation of automatic reports consolidating indicators from its dashboard, accompanied by brief explanations and a summary table enabling a quick comparison of available Romanian indicators with various benchmarks. Additionally, an initial version of the annual report can provide deeper insights into covered topics, fulfilling Romania's statutory obligation. This report offers direction on thematic analyses for RO-RIO, outlining suggested rationales, existing resources, and the anticipated value added across all identified aspects (Appendix 6).

RO-RIO's third suggested function, "Disseminate knowledge and information", could comprise three primary services: SERVICE 5 "Dissemination workshops and capacity building", SERVICE 6 "Knowledge base for evidence-based decisions in R&I" and SERVICE 7 "News and updates on topics related to R&I". This function aims to enhance the dissemination of evidence on R&I performance, increase the observatory's visibility, and improve the skills of Romanian R&I actors in producing and using rigorous evidence for decision-making.

- SERVICE 5 may include annual or bi-annual dissemination conferences showcasing RO-RIO's key products and results, along with regular capacity-building workshops on R&I evidence generation and utilization. The first event could promote the launch of the observatory's website and its inaugural annual report.
- SERVICE 6 could establish a digital library housing training materials and policy documents related to R&I, including RO-RIO's annual reports and knowledge materials produced under the World Bank and MCID's collaboration.
- SERVICE 7 might involve a newsfeed on RO-RIO's website or a digital newsletter distributed via email, offering updates on R&I developments (for example, calls for proposal, key innovation brought to the market, research findings or happening of an event) and new RO-RIO functions and services. In the short term, implementing a newsfeed to share updates on RO-RIO services and products could be prioritized.

Key success factors for RO-RIO

Several key lessons were derived from the experiences of international examples of RIOs and related institutions. Existing RIOs in other countries differ in terms of scope, governance and funding models, as well as in the services they provide. This report provides stand-alone case studies of RIOs and related institutions within Europe and beyond (Appendix 8). Despite these observed differences, common patterns emerge. Key lessons learned were grouped into eight success factors for establishing and operating a RIO: (i) a clear mission, (ii) user-driven functionalities and on-going development, (iii) continuous data provision to the observatory: (iv) highly skilled personnel, (v) effective governance structure, (vi) strategic partnerships and networks, (vii) sustainable fundings, and (viii) gradual implementation.

Services provided are derived from a RIO's mission and on-going needs assessment of its users. The insights gained from international case studies highlight the importance of designing the observatory's website to be user-friendly right from the outset. After RO-RIO's launch, quarterly consultations with representatives of key R&I governance agencies, user tests, and frequent (e.g., annual) user surveys should be set up to guide MCID on the continuous improvement of RO-RIO design and functionalities. The survey results should be summarized, actionable, and published on RO-RIO's website. They should be presented during an annual conference to demonstrate commitment to ongoing improvement and transparency.

Continuous access to relevant data represents another essential success factor for RO-RIO. RIOs rely on rigorous evidence derived from reliable and preferably repeatedly collected data for thorough analyses. However, obtaining the necessary rights to access such data proves to be a notable challenge. Data on public expenditures on outputs, outcomes and impacts of R&I policies that will be centralized by the National Integrated Monitoring Platform (PNIM), currently being developed by MCID, represents a key information source for the work of RO-RIO, which may require an amendment of existing data sharing agreements to extend access to RO-RIO. Continuous efforts are needed to convince data providers to make their data available at more granular levels for RO-RIO's analyses. This requires emphasizing the added value of a RIO in Romania, explicitly addressing specific needs of data providers within RO-RIO services, and demonstrating the effective accomplishment of initial steps such as hiring dedicated staff and developing a mock website. RO-RIO should rely on a team of skilled individuals possessing a mix of analytical, information technology (IT), and communication skills. As demonstrated by international practices, a RIO requires complementarity of balanced job profiles, including a blend of skills in IT expertise, data analysis and visualization, and science communication, with high levels of qualifications. Several stakeholders consulted for this report highlighted the current lack of sufficient analytical skills within MCID, underscoring the necessity of recruiting individuals with specialized expertise from outside the ministry.

Good governance ensures easy data access by the observatory, consistent data provision, its independence, scientific integrity and financial stability, and guards against control by a single entity or user group. Four main governance models of a RIO were identified: a ministerial unit, a governmental agency, an academic structure or a non-profit organization. Each model presents presumed advantages and risks that need to be assessed in the local context. Initially developed and operated by MCID, RO-RIO could either continue within MCID or transition to a location closer to the central government in the medium and long term.

A partnership and networking strategy should complement RO-RIO's activities, promoting platform use, fostering collaboration for additional knowledge production and knowledge exchange on best practices. The experiences of RIOs reviewed for this report point to four levels of partnerships and networks: (i) with data providers, (ii) with target users, (iii) with experts, and (iv) with local and international working groups working towards similar goals. The legal foundation of the PNIM establishes a formal relationship between key institutional users and RO-RIO. This framework could be enhanced with the inclusion of the Ministry of Economy, Entrepreneurship and Tourism (MEET) and the Ministry of Finance (MoF), enabling a greater coordination over policies aiming at productivity enhancement and granting access to firm-level data, essential to monitor and evaluate the impact of public investments in R&I. This framework could also include the formal recognition of the roles of the Committee for Coordination of Smart Specialization (CCSI) and of the National Committee for Science, Technology, and Innovation in RO-RIO's governance. RO-RIO should aim to form partnerships with local initiatives focused on enhancing governance, such as the National Productivity Committee, the Romanian Innovation Lab, and the Digital Policy Lab. RO-RIO

should leverage the expertise of international working groups in which MCID is involved, such the Digital Economy and the Working Party of National Experts on Science and Technology Indicators (NESTI) of the Organisation for Economic Co-operation and Development (OECD), along with the joint European Commission (EC)-OECD project Research and Innovation Careers Observatory (ReICO). Finally, RO-RIO should elaborate an effective outreach strategy to promote awareness and use of RO-RIO's activities, including active engagement with RO-RIO users through various communication channels and regular engagement.

All observatories reviewed in the case studies depend, to varying degrees, on national public funding, thus necessitating political backing. Most of the funding of RIOs comes from national public funding, whose sustainability hinges on political support that can be fostered by demonstrating the observatory's benefits to national R&I stakeholders. European Union (EU) grants provide financing opportunities to RIOs that can be used either directly or indirectly, whether through proprietary projects, collaborative partnerships, or by serving as a consultancy services provider for external entities. In the near future, RO-RIO could seek to attract extra funding from the European Structural and Investment Funds (ESIF) programs, such as from programs dedicated to strengthening the administrative capacity and/or technical assistance.

RO-RIO's institutional set-up

Building RO-RIO and implementing its core services requires technical, legal, administrative, and political considerations by MCID, who will initially lead RO-RIO's institutional setup.

In technical feasibility terms, the PNIM could serve as the "back office" for data while RO-RIO could serve as the "front office" for user interaction with data. This means that both platforms need a set of IT requirements that require a specific set of internal IT skills as well as outsourced knowledge.

In terms of legal requirements, the methodological norms governing the monitoring and evaluation (M&E) of SNCISI[2] provide the legal definition of an R&I observatory and its purpose, but several elements are still to be determined in legislative terms. Hence, two further legal procedures could be followed for the establishment of RO-RIO. First, MCID should promote the inclusion of a legal setup for RO-RIO in the law, so that it provides particularly RO-RIO's clear and comprehensive mission, and it defines its legal nature (whether a service, unit, or other entity), its functions (and corresponding services as proposed in this report), and its responsibilities (including data gathering routines and publishing of reports), as has been the case in international case studies. A second procedure could consist of a Ministerial Order from MCID to act as the policy and methodological guideline for the observatory and its stakeholders.

As for administrative considerations, this report includes a gradual approach to the buildup of RO-RIO, based on a first prioritization of its services. In the short-term, RO-RIO is envisioned to operate as a unit consisting of three staff members: (i) RIO Manager, (ii) Data Manager, and (iii) Data Scientist. In the medium term, a Research and Analysis Leader and IT professional become important, followed by the recruitment of a Researcher and a Science Communication and Outreach Specialist. RO-RIO's staff can be supported by a Steering Committee overseeing the observatory and an Advisory Committee specialized in methodological and technical guidance. The Steering Committee should be composed by a group of senior representatives from the key stakeholders of RO-RIO, including a

[2] MCID Order no. 21903/2023 on the approval of the methodological norms governing the M&E of SNCISI.

representative from the National Committee for Science, Technology and Innovation, a representative from the CCSI, senior officials from MCID, the Executive Agency for Higher Education and R&I Funding (UEFISCDI), the Ministry of European Investments and Projects (MIPE) and MEET, as well as representatives from regional development agencies (RDAs), from the Romanian Academies, and from private sector organizations. The Advisory Committee should be formed by technical representatives from those same institutions, as well as one or two experts in R&I indicators and statistical methodologies (for instance, a representative from NESTI).

An agile management approach for RO-RIO could significantly enhance its operational efficiency and achieve results with limited staff and resources. The iterative cycles used in *Agile* management—which include planning phases, implementation steps through a so-called sprint, and retrospective sessions—can improve efficiency and help gain lessons on how to optimize the observatory's work.

This report provides initial estimates of the budget required for RO-RIO, based on the anticipated tasks, staff requirements, and its planned gradual implementation. These estimations lead to a suggested annual budget of EUR 400K (under the scenario of market salary rates—around EUR 3m for 5 years) or EUR 274K (under the scenario of salaries in accordance with Law no. 153/2017—around EUR 1,8m for 5 years). Exploring options to provide competitive market-based salary rates may be essential to attract highly skilled staff required for the success of RO-RIO.

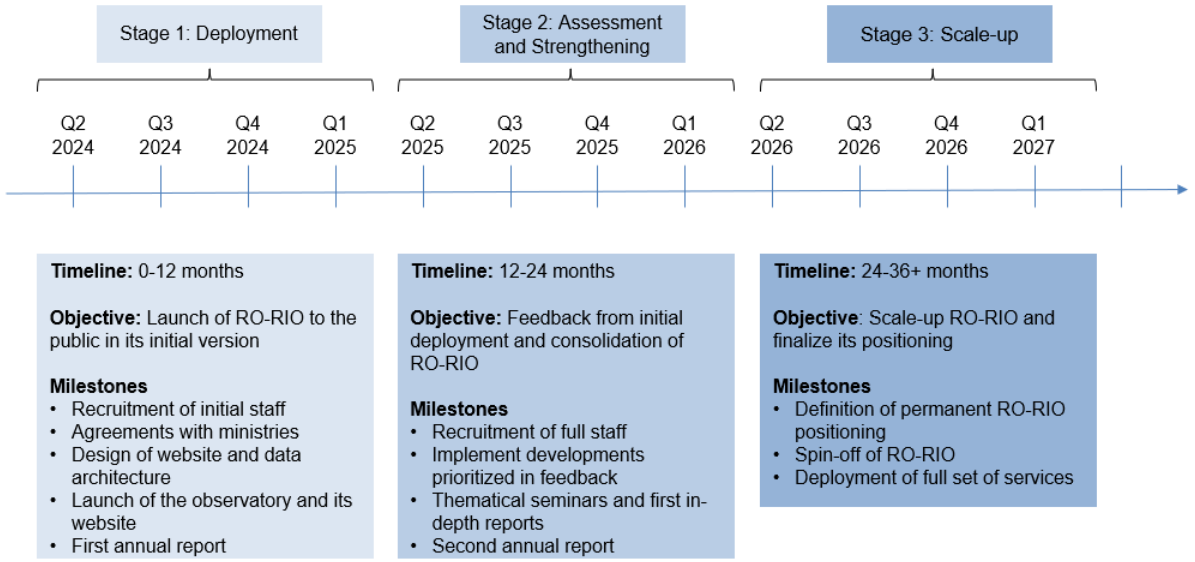
MCID will be the founding host of RO-RIO in its first stage, but in the medium term the observatory could be either continued to be strengthened internally or be spun-off to a different location of the Romanian Government to fulfill other policy objectives. This report considers four alternatives for the medium-term operation of RO-RIO: first, as a service within the Directorate of Policies and Strategies for Research, Development, and Innovation and Technological Transfer (DPSCDITT) in MCID; second, as a permanent unit reporting directly to the Minister in MCID; third, as a unit within an independent agency focused on R&I or productivity; and fourth, as a service under a directorate at the General Secretariat of the Government (GSG). This report assesses the strengths and weaknesses of each of these alternatives based on a comparison of the political viability of achieving the technical and administrative requirements needed to deliver the core services proposed for RO-RIO. This comparative analysis confirms that there is no single answer to the positioning of RO-RIO, but it portrays a balance of strengths and risks that could be used by MCID and the Romanian Government to better plan the evolution of the observatory.

RO-RIO's workplan

RO-RIO should be developed in a gradual manner, following a roadmap to implement its service lines in a sequence of three stages: (i) deployment; (ii) assessment and strengthening; and (iii) scale-up. The deployment stage's objective is the launch of RO-RIO to the public in its initial version, including its website and an initial set of services. Priority services include (i) SERVICE 1: a basic overview of the R&I System, including initial versions of the tab for R&I governance, the tab for R&I enablers and the tab for research and technology infrastructure, (ii) SERVICE 3: an initial dashboard with priority indicators on R&I funding performance, (iii) SERVICE 4: reports generated automatically based on the indicator dashboard and a first annual report, and (v) SERVICE 6: an initial knowledge base, including selected reports and knowledge products produced in collaboration with the World Bank. This report estimates that the official RO-RIO website could be launched in Q2 2025, with a twelve-month development stage beginning in Q2 2024 and led by MCID, who is also going to lead the foundational decisions on the observatory and the recruiting of its core team. The

assessment and strengthening stage, spanning between Q2 2025 and Q2 2026, seeks to assess the lessons from the initial deployment and consolidate the observatory's services. The objective of the scale up stage, starting from Q2 2026 onwards, is to scale-up RO-RIO by developing its complete set of services and finalize its institutional positioning in the R&I system. The first step in this scale-up stage is the analysis and definition of the final institutional positioning of RO-RIO, according to the Romanian Government's assessment of the alternatives presented in this report. As the spinning-off process occurs, the staff of the observatory can work on the development of the complete set of services. The figure below provides an overview of RO-RIO's phased implementation, highlighting its objectives and milestones.

Figure 1 Overview of RO-RIO's phased implementation



Source: World Bank.

Next steps

This report should be followed by three main activities: (i) a continuous engagement with MCID and key representatives of R&I governance agencies; (ii) the consultation of non-institutional target users of RO-RIO; and (iii) the development of templates for RO-RIO prioritized services. This report proposes an initial framework for RO-RIO, laying the groundwork for discussions between MCID and other Romanian R&I governance agencies. The World Bank's initial need assessment could be complemented by organizing a round table where stakeholders from public administration come together to reach agreement on RO-RIO's mission, ensuring a collective understanding of the mission's objectives and priority services. This assessment could be extended to additional target groups of RO-RIO, such as researchers, innovative firms and R&I enablers to better guide the operationalization of RO-RIO's priority services. Following this report, the World Bank will support MCID on shaping the design of core services and supporting the design of a mock website, which could be integrated with the PNIM. This mock website will serve as a tool for engaging institutional stakeholders through a live demonstration of the observatory, allowing for the collection of valuable feedback on its format. Subsequently, the World Bank, in partnership with MCID, will provide inputs to an initial template for RO-RIO's annual report and to a first draft report to determine the optimal format for this critical output.

SECTION 1

INTRODUCTION

1. Introduction

1.1 Objectives of the report

- This report presents key recommendations for establishing a Romanian Research and Innovation Observatory.

This report offers recommendations that the Government of Romania could use to establish a Research and Innovation Observatory (RIO). The recommendations draw on a domestic review and institutional needs assessment (including interviews with representatives of 12 R&I governance agencies) and international best practices (including the review of 23 institutions' websites and 13 interviews). They are intended to inform the design and creation of a Romanian RIO (RO-RIO). The report covers aspects of governance, operations, evaluation, estimated resources, and core services. It presents a suggested framework for RO-RIO, laying the groundwork for initial discussions among the institutions directly engaged in its operations. This deliverable will be followed by regular consultations with the Ministry of Research, Innovation, and Digitalization (MCID) and relevant stakeholders to further guide the operationalization of core services of RO-RIO.

1.2 What is a RIO?

- A RIO systematically centralizes, analyzes, and disseminates information to strategically direct R&I funding towards enhancing productivity and achieving broader economic and societal benefits, often leveraging a structured website to provide some of its services.

A RIO compiles, produces, and disseminates information to help distribute R&I funds based on their potential to improve productivity and other economic and societal outcomes. The purpose of a RIO is to guide the allocation of public and private financial resources in R&I to maximize outcomes, including productivity. A RIO therefore aims to fill information and knowledge gaps concerning the current state and development of R&I. A review of international good practices (whose methodology can be found in Appendix 1) reveals that a RIO gathers a comprehensive and robust repository of information and produces evidence to guide the allocation of public and private financial resources in R&I. It thereby addresses information and knowledge gaps related to R&I sectoral trends, actors, and funding. As such, a RIO contributes to a greater understanding of how investments in R&I can lead to better economic and societal outcomes, including gains in productivity. (See Box 1.)

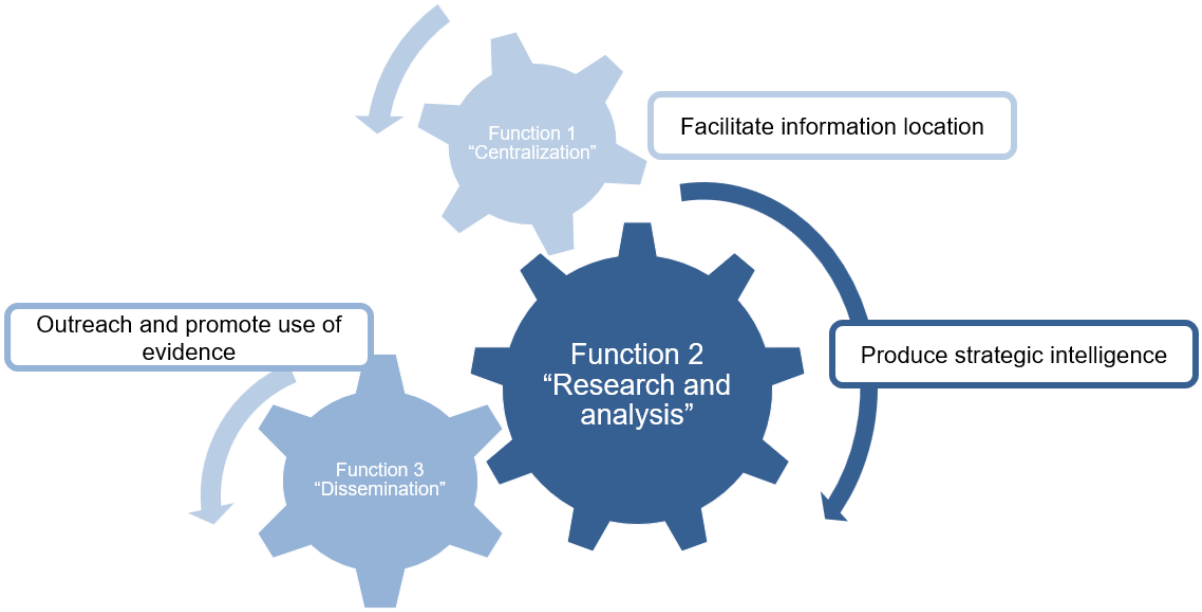
Box 1 Why introduce productivity in the observatory?

Productivity is a primary goal of R&I policies because it is closely tied to economic growth, competitiveness, and living standards in an economy (European Commission, 2022b). While R&I activities are fundamental to the increase in productivity, the effectiveness of this link relies on companies' capacity to absorb and disseminate innovation. A RIO can play a crucial role by providing a deeper understanding of the factors that stimulate innovation within firms and facilitate the effective diffusion of innovation across the economy. This, in turn, allows for more informed policymaking aimed at enhancing competitiveness and can contribute to better coordination between R&I and competitiveness policies, helping to break existing policy silos. Therefore, linking R&I activities with productivity should be an explicit objective of the observatory.

Source: World Bank.

A RIO performs three primary functions: (i) centralizing, (ii) analyzing, and (iii) disseminating information to R&I stakeholders and society. Figure 2 illustrates the three interrelated primary functions of a RIO. By performing Function 1 "Centralization," a RIO aims at centralizing information on R&I inputs, outputs, and outcomes. This can include information on the governance of the R&I system, its actors, infrastructure, funding, outputs and datasets on R&I activities and their economic and societal effects, including on productivity. Function 2 "Research and analysis" is at the core of a RIO's activities. A RIO analyzes its centralized information on R&I (together with a potentially wide range of other data on R&I) to identify local strengths and weaknesses within an international context. Function 3 "Dissemination" is essential to ensure the results of these analyses, or analyses performed by other knowledge institutions, effectively reach their intended audiences. Effectively reaching non-experts, including citizens, requires presenting results in an understandable and engaging format. The format could be an indicator dashboard, briefs, reports, or workshops, among other possibilities.

Figure 2 The three primary functions of a RIO



Source: World Bank.

A RIO uses technology to facilitate oversight of the R&I system, enhance productivity, and coordinate R&I and productivity stakeholders. Typically, a RIO is accompanied by a well-structured website, contributing to greater visibility of the observatory's activities and easy access to its services. A RIO's website can facilitate coordination among R&I and productivity stakeholders by improving information access. It serves as a centralized source of information for all users, reaching out to diverse stakeholders from various ministries, agencies, sectors, and roles within the R&I ecosystem.

1.3 Why a RIO?

- The expected impact of a RIO is to increase the impact of R&I investments on productivity and other outcomes.
- By performing the three primary functions described in Section 1.2 "What is a RIO?", a RIO can achieve the expected impact through ten intermediary outcomes: providing stakeholders with better access to relevant data, making information more actionable, providing greater visibility in the use of public funds and funding gaps, breaking silos of R&I information and fundings, using evidence to guide decisions on future investments in

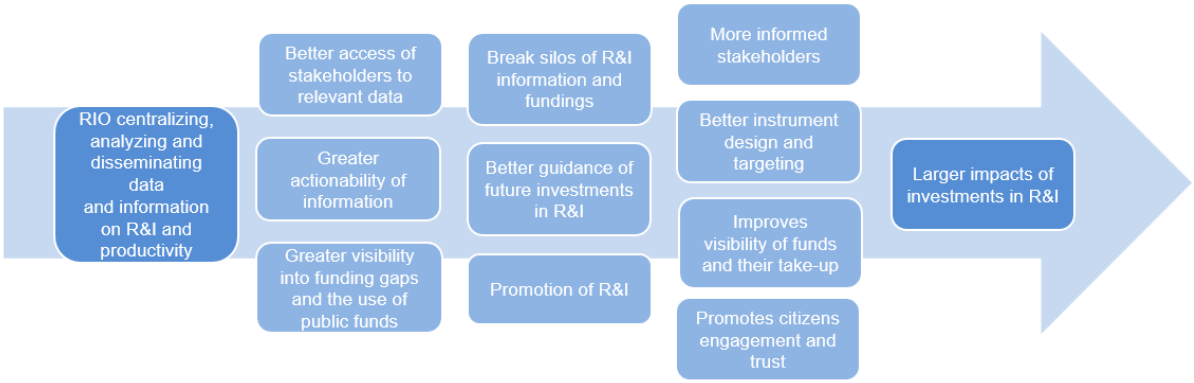
R&I, promoting R&I, making stakeholders more informed, developing better instrument designs and targeting, improving visibility and take up of funds, and promoting citizen engagement and trust.

- By achieving these ten outcomes, a RIO provides key benefits that enhance the R&I landscape, ultimately benefiting funders, agencies, performers, enablers, and citizens.
- Long-term success of a RIO depends on quality information, skilled staff, and sustainable financing; overcoming barriers like limited information access, resource constraints, and lack of actionable analysis is crucial for RIO effectiveness.

RIOs rose from the need to understand the results of R&I investments to increase the impact of R&I on productivity and other outcomes. RIOs identified in our mapping (Appendix 1) contribute to a greater understanding of the results of investments in R&I (Ohayon et al., 2014). The need for such an improved understanding usually came from both within and outside public administration, with a growing demand from citizens, researchers, private companies, and international organizations for more visibility into the use of public funds and more evaluations of public policies.

A RIO contributes to enhancing the impacts of investments in R&I. Figure 3 illustrates the theory of change (ToC) of a RIO. Through its three primary functions, a RIO eases stakeholders' access to relevant data and information and makes this information more actionable. Greater dissemination of information leads to greater visibility into the use of public funds and funding gaps. By fulfilling these three primary functions, a RIO produces evidence that guides future investments in R&I while promoting local R&I investments and activities. Actionable evidence results in more informed stakeholders mobilizing this information to design, update, and improve the targeting of R&I instruments. Easier access to information improves the visibility and take up of funds, fosters citizens' engagement in public debate on R&I, and contributes to greater trust in the R&I system.[3] In the longer term, these intermediary outcomes are expected to increase the impacts of investments in R&I.

Figure 3 The theory of change of a RIO



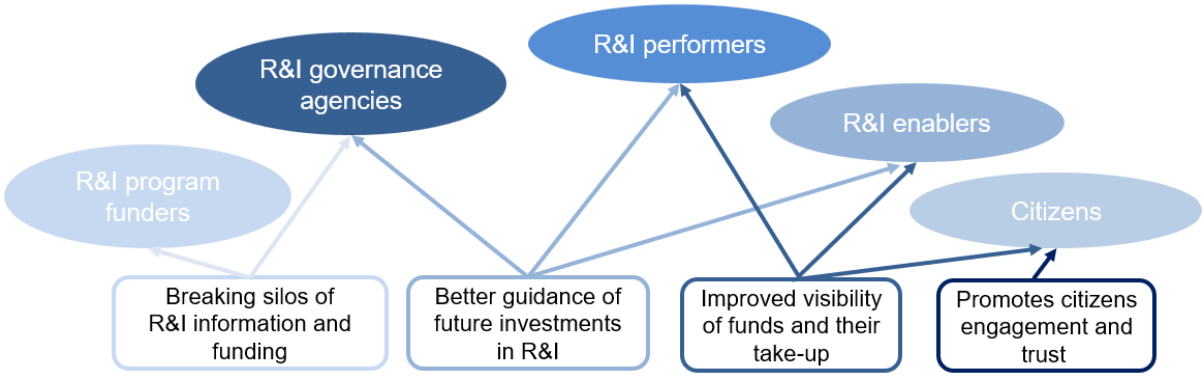
Note: This theoretical pathway relies on several assumptions. Among other things, a RIO should provide high-quality and relevant information to its target users and effectively reach its target audience. This requires highly skilled staff and adequate long-term financing of its activities.
Source: World Bank.

Through achieving the outcomes in the ToC, a RIO provides a variety of benefits that support all R&I and productivity stakeholders. Figure 4 summarizes the main reported target groups and benefits of RIOs identified for this report. Through the outcome "Better

[3] (Alessandro et al., 2021) conducted an online randomized experiment in Argentina, demonstrating that providing information to citizens enhances their trust in the government. However, they found that this relationship is mediated by the government's performance.

access of stakeholders to relevant data", a RIO helps to break information and funding silos in the innovation system, contributing to more complementarity and synergies of funds. This benefits R&I program funders and R&I governance agencies. Through the outcome "Greater actionability of information", a RIO contributes to better guidance of future investments in R&I and productivity by easing access to evidence regarding what works and does not work and by identifying strengths and weaknesses in international comparison, areas of prioritization, and relevant societal challenges. This benefits R&I governance agencies, R&I performers, and R&I enablers. Through the outcome "Greater visibility of the use of public funds and funding gaps," a RIO also improves the visibility of funds, leading to more applications and more diverse applications. This benefits R&I performers, R&I enablers, and citizens. Finally, through the outcome "Promotion of R&I," a RIO contributes to greater citizen engagement and trust in the R&I system, which benefits citizens.

Figure 4 Key target groups and benefits of RIOs



Source: World Bank.

The fundamental assumptions of this ToC revolve around addressing current barriers hindering the use of evidence throughout the policy cycle. These barriers include constraints such as limited time or knowledge to locate relevant information, inadequate resources (both human and financial) to analyze existing data, and a lack of actionability and visibility of analysis on the R&I system. To effectively implement this ToC, a RIO must successfully address these barriers and reach its target audience. This requires dedicating sufficient human and financial resources to the RIO to ensure timely updates and content maintenance.

1.4 Why a RIO in Romania?

- Romania has experienced substantial economic growth and is now a high-income country. Yet, it struggles with innovation challenges and requires enhanced investment in R&I to sustain productivity and competitiveness.
- Romania demonstrates international competitiveness in science, technology, and the economy, with solid sectors and innovative companies. However, it requires strategic support and policy interventions to leverage its Smart Specialization domains and align with the Sustainable Development Goals.
- To enhance Romania's R&I performance, it is essential to improve the design, implementation, and coordination of R&I instruments supported by solid evidence while addressing the system's fragmentation and lack of evidence use in policy cycles.
- The establishment of a RIO in Romania would centralize R&I data, enhance evidence-based decision-making, and demonstrate the sector's impact on productivity and other economic and societal outcomes.

- The Government of Romania has a clear policy mandate to monitor the national R&I system. However, existing bodies based on this mandate provide limited centralization, analysis, and dissemination of information on the Romanian R&I system.
- The PNIM collects data and provides visualizations for users, but it lacks several features that RO-RIO would need. Thus, RO-RIO has the potential to add significant value to the PNIM and could clearly complement its role.

1.4.1 Romania's R&I landscape

Romania has taken major steps to enhance its economic growth over the last two decades but continues to face innovation challenges. Nowadays, Romania is a high-income country with a complex economy[4] and one of the highest economic growth rates among the EU countries over the last two decades (World Bank, 2023b). Nevertheless, Romania's innovation performance is modest, and the gap between Romania and other EU countries is widening. According to the 2023 European Innovation Scoreboard (EIS), Romania is last in the EU, with relative strengths in digitalization and exports and weaknesses in human resources, business innovation, linkages, and employment in innovative enterprises. Similarly, Romania ranks 47th among 132 economies featured in the 2023 Global Innovation Index (GII), performing below expectations for its level of development. It appears from the index that Romania produces more innovation outputs than average, given its level of innovation investments. Still, it remains below the regional average and the high-income group average in all index categories.

The country has made significant progress in catching up with productivity levels, but limited investments in R&I threaten this trend. Like other catching-up countries in Central and Eastern Europe, such as Poland and Hungary, Romania has experienced rapid productivity growth in recent decades. It had average labor productivity growth of 3.5% between 2010 and 2019 compared to an OECD average of 1% (OECD, 2022). Yet, this growth was fueled mainly by foreign direct investments, advances in global value chains, and capital deepening rather than by investments in R&I (European Commission, 2022b). Firm-level evidence shows substantial differences in productivity performance between domestic and international firms and between micro/small and medium/large enterprises. At the aggregate level, huge productivity disparities exist across sectors and regions. As the return to physical capital accumulation diminishes, productivity growth decelerates. With an aging population, Romania faces a near-term risk of a slowdown in its productivity growth. In such conditions, shifting to an innovation-driven growth model fueled by investments in human capital and R&I will be essential to keep Romania on a competitive and sustainable productivity growth path.

Romania shows many signs of international economic competitiveness, both in science and technology and in the economy at large. Pockets of excellence exist in some scientific areas, such as engineering, electrical and electronics, material science, and chemistry (European Commission, 2022a). The country is also home to several successful unicorns (such as UiPath, Bitdefender, and Elrond) and many dynamic technology startups. The automotive and ICT sectors are vital innovation hubs and export champions, whereas the energy and agri-food sectors show high economic potential.

Romania needs to support these economic competitive advantages better. Matching knowledge and innovation strengths to such economic competitive advantages is the

[4] The Harvard Atlas of Economic Complexity (available at https://atlas.cid.harvard.edu/countries/185) rates Romania's economy as the 19th most complex in the world's 133 economies.

underlying rationale of Smart Specialization.[5] Collecting ample evidence of advances in Smart Specialization domains is imperative for Romania. Moreover, the evidence must be further translated into better-targeted and more impactful policy interventions. The same is true for Romania's Strategic Research Agendas, which are connected to the Sustainable Development Goals (SDGs). Moving up in global value chains, supporting the digital and green transitions, and contributing to the socio-economic goals associated with the SDGs are ultimate objectives for modern transformative innovation policies and Strategic Research Agendas.

Enhancing Romanian performance in R&I requires improving practices in R&I instrument design, implementation, and coordination backed by robust evidence. The World Bank conducted a PER STI in Romania (World Bank, 2023a), based on a policy mix analysis of all instruments supporting R&I in Romania in the 2014–2020 programming period and a functional analysis of the key R&I support instruments. Among the three key challenges identified, there is a critical need for improved practices in R&I instrument design, implementation, and coordination. Notably, there is a pervasive lack of use of evidence throughout the policy cycle, from instrument design to implementation tracking.

Fragmentation is a crucial challenge for the Romanian R&I system. The Romanian R&I system involves a variety of R&I governance agencies, R&I performers (such as researchers and research organizations), and enablers (such as innovation and technology transfer entities and innovation hubs) of varying capacities, missions, and visibility. (See Appendix 4 for an overview of the Romanian R&I system.) Horizontal coordination between different ministries and agencies with a role in the R&I system and vertical coordination between national and regional R&I actors remain challenging, resulting in limited oversight of the R&I system and its performance. The landscape of public R&D units is very diverse and is governed by different regulatory frameworks. R&I enablers play a crucial role in connecting researchers and innovators to industry and society and in matching the offer and demand for knowledge and technology. To better support R&I enablers, the ROStartup white paper (ROStartUp, 2021) calls for more information on these actors and their capacities and needs.

1.4.2 Potential benefits of a RIO in Romania

Having a RIO in place would help Romania increase the importance of the R&I sector to the economy and society. Romania acknowledges the significance of the R&I sector in almost all public strategies and plans. Nevertheless, its support for the R&I sector is not sufficiently aligned with global trends. A RIO focuses on centralizing R&I data, providing in-depth thematic analyses, and disseminating R&I results. As such, a RIO can enable decision-making better informed by evidence on the impact of R&I on productivity growth, competitiveness, and socio-economic outcomes. Many of the 13 RIOs and related institutions interviewed for this report experienced this transformation. Ultimately, a RIO can be a strategic intelligence tool that produces a more coherent vision for prioritizing R&I investments.

Improving the centralization, analysis, and dissemination of information on Romanian R&I would do more than facilitate evidence-based decision-making. Enhancing access to information and knowledge about the performance of Romanian R&I could improve visibility and trust in the government's actions among R&I performers, enablers, and society. Centralizing information about R&I funds can contribute to a broader outreach of R&I policies, potentially attracting a larger pool of potential beneficiaries.

[5] Smart Specialization is a location-based strategic concept aimed at promoting structural transformation towards knowledge- and innovation-driven growth, where regional development priorities are set based on the potential success of existing knowledge and technologies. Please find more information here: https://s3platform.jrc.ec.europa.eu/what-we-do.

1.4.3 Romania's policy mandate for improved oversight of R&I performance

The Government of Romania has a clear policy mandate to monitor the national R&I system. This mandate is grounded in four sources—Vision 2030, the PSF Open Report, the National Recovery and Resilience Plan (NRRP), and MCID Order no. 21903/2023.

Vision 2030 of the *National Strategy Research, Innovation and Smart Specialization* established responsibility for system-level monitoring. The MCID drafted the *National Strategy for Research, Innovation, and Smart Specialization 2022–2027* (abbreviated SNCISI)[6] to outline Vision 2030 for the Romanian R&I system. This vision emphasizes recognizing and supporting excellence, rewarding performance, and fostering public-private cooperation in R&I. The envisioned budget for SNCISI during the 2022–2027 period of approximately €16.6 billion—about 1% of the gross domestic product (GDP)—(see Annex 2 of SNCISI) was defined to meet this objective and includes a variety of funding sources (see Table 20 in Appendix 4 for a complete list).[7] However, at the time of writing, the goal of 1% of GDP for public R&D spending by 2027 (of 0.12% in 2022) is unlikely to be met.

The PSF Open Report specifically recommends setting up a RIO. It outlines the result of an independent review of Romania's R&I system conducted between 2021 and 2022 by a panel of independent experts. Recommendation 3.2 relates to establishing a RIO in Romania: "Establish an R&I Observatory, to map Romania's best R&I strengths in the international context and study national developments in the light of EU and international trends. Reinforce the use of such evidence to serve the needs of the MCID in terms of policy implementation (including for an internationalization strategy)" (European Commission, 2022a). The PSF panel's key recommendations for improving the quality and performance of the Romanian R&I system (European Commission, 2022a) highlight the importance of promoting policy intelligence in strategic planning by establishing an R&I Observatory. Setting up a RIO is part of Romania's commitment to fulfilling 80% of the recommendations made by the PSF panel. Box 2 highlights how the RIO proposed in this report would address Recommendation 3.2 and contribute to other recommendations of the PSF report.

Box 2 RO-RIO's potential contribution to PSF recommendations

RO-RIO's key objectives and primary functions proposed in this report are based on the recommendations of the PSF Report (see Appendix 5 for more details):

- The PSF report highlights ***four key objectives*** of RO-RIO:

"**Recommendation 3.2**: Establish an R&I Observatory, to **map Romania's best R&I strengths in the international context [*Objective 1*]** and **study national developments in the light of EU and international trends [*Objective 2*]**. **Reinforce the use of such evidence [*Objective 3*]** to serve the needs of the MCID in terms of policy implementation (including for an **internationalisation strategy [*Objective 4*]** – see Recommendation 9.1)." ((European Commission, 2022a), p.27).

- The PSF report emphasize ***three primary functions*** of RO-RIO, aligned with primary functions identified in our international case studies of RIOs:

[6] Governance decision no. 933/2022 on the approval of SNCISI.

[7] Table 20 in Appendix 4 highlights the main funding sources for SNCISI, along with the managing authorities and implementing bodies responsible for SNCISI's execution.

"A Romanian R&I Observatory could **collect statistical data from international databases [*Function 1: centralization of data and information*]**, **analyse them in the Romanian context, and map Romania's position [*Function 2: research and analysis*]**. **The information should be shared [*Function 3: dissemination*]** with policy makers and the public." ((European Commission, 2022a), p.59).

- RO-RIO's proposed **mission statement** directly **serves these objectives** and emphasizes RO-RIO's core functions.
- RO-RIO's proposed **roles and services** further contribute to **other PSF recommendations** (Recommendations 1.3, 3.1, 3.3, 6.1, 7.1, 8.3 and 9.1).
- RO-RIO's **prioritization strategy** accounts for services most valuable to **policy makers and the public, two key target groups** emphasized by the PSF report ((European Commission, 2022a), p.59).

Source: World Bank, based on (European Commission, 2022a).

MCID's guidance related to the NRRP requires that a RIO be built. As part of the NRRP, Romania committed to enhancing the monitoring of the national R&I system and gathering intelligence to guide R&I stakeholders. In 2023, MCID issued Order No. 21903, outlining legal and technical guidelines as initial steps in implementing these commitments. This includes the development of a monitoring platform for SNCISI, that is, the PNIM. The PNIM aims at monitoring SNCISI by collecting information on policy implementation at the project, call, and program levels from program and sub-program coordinators and managers involved in the implementation of SNCISI, in addition to system-level indicators from non-governmental sources. The Order specifies key performance indicators (KPIs) for the PNIM and provides guidelines for collaboration with MCID for data provision. Additionally, it mentions the future development of a RIO as a further function of the platform. The RIO is also mentioned in the Law on the Status of Research, Development and Innovation Personnel, under approval in May 2024, in its role of monitoring research careers: "Art.5.- (1) MCID has the following direct responsibilities: (…)
e) in monitoring the application of national and European provisions regarding to the recruitment, placement and promotion of RDI personnel, including through the Research and Innovation Observatory, which responds to the recommendations regarding the monitoring of research careers provided for in the European Charter of Researchers".

Existing bodies based on these mandates provide limited centralization, analysis, and dissemination of information on the Romanian R&I system. Currently, the DPSCDITT of MCID leads responsibilities over the design, implementation, and update of monitoring at the system level. Together with the PSF unit of MCID, DPSCDITT is responsible for the establishment of RO-RIO. The UEFISCDI and MCID dominate current efforts in centralizing information on the Romania R&I system. UEFISCDI manages multiple national registries, and MCID has developed the National Integrated Monitoring Platform (PNIM) of SNCISI. Dissemination of R&I information primarily takes the form of events organized by MCID and UEFISCDI, and citizen engagement in consultative policy processes.[8] At the moment, limited information on the position and evolution of Romanian R&I and productivity in the international context hampers the visibility of Romania's strengths and hinders the ability to identify and address weaknesses in R&I.

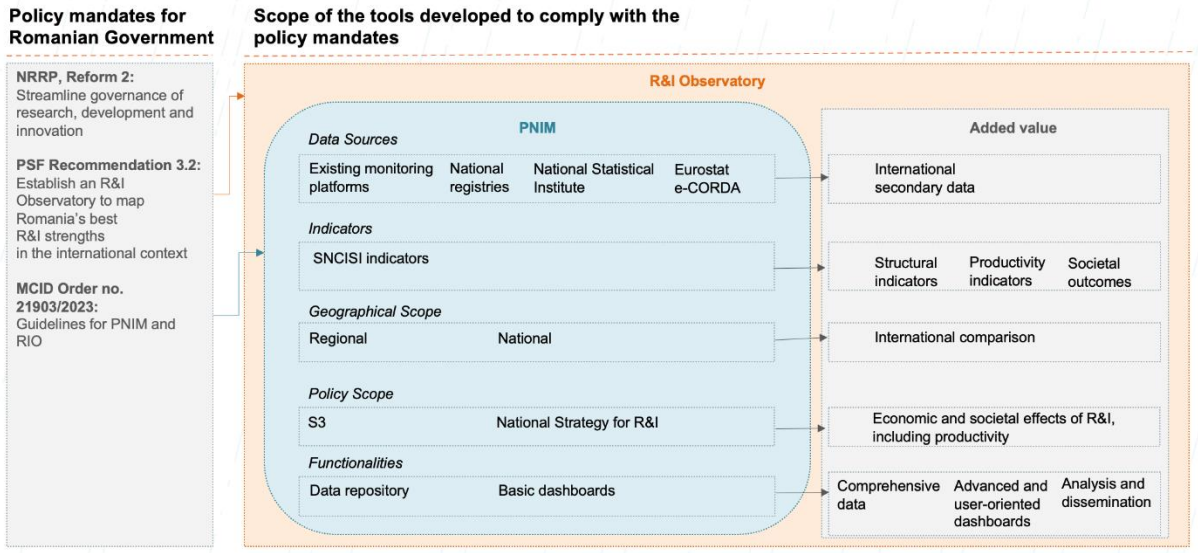
[8] MCID and UEFISCDI organized public consultations during the development of the SNCISI. Similarly, the voice of society is part of the consultative processes for the development of the Strategic Research Agendas and in the Entrepreneurial Discovery Processes. MCID and UEFISCDI organize conferences to promote R&I to society, for example, the annual Romanian Research Gala which is an initiative through which results of Romanian research are promoted, also for society. UEFISCDI, MCID, RDAs and the Romanian Academy operate newsfeeds on their website and disseminate relevant information through digital newsletters.

UEFISCDI plays a key role in centralizing and producing knowledge on Romanian R&I, but focuses on a subset of instruments and information. UEFISCDI implements about 15 percent of national R&I funds and manages national registries of researchers, R&I organizations, and research and technology infrastructure. However, UEFISCDI's evidence on national R&I funds do not cover all funds, and its registries either lack completeness or require supplementary information to better guide R&I investments and foster collaboration.

The PNIM collects data on the monitoring of SNCISI and provides visualizations for users. MCID has undertaken substantial efforts to enhance its oversight of public R&I funds through the implementation of the PNIM. In fact, in the PNIM, MCID has developed a set of features that implement the policy mandates for the Romanian government, as is shown in Figure 5. MCID developed the PNIM in 2023 and early 2024. During this period, MCID carried out a comprehensive effort to gather the indicators outlined by the PNIM and set up an initial data website. Led by DPSCDITT, MCID undertook a comprehensive effort to locate and gather data on the indicators of the monitoring of SNCISI, including both internal data from MCID and external data from ministries and agencies of the Romanian government as well as from the EU. As an initial interface, MCID created a PNIM website that gathers data in a collection of dashboards listing the SNCISI national and regional monitoring indicators by objectives and level (national or regional) and allowing users to visualize each indicator in the form of bar charts.[9] The PNIM plans to include public resources such as documentation on the Entrepreneurial Discovery Process[10,] surveys, questionnaires, and evaluation reports. The PNIM's data on the monitoring of R&I public funds should include existing Romanian platforms (including MySMIS, EvoC, and Nucleu, among others), data from program and sub-program managers not available in existing platforms, and EU data from Eurostat and e-CORDA.[11] Monitoring data is captured at the project, call, and program level. It is planned to be complemented by additional secondary sources on the capacities and performance of the R&I system, including national registries (such as BrainMap or National Institute of Statistics (INS). Finally, the functionalities embedded in its current website include a data and policy repository and a set of basic dashboards. MCID's objective is to finalize the PNIM data agreements with R&I governance agencies In Q3 2024.

[9] PNIM can be consulted at https://www.pnim.mcid.gov.ro/dashboard/dashboards. MCID is still in the process of securing data sharing agreements with Romanian R&I governance agencies. Some data available on the platform is testing data used to evaluate the website's functionalities.
[10] https://s3platform.jrc.ec.europa.eu/en/w/the-entrepreneurial-discovery-process
[11] e-CORDA (External Common Research Data Warehouse) is a non-publicly available database established by EC in 2007. e-CORDA contains rich information on all project proposals submitted under Research and Technological Development Framework Programs' calls for proposals.

Figure 5 Policy mandates and scope of the PNIM and RO-RIO



Source: World Bank analysis based on (European Commission, 2022a).

RO-RIO could complement the PNIM, providing additional value to the PNIM for each of the features described above and contributing to evidence-based decision-making. The PNIM lacks several features that RO-RIO would need. Thus, RO-RIO has the potential to provide significant added value to the PNIM and could clearly complement its role (see Figure 5). The PNIM's objective is to facilitate the monitoring of SNCISI by all Romanian R&I governance agencies. RO-RIO aims at identifying Romania's best R&I strengths and performance in the international context. Its target audience can extend beyond R&I governance agencies to engage with R&I performers, enablers, and citizens. Although the PNIM aligns with its objective to meet the evidence needs on the monitoring of SNCISI, RO-RIO would need to provide more comprehensive data, advanced user-oriented dashboards, and in-depth data analysis. Regarding data sources, RO-RIO could incorporate secondary data from other countries on R&I investments and performance, providing valuable benchmarks for Romania. As such, RO-RIO would extend the PNIM's geographical scope to international comparisons. In terms of indicators, RO-RIO could offer additional insights into the overall performance of the R&I system, including structural, productivity, and societal outcome indicators, supplementing those of the PNIM. RO-RIO could extend the PNIM's policy focus to encompass the effects of R&I on productivity and society. In terms of additional functionalities, RO-RIO could serve as a central repository for R&I policies and data, while also developing more advanced and user-friendly dashboards. Beyond data centralization, RO-RIO could assume responsibility for analyzing data in reports and conducting dissemination efforts, filling a current gap in Romania. Each of these propositions is discussed in more length in Section 2. "Core services to be provided by RO-RIO".

1.5 Scope of the RAS

- This report contributes to the third pillar of the MCID–World Bank Reimbursable Advisory Services (RAS) agreement. Specifically, it is the deliverable for the third activity, which is on supporting the establishment of an R&I observatory.

This report contributes to the third pillar, "Generating evidence for better policy making," of the MCID and World Bank project Research Modernization in Romania: Improving the Quality and Relevance of the Research Sector. Pillar III encompasses three main activities: (i) providing inputs for the development of a monitoring framework for the R&I

system, (ii) designing two impact evaluations for R&I investments, and (iii) supporting the establishment of an R&I observatory. The present report is the deliverable for the third activity. See Box 3 for more details on the support provided to research modernization efforts.

Box 3 Scope of World Bank support to the Government of Romania in research modernization efforts

The scope of the RAS agreement on Research Modernization in Romania: Improving the Quality and Relevance of the Research Sector includes capacity building and support in designing and establishing new R&I institutions, such as an innovation agency and an R&I observatory. The activities to be carried out by the World Bank under the project are organized into three components:

Component 1: Support for research sector modernization reforms and investments. Work under this pillar includes, among other activities:

Recommendations and inputs for recalibration of the policy mix and identification of procedural bottlenecks in the design and implementation of R&I policies;

Recommendations detailing a plan for financing industry-academia linkages and technical assistance in the design of a pilot intervention encouraging collaborative research;

Analysis of the effectiveness of intermediary institutions (for example, technology transfer offices, digital innovation hubs, innovation clusters, incubators, accelerators) and recommendations for strengthening their institutional capacity;

Support for the development of evaluation and transformation plans of Public Research Organizations (PROs) to increase research excellence and relevance; and

Inputs and recommendations to integrate Romanian research organizations in the European research area.

Component 2: Capacity building to design and implement R&I reforms and investments. Work under this pillar includes, among other activities:

To improve logical frameworks and policy linkages, MCID under the NRRP will organize workshops on the development of a ToC for R&I reforms and investments;

A cross-country analysis of research sector reforms and a series of country showcases will build the capacity of the MCID's PSF delivery unit and other relevant stakeholders to design and implement R&I policies;

Support for the design and establishment of an innovation agency, including examples of global good practices, capacity building support, and recommendations for the agency's governance, advisory team, operational procedures, programs, and instruments, and M&E procedures; and

Support for the development of a co-investment fund for startups to attract private sector investments into innovative early-stage companies.

Component 3: Support for generating evidence for better policy making. Work under this pillar includes, among other activities:

Support for the development of a monitoring framework for the R&I system to support evidence-based policy making;

Support for the establishment of an R&I observatory, which will gather evidence on Romania's R&I support policies and investments for better strategic governance and policy making (the topic of this report); and

Performance of two impact evaluations of select R&I investments to inform research sector modernization reforms in Romania and other countries.

The project will provide support until 2026. The project was initiated in 2022, and many of the key activities will take place in 2023 and 2024 to support the Government of Romania in achieving its ambitious research sector reforms; however, the project will include ongoing support for capacity building, M&E, and knowledge sharing until 2026.

1.6 Report preparation activities and limitations

- This report builds on two primary assessments: (i) a domestic review and institutional needs assessment, including interviews with representatives of 12 Romanian R&I governance agencies; and (ii) international good practices, including interviews with 13 RIOs and related institutions.
- This work should be extended to the consultation of additional institutional stakeholders and R&I performers (e.g., research organizations, researchers, private companies).

This report builds on two primary assessments: (i) a domestic review and institutional needs assessment and (ii) international good practices. This report builds on an initial assessment of information and functional gaps in Romania, taking advantage of previous consultations with governance agencies conducted as part the World Bank's efforts to support the monitoring of the Romanian R&I system as well as the review of existing national platforms and relevant legislative documentation. This assessment was complemented with interviews with representatives from 12 key target institutional users of RO-RIO and regular discussions with MCID's DPSCDITT and PSF Unit divisions. International good practices were identified through mapping 23 examples of existing institutions (among which 12 of them are RIOs) contributing to the collection and production of evidence on R&I performance. Identifying the pool of international institutions was followed by interviews with 13 RIOs and related institutions (among which 6 are RIOs). More information on this report's preparation activities, including a list of institutions interviewed, can be found in Appendix 1.

Key institutional stakeholders involved in R&I and the promotion of productivity and economic competitiveness should validate the inputs for RO-RIO presented here. This report should be used to continue discussions with the institutional stakeholders consulted for its preparation to reach consensus on RO-RIO's services and priorities and to raise awareness of this initiative. The list of stakeholders should be further extended to other R&I governmental actors that were not met by the World Bank's team. This includes other government officials and divisions of the agencies consulted, and among others, the Romanian Academy, the Academy of Romanian Scientists, the Institute of Atomic Physics (IFA), the Ministry of Internal Affairs, the Ministry of Defense, the Ministry of Health (MoH), the Ministry of Environment, and the Parliamentary Committee.

An extension of this work should include the point of view of R&I performers (such as research organizations, researchers, and innovative firms). This report placed a priority on engaging with institutional stakeholders as the primary focus for RO-RIO. However, insights from international case studies highlight the advantages of more closely involving R&I performers in the services offered by RIOs. Therefore, the future development of RO-RIO

should incorporate direct consultations with representatives from research institutes, higher education institutes, researchers, innovative firms, R&I enablers (such as accelerators and incubators), and the Romanian diaspora, in addition to representatives of civil society.

1.7 Report outline

The remainder of this report presents a proposed framework for RO-RIO. Section 2 focuses on the functions of RO-RIO, outlining seven core services that collectively fulfill the three primary functions of a RIO: (i) “centralize information and data”; (ii) “research and analysis”; and (iii) “disseminate knowledge and information”. Each service is defined, its value added is discussed, and detailed guidance on operationalization, prioritization, and gradual implementation is provided. Section 3. “Key success factors for RO-RIO” highlights key success factors for RO-RIO based on international best practices. Through eight identified success factors, the report offers insights gleaned from international case studies before discussing specific implications for RO-RIO. Section 4. “Institutional Setup of RO-RIO” details the organizational structure of RO-RIO, beginning with background information on its guiding framework. It covers technical and legal requirements, management and human resources, estimated resources, and political considerations for positioning RO-RIO within the Romanian R&I system in the medium term. Section 5. “Workplan” outlines an action plan for the phased implementation of RO-RIO across three key stages. The section presents key action points, their corresponding timelines, and suggested responsibilities. The report concludes with a discussion of immediate next steps in Section 6. “Next steps”.

SECTION 2

CORE SERVICES TO BE PROVIDED BY RO-RIO

2. Core services to be provided by RO-RIO

- In alignment with international practices, the needs of stakeholders, and its proposed mission, RO-RIO could provide seven core services that would together perform the three primary functions of a RIO:
    - Function 1 “Centralize information and data”:
        - Service 1 “Overview of the R&I system”
        - Service 2 “Mapping of available R&I instruments”
    - Function 2 “Research and analysis”:
        - Service 3 “Visual analysis of Romania’s R&I and productivity performance”
        - Service 4 “Annual reports and in-depth studies”
    - Function 3 “Disseminate knowledge and information”:
        - Service 5 “Dissemination workshops and capacity building”
        - Service 6 “Knowledge base for evidence-based decisions in R&I”
        - Service 7 “News and updates on topics related to R&I”
- Over time, RO-RIO could gradually phase in these services and add additional ones.

RO-RIO’s mission is aligned with the primary functions of a RIO highlighted in the PSF report and aligned with the functions identified in other RIOs. RO-RIO’s proposed mission directly addresses Romania’s needs for evidence on R&I as emphasized by the PSF report.[12] According to the mission, RO-RIO should provide a rigorous evidence base and promote its use in policy decision-making in R&I by performing the functions of (1) centralizing, (2) analyzing, and (3) disseminating statistical data from national and international databases and information on R&I and productivity. The dissemination function includes building the capacities of R&I stakeholders. Through the analysis function, RO-RIO will identify Romania’s areas of excellence in R&I, which can guide investments in R&I and Romania’s internationalization strategy. The definition of RO-RIO’s mission is discussed in more detail in Section 3.1 “A clear mission”.

A RIO achieves its mission by providing core services that perform its primary functions.1.2What is a RIO? To determine what services RO-RIO should provide, we mapped the services of 25 international RIOs and related institutions (among which 12 are RIOs). We also consulted with stakeholders about what they need to increase use of evidence-based decision making. The result was a list of seven services that would be effective in performing the functions of a RIO in the Romanian context.

Different RIOs provide different services. In our mapping of 12 RIOs, we identified various services available to the public on the RIOs’ websites (Table 1). The services offered by a RIO depend on its mission, its target audience, the needs it aims to address, and how developed it is. The most common services are:

- creating annual reports and in-depth studies (provided by 10 out of 12 RIOs),
- indicator dashboards for national or regional R&I indicators (7 out of 12 RIOs),
- sharing news and updates on R&I (6 out of 12 RIOs), and

[12] “A Romanian R&I Observatory could collect statistical data from international databases [Function 1: centralization of data and information], analyse them in the Romanian context, and map Romania’s position [Function 2: research and analysis]. The information should be shared [Function 3: dissemination] with policy makers and the public.” (European Commission, 2022a, p.59)

- presenting an overview of actors in the R&I system (5 out of 12).

Colombia, Chile, and the Basque country in Spain have RIOs that offer the widest range of services available to the public.

Table 1 Overview of public services provided by existing RIOs

		OCTI (Brazil)	OST (Quebec)	Observa (Chile)	OcyT (Colombia)	OST (France)	STI Obs. (Palestine)[a]	OPCyT (Panama)	OCTI (Peru)	Observatory	Obidic (Canary Isles)[c]	InnoScopEx (Spain)[d]	Innovation Obs.
Centralizing	**Overview of the R&I system, including:**												
	Overview of the governance structure of the R&I system				■					■			■
	Overview of actors of the R&I system			■	■					■	■		■
	Mapping of available research, development, and innovation (RDI) instruments			■									■
	Open data repository, including:												
	Download option of indicators displayed on the website			■	■			■		■			■
	Micro-data from projects monitoring												
	Micro-data from R&I related surveys			■	■								
	eLibrary of reports and publications in R&I, including:												
	Key legal documentation on R&I policies				■			■		■	■		■
	M&E reports			■									■
	Other publications related to R&I							■	■				■
	Scientific publications involving a local researcher				■								
Research and analysis	**Visual analysis of the performance of R&I public funds**			■									■
	Visual analysis of R&I performance, including:												
	National or regional R&I indicators	■		■	■			■		■	■		■
	International perspective			■	■					■			■
	Visual analysis of gender in science			■	■			■			■		■
	Primary data collection				■		■	■		■			
	Annual reports and in-depth studies on selected topics	■	■		■	■	■	■	■	■		■	■
Informing and dissemination	**Dissemination workshops and capacity building**			■	■			■		■		■	
	Knowledge base for evidence-based decisions in R&I, including:												
	Methodology for data collection			■	■								
	Methodology for indicators construction			■	■								■
	News and updates on R&I system		■	■	■			■		■	■		■
	Feedback form				■			■					■

Note: a. STI Observatory (Palestine)
b. Observatory of Basque's RDI European Projects (Basque, Spain)

c. Obidic (Canary Islands, Spain)
d. InnoScopEx (Extremadura, Spain)
e. Innovation Observatory (Navarro, Spain)

Source: World Bank, based on mapping of and interviews with RIOs and related institutions.

Stakeholders of Romanian R&I governance agencies consulted for this report confirmed the need for certain RIO services. The World Bank team organized interviews with representatives of crucial R&I governance agencies to understand better how RO-RIO could address their needs and those of the entire R&I ecosystem (see Appendix 1). Box 4 gathers the key needs for evidence on R&I identified by these stakeholders, organized by function. Stakeholders particularly emphasized improving the centralization of data and information, conducting a thorough ecosystem analysis, and enhancing dissemination of knowledge and capacity building in generating and using evidence to inform R&I instrument design and implementation.

Box 4 Key needs identified in stakeholder interviews on the need for evidence on R&I

Function 1 "Centralize information and data"

1. Comprehensive coverage of all R&I instruments.

2. Detailed data on R&I funding by source, sector of activity, and R&I activity.

3. Easier access to granular data, including geographic breakdowns (at the regional and county level) and information on research and technology infrastructure services.

Function 2 "Research and analysis"

1. System-level analyses to understand R&I funding impacts.

2. Sectoral analyses and insights into international funding and technology trends.

3. Identifying data gaps and advising on how these gaps could be filled.

Function 3 "Disseminate knowledge and information"

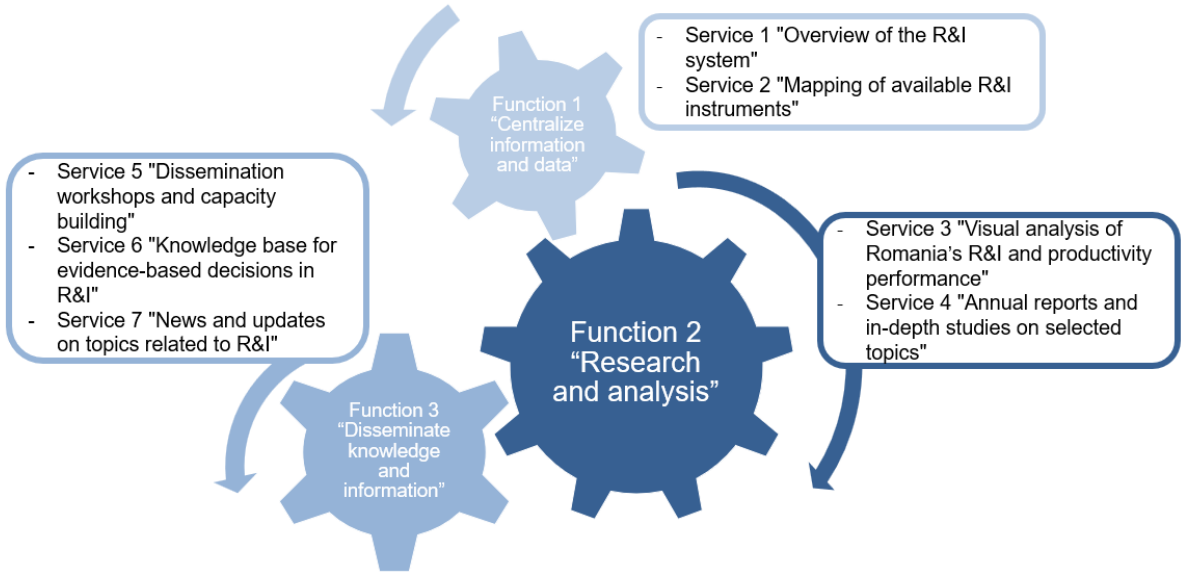
1. More detailed and clearer information on the production of indicators used for international comparisons.

2. Capacity building in evidence collection and utilization for R&I instrument design and implementation.

Source: World Bank, based on stakeholder interviews (see Appendix 1).

Based on international practices and stakeholders' needs, RO-RIO will be most effective if it provides seven services. Figure 6 suggests that, in the Romanian context, RO-RIO can perform the three core functions of a RIO by providing seven services. This recommendation aligns with international practices and the needs of stakeholders (Appendix 1). Although Function 2 "Research and analysis" is the core of RO-RIO, all three functions, displayed as cogwheels in Figure 6, and the seven corresponding services are closely interconnected. For example, the insights produced with the indicator dashboard (Service 3 "Visual analysis of Romania's R&I and productivity performance") are important inputs for knowledge dissemination. Similarly, the centralization of actors in the R&I system (provided by Service 1 "Overview of the R&I system") is a relevant source for RO-RIO's outreach strategy, which is also part of Function 3 "Disseminate knowledge and information."

Figure 6 Core services to be provided by RO-RIO



Source: World Bank.

2.1 Centralize information and data

- RO-RIO's Function 1 "Centralize information and data" aims to provide a comprehensive overview of the Romanian R&I actors and policies, facilitating understanding, easing information location, and promoting transparency.
- Service 1 "Overview of the R&I system" could be provided via a webpage with four dedicated tabs, providing summary information on: (i) R&I governance; (ii) R&I performers; (iii) R&I enablers; and (iv) R&I infrastructure.
- Service 2 "Mapping of available R&I instruments" provides a structured overview of R&I public financing instruments. The service can take the form of an interactive graph categorizing instruments based on topics, following international or national taxonomies, or based on target beneficiaries.

The aim of Function 1 "Centralize information and data" can be achieved through providing two services. Service 1 "Overview of the R&I system" aims to centralize information and data to provide a comprehensive overview of the R&I system in Romania. Service 2 "Mapping of available RDI instruments" focuses on mapping available R&I instruments and funding opportunities in Romania to address challenges related to decentralized funding opportunities.

2.1.1 Service 1 "Overview of the R&I system"

Definition of the service

A key service of RO-RIO is to provide a comprehensive overview of the Romanian R&I governance, performers, enablers, and infrastructure. RO-RIO could create a webpage dedicated to the presentation and description of the governance of the R&I system, highlighting the respective responsibilities of R&I governance agencies. Additional webpages could emphasize the expertise and services offered by R&I performers, R&I enablers, and the research and technology infrastructure. The information included in the presentation and description would vary depending on the actor or infrastructure.

What value does the service add?

A centralized overview of R&I governance and performers and their respective roles in the R&I system increases understanding and visibility of the R&I system. A missing centralized and comprehensive overview of Romanian R&I governance agencies impedes transparency and understanding among citizens and R&I performers alike. By outlining the roles and responsibilities of R&I governance and performers within the R&I system, RO-RIO users could gain clarity on how decisions are made, and who holds decision-making power. This transparency would contribute to a better image of the R&I system and would promote its relevance for Romania's development among citizens. A better understanding of the R&I system also would empower citizens and the private sector, who do not necessarily possess any prior insights into the R&I system, to engage more in the R&I system. Finally, by presenting a comprehensive set of the actors involved in funding and promoting R&I, it could help break some of the policy silos that are typically embedded in the system and allow for a more effective promotion of the channels through which R&I outputs result in firm innovation and productivity growth.

Centralizing relevant information on (support) services offered by R&I performers and R&I enablers could contribute to easier accessibility for interested partners. The limited coverage of existing overviews of R&I performers and enablers poses challenges to effectively monitor research and technology infrastructure, hampering the strategic planning of investments into these critical infrastructures. For researchers and companies, the limited scope and comprehensiveness of existing overviews impedes the identification of potential partners, including research collaborators and expert services, and complicates the process of forming strategic alliances and accessing necessary expertise. The process of finding suitable research partners for private companies and the research community could be simplified by providing relevant information on the support services that are provided by R&I performers and existing infrastructure, thereby reducing searching costs. This increases the likelihood for joint research projects or new private-public collaborations and partnerships within the R&I ecosystem. This service was repeatedly seen as a valuable addition to the R&I ecosystem during stakeholder interviews. Supporting R&I performers and firms to collaborate could also help public administration to reach their objectives of improved public-private linkages[13].

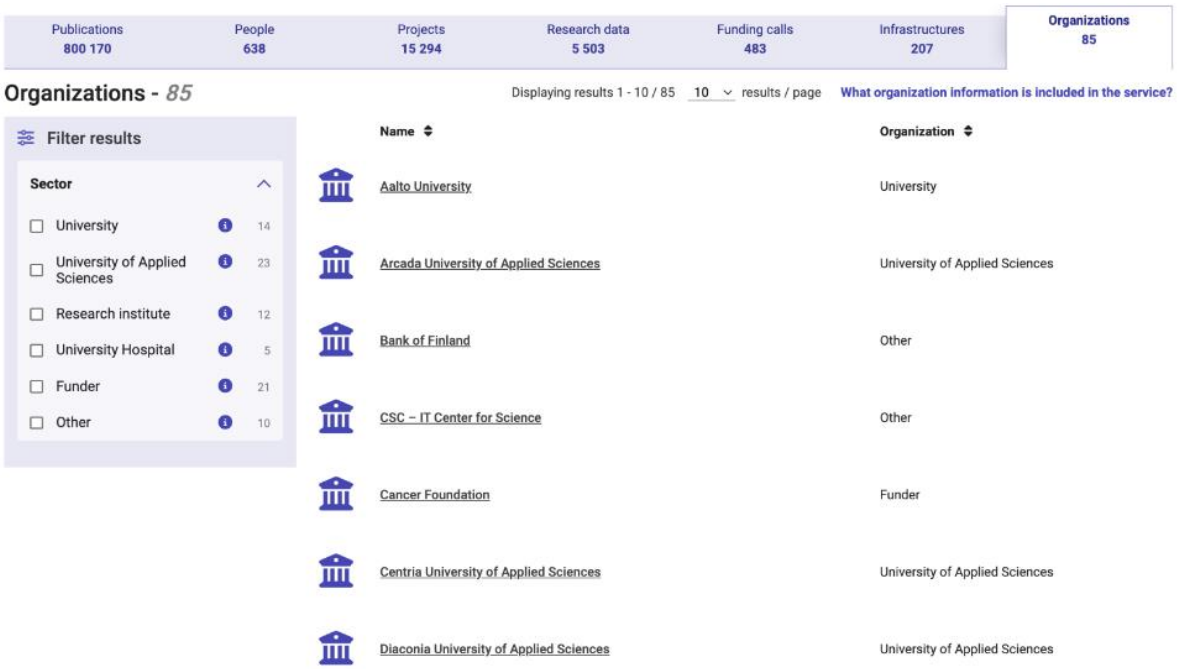
How will the service be operated?

Other observatories use different formats to publicly display the overview and information of the R&I system ranging from a summary table to interactive visualization. Research.fi dedicates an entire webpage with different tabs listing R&I performers (people, organizations) and existing infrastructure of the R&I system (see Figure 7). While each tab of the webpage is structured as a table, the type of information included in the table differs: "People" includes the columns "Name", "Organization", "Title" and "Keywords"; "Organizations" include "Name" and "Organization". In both cases, once you click on the name of the R&I performer, more detailed information is shown, such as the publications of the respective people, or indicator dashboards related to publications for the respective organization. The webpage includes a "search" function to quickly find results across the different tabs. Each tab includes different options for filtering to enhance navigation for users, for example, for people it can be filtered by organization or titles, and for organizations by sectors. Another format for displaying an overview of the R&I system, used by the Chilean observatory, is an interactive chart using one bubble per actor to improve the

[13] E.g., specific objective 3.1 of SNCISI: "Support and encourage collaboration between research organizations and the private sector to engage in innovation projects and exploit the results".

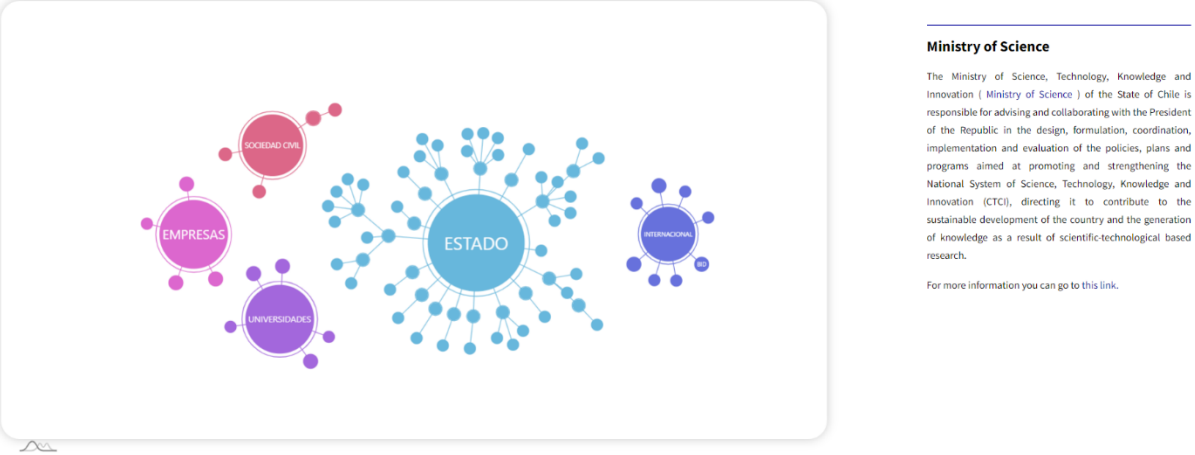
visual representation of linkages between actors of the R&I system (Figure 8). When clicking on a bubble, more information about the respective actor's role and responsibility in the R&I system is displayed, and a link to the website of the actor is provided.

Figure 7 Example of an overview of research organizations, the case of the Finnish Research Information System



Source: https://research.fi/en/results/organizations?size=10, consulted on 3/26/2024.

Figure 8 Example of overview of R&I actors, the case of the Chilean observatory



Source: https://observa.minciencia.gob.cl/sistema, consulted on 3/26/2024.

RO-RIO could create a webpage divided into tabs focusing on R&I governance, performers, enablers, and infrastructure, leveraging existing data sources to swiftly establish the service. For RO-RIO, the initial format for the overview of the R&I system could be a webpage with one tab for R&I governance, one tab for R&I performers, one tab for R&I enablers, and one tab for research and technology infrastructure. Each tab would provide summary information specific to the type of actors or facilities, as summarized in column "Summary information in RO-RIO" in Table 2. To make the service quickly operational, RO-RIO could build on already existing overviews and registries to the largest extent possible, as

those listed in Table 2.[14] The table provides a column for whom (type of actors) the existing data sources provide information on.

Table 2 Suggested content of RO-RIO's overview of R&I actors

Type of actors	*Actors*	*Summary information in RO-RIO*	*Existing data source*
R&I governance	Governance actors	- Short description of policy role and responsibilities - Presentation of important policy documents (for example, SNCISI) - Link to website - Contact address	**Romania's PER STI (World Bank, 2023a) -** Overview and description of the Romanian R&I governance system
R&I performers	Researchers	- Summary statistics based on data from BrainMap, e.g., number of researchers by fields or specializations	**BrainMap** (National registry of researchers, innovators, technicians, and entrepreneurs, *UEFISCDI*): Link
	Research organizations	- Short description of each research organization - Link to website - Contact address - BrainMap users - Financed projects - Research and technology infrastructure	**Organizations Registry** *(UEFISCDI):* Access via BrainMap **List of National R&D Institutes (INCDs):** Link **List of institutes of the Romanian Academy:** Link **List of research units—Academy of Medical Sciences:** Link **List of institutes of the Academy of Agricultural and Forestry Sciences:** Link **List of higher education institutions (HEIs):** Link
	Private organizations	- Short description of private organizations - Link to website - Contact address	**National registry of potential contractors** (Private organizations having benefited from public R&D funds in time, *MCID*): Link
R&I enablers	Innovation and technology transfer entities	- Short description of each entity including services offered - Link to website - Contact address	**Registry of Innovation and Technology Transfer Entities** (National registry of R&I intermediaries, namely technological transfer centers, technological information centers, technological and business incubation centers and research liaison offices): Link
	Cluster organizations	- Short description of each organization including services offered - Link to website	**Platform for cluster organizations** *(Clustero):* Link

[14] To enhance the complementarity between RO-RIO and BrainMap, RO-RIO could produce and display descriptive statistics on researchers based on data from BrainMap.

		- Contact address	
	Digital innovation hub	- Short description of each organization including services offered - Link to website - Contact address	**National Network of Digital Innovation Hubs** *(ADR):* Link
	Accelerators, facilitators, workspaces, start-ups	- Short description of each organization including services offered - Link to website - Contact address	**Accelerate Romania** *(UEFISCDI):* Link
	Science and technology parks, Smart Specialization parks, industrial parks	- Short description of each park including services offered - Link to website - Contact address	**Industrial parks** *(MCID)*: Link
Research and technology infrastructure		- Short description for each infrastructure including who offers it - Link to website - Contact address	**Engage in the European Research and Technology Infrastructure System** - EERTIS (*UEFISCDI):* Link

Source: World Bank

Data sharing agreements could authorize RO-RIO to use automatization techniques like web scraping to collect data and centralize it for the comprehensive overview of the R&I system. When writing this report, the PNIM has established data sharing agreements, for example with INS, and is working on data sharing agreements with other actors, for example UEFISCDI. Based on the established data sharing agreements, RO-RIO could develop techniques to automatize the aggregation of information and metadata from various sources and centralizing it at one location. One approach consists of web scraping, which involves extracting relevant data from other websites, databases, and online repositories, as from the sources listed in Table 2. Through carefully designed algorithms, automated bots can crawl through numerous web pages, extracting pertinent details. This data is then organized and structured in a standardized format, ensuring consistency and ease of access for users of RO-RIO. The centralization of data and information and the seamless accessibility to its users would contribute to the promotion of Open Science in Romania (see Box 5).

Box 5 Open Science in Romania

According to the Open Data Maturity score, Romania belongs to the cluster of beginners. While Romania performs well in the functionality dimension of the open data portal (data.portal.ro), improvements are needed in the dimensions: open data policy, impact, and quality. In reaction to this situation, Romania has made significant strides in advancing open science, including a focus on open data, aligning with the EC's imperative for collaborative research that emphasizes the early and widespread sharing of knowledge, results, and tools. Mandated under Horizon Europe, this approach is guided by the principle of being 'as open as possible, as closed as necessary'.

In response to this policy priority, a dedicated Open Science department was established within UEFISCDI in 2018 and the objective of a transition to open science was integrated into the National Strategy for Research, Innovation, and Intelligent Specialization 2022-2027. The

culmination of these efforts is the "White Paper on the Transition to Open Science (2023-2030)" a strategic document developed based on the dialogue support version "Green Paper on the Transition to Open Science" and outlining the implementation of open science principles.

Under the strategic objective 1.2. "Ensuring the transition to open science and facilitating the path to excellence in scientific research" of the National Strategy, key actions have been formulated, encompassing mandatory open access to publicly funded research publications, the introduction of research data management plans adhering to FAIR (Finable, Accessible, Interoperable and Re-usable) and open data principles, and the promotion of initiatives supporting open science, including citizen science. UEFISCDI, in collaboration with the National Institute for Research and Development in Informatics (ICI Bucharest), actively participates in the European project "NI4OS Europe", initiating the establishment of the Romanian national Open Science Cloud Initiatives (RO-NOSCI).

Established in 2021, RO-NOSCI is a coalition working towards creating a national cloud for open science, optimizing integration with the European Open Science Cloud (EOSC), and facilitating academic and research access to EOSC resources. Furthermore, UEFISCDI has developed tools to enhance open collaboration, such as the Open Science Community on BrainMap, featuring sections for news on the Open Science ecosystem, information and idea sharing, and updates on national and international events. Additionally, a dialogue platform on the Romanian Open Science webpage enhances communication and engagement in the open science domain.

Sources:
https://rea.ec.europa.eu/open-science_en
https://uefiscdi.gov.ro/ro-nosci
https://www.open-science.ro/resurse/the-white-book-of-the-transition-to-open-science

A self-registration feature enables actors to provide relevant information about their role, complementing automatization techniques. Self-registration is an additional feature to gather and update visible information and metadata.[15] It would allow actors in the system to register themselves and their services on the webpage of RO-RIO and provide relevant information about their role in the R&I system.[16] The self-registration feature would be complementary to the automatization techniques.

The overview of the R&I system should be a continuous exercise gradually increasing the number of actors and the relevant information included in the overview. The initial version of the overview does not need to contain all the actors nor all information. Even if the process of information gathering is ongoing, information already available can be made accessible to the public through the observatory's website. The number of actors and information included in the overview of the R&I system could be gradually increased.

[15] The operation of the self-registration service could be guided by the manual-upload option used in the PNIM which allows for the manual upload of data and information.
[16] In accordance with the General Data Protection Regulations (GDPR), self-registration forms will include an option to select the preferred level of privacy for information displayed on the website.

2.1.2 Service 2 "Mapping of available R&I instruments"

Definition of the service

By centralizing data about all R&I instruments, RO-RIO would provide easy access to information about funding opportunities from different sources. To be effective, the information about R&I instruments needs to provide a comprehensive overview of current international, national, and regional R&I instruments. The overview could cover funding opportunities from public and private program funders. The overview needs to contain information about the topic of each instrument, the total budget, the funder, and details on the calls for proposals (opening date, closing date, link to website to apply).

What value does the service add?

A mapping of Romanian R&I instruments can benefit program funders by improving the visibility and the design of funds. The Romanian R&I system faces gaps and inefficiencies in its policy mix, such as the large number of instruments with budgets that are too small to achieve their objectives (World Bank, 2023a). As highlighted in the stakeholder interviews, the Romanian R&I system would gain from a complete view of the funding for innovation listed in the SNCISI and funding channeled through complementary policies. Other instruments that target R&D-based innovation, technology development and prototyping, startup support, and non-R&D innovation are implemented by ministries and agencies under other umbrella policies, like the National Strategy for Competitiveness or sectorial strategies. Mapping R&I instruments from different sources, including their characteristics (such as beneficiaries and objectives), in one place could inform both the design of the portfolio of R&I programs and the design of instruments, enhancing synergies and complementarities. This service can help identify efforts that require coordination across ministries to achieve the objectives of complementary strategies, which is an essential element in promoting productivity growth.

A mapping could also provide potential beneficiaries of R&I funding (for example, PRIs, universities, and researchers) with better access to funding opportunities. R&I instruments and funding opportunities in Romania lack synergies and centralization, creating uncertainty among potential beneficiaries when planning their own R&I agendas (World Bank, 2023a). The mapping could increase the visibility of funding opportunities by potential beneficiaries, which would lead to more numerous and more diverse applications, increasing outreach among different segments of the targeted beneficiaries. This could reduce the time spent by potential beneficiaries of R&I funds searching for available sources of funding and help them navigate the complex landscape of R&I instruments.

Centralizing R&I instruments and funding opportunities might enhance the understanding on how R&I funds are used among citizens. By gathering all public R&I instruments and funding opportunities from different sources in one location, citizens can better follow how and to whom money is disbursed. Additionally, the overview of available instruments and information allows citizens to acquire a better understanding of the thematic focus of R&I funding. The transparency of funding plans can improve the trust citizens have towards public administration and makes the public administration more accountable for their public spending.

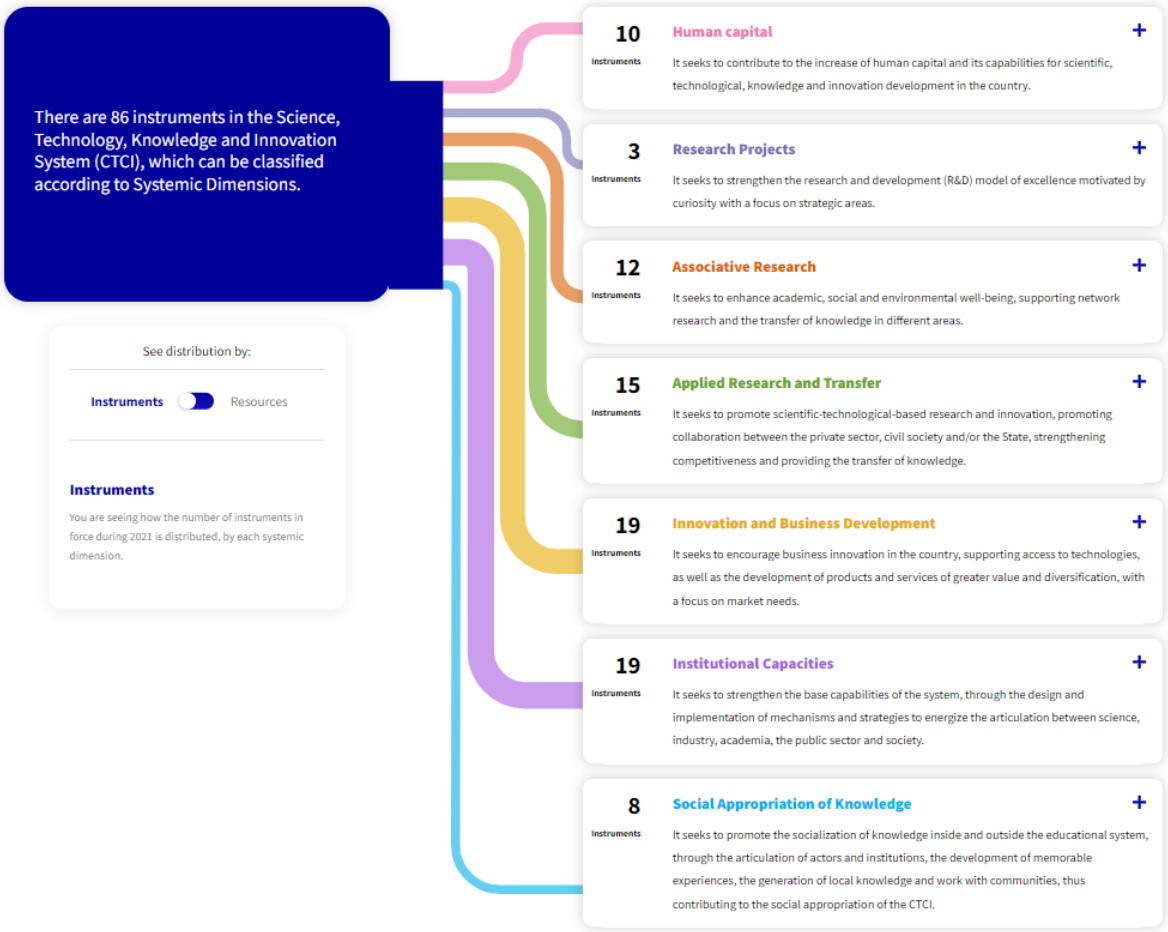
The mapping of R&I Instruments can improve firms' planning and take-up of relevant funding opportunities. It is crucial to ensure that businesses have comprehensive knowledge of the various funding and support mechanisms tailored to their needs. This

includes not only traditional R&D funding opportunities, but also non-R&D innovation instruments designed to foster innovation across different stages of the product lifecycle. With greater clarity on the availability and scope of R&I instruments, firms can better navigate the innovation ecosystem, identify relevant funding opportunities, and leverage support mechanisms tailored to their innovation needs. This would contribute to a more inclusive and dynamic innovation ecosystem**.**

How will the service be operated?

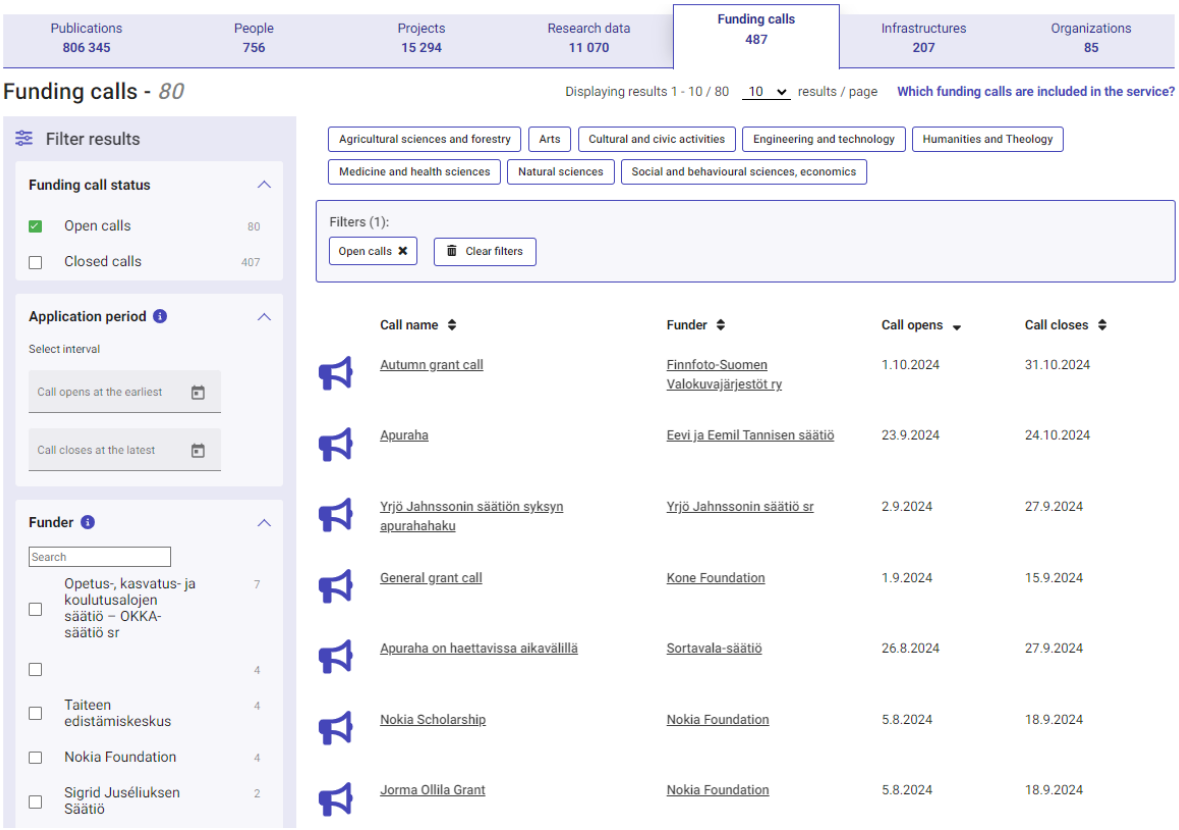
Various observatories employ different formats to centralize R&I instruments, with examples including interactive graphs and detailed tables. Other observatories use different formats to centralize R&I instruments. The Chilean observatory displays an interactive graph allowing the user to have a higher-level overview of R&I instruments at one glance, thanks to a grouping of available instruments into main interventions areas (for example, human capital, institutional capacities, applied research and transfer) (Figure 9). By clicking on each topic, the respective funding opportunities are shown. The innovation observatory of Navarra summarizes funding opportunities by target group of the instrument, for example companies and actors of the R&I system. Research.fi in Finland uses a table to publicly display current funding opportunities on a webpage (Figure 10). The table contains, for each funding call, the following information: call name, funder, call opening and call closing date. More information on each call can be received by clicking on the respective call. The calls can be filtered by topics (for example, agricultural sciences and forestry, or engineering and technology), call status, application period and funder.

Figure 9 Example of a visual overview of R&I instruments, the case of the Chilean observatory



Source: https://observa.minciencia.gob.cl/programas-publicos/instrumentos, consulted on 3/26/2024.

Figure 10 Example of a list of current funding opportunities, the case of the Finnish's Research Information System



Source: https://research.fi/en/results/funding-calls?status=open&size=10, consulted on 3/18/ 2024.

RO-RIO may utilize an interactive graph to categorize R&I instruments based on topics, following existing international or national taxonomies or grouping by relevant target audiences. RO-RIO could use an interactive graph to group R&I instruments by topics. The topics for grouping could follow existing international or national taxonomies, such as World Bank's methodology for grouping R&I instruments in PER STI (World Bank, 2023a) for an application of the methodology to Romania).[17] Another option is the grouping by relevant target groups, such as researchers, universities, or companies. MCID and other key R&I governance agencies should prioritize selecting the most pertinent classification system for Romanian R&I actors. The interactive visualization would allow users to see all funding opportunities when clicking on the respective topic. The graph could be complemented by a table containing details on each instrument and funding opportunities, such as the funder, eligible beneficiaries, budget, opening and closing date, and a link to the webpage of the financing opportunity. The webpage should include a "search" function to facilitate navigation and quickly finding relevant funding opportunities.

Data sharing agreements could authorize RO-RIO using automation techniques to facilitate its mapping of R&I instruments on its website. Data sharing agreements would allow to effectively utilize the available information from existing sources (for example, UEFISCDI, MCID, MIPE, EC) for the mapping of R&I instruments on RO-RIO's website.[18] The observatory could leverage automation techniques, for example Application Programming

[17] Alternative taxonomies include a classification by general and specific objectives of the SNCISI or EC-OECD's classification of R&I instruments. The EC-OECD Stip Compass provides information on STI policy initiatives, including a grouping of initiatives by themes. For more information, see https://stip.oecd.org/stip/interactive-dashboards/countries/Romania.

[18] The information for the mapping of R&I instruments gathered by RO-RIO could be aligned with data and information about R&I instruments available on PNIM.

Interfaces (APIs) or web scraping. Table 3 presents a curated list of existing data sources (with a link to this source) containing pertinent information on R&I instruments and funding opportunities. Complementary to the automation technique, RO-RIO could provide a self-registration feature for manually uploading instruments and funding opportunities for example relevant for funding opportunities of intermediaries such as incubators.

Table 3 Key data sources for the mapping of R&I instruments

Ownership of the webpage	*Existing data source/link to website*	*Funding source*	*Summary information*
UEFISCDI	Link	National RDI Plan (PNCDI) IV	- R&I instruments and funding opportunities from the PNCDI IV, managed by UEFISCDI
MCID	Link	NRRP	- Overview of instruments from Component 9 of the NRRP, managed by MCID
MCID	Link	PNCDI IV	- Nucleu Program, Installations and Special Facilities of National Importance (IOSIN), "Regele Carol I" grants, other programs managed by MCID
MIPE	Link	Not restricted to one	- European, national, and regional instruments and funding calls, not restricted to R&I or productivity
EC	Link	Programs with R&I components funded and managed by the EC	- Innovation Fund, Digital Europe Programme, EU4Health, Interregional Innovation Investments, European Defence Fund etc.
MEET	Link	Grants for small and medium-sized enterprises (SMEs)	- StartUp Nation, StartUp Nation Diaspora, Women Entrepreneurs etc.
MCID	Link	Tax incentives	- Fiscal facilities for RDI activities in firms
Romanian Academy	Link	R&D Plan of the Romanian Academy	- Grants of the Romanian Academy

Source: World Bank.

2.1.3 Implementation phases

Function 1 could be implemented in three phases. Box 6 shows how services 1 and 2 might evolve over the course of this phased implementation.

Box 6 Implementation phases for Function 1 "Centralize information and data"

Phase 1: Deployment (0-12 months)

- **Services 1 and 2:** Concluding data sharing agreements with relevant data and information providers (e.g., UEFISCDI)
- **Services 1 and 2:** Implement automation techniques for data and information

centralization (in line with data sharing agreements)

- **Service 1:** Implement tabular overview of R&I governance agencies and an initial overview of services provided by R&I enablers and research and technology infrastructure
- **Service 2:** Implement graphical mapping of R&I instruments managed by MCID (e.g., National RDI Plan (PNCDI) IV)

Phase 2: Assessment and strengthening (12-24 months)

- **Services 1 and 2:** Conclude additional data sharing agreements as necessary
- **Service 1:** Design an interactive graph providing an overview of Romanian R&I actors
- **Service 1:** Implement the tabular overview of R&I performers and expand the overview of R&I enablers and research and technology infrastructure
- **Service 2:** Integration of remaining R&I instruments into the graphical mapping
- **Services 1 and 2:** Operationalization of a self-registration service

Phase 3: Scale up (24-36+ months)

- **Services 1 and 2:** Update information and expand coverage
- **Services 1 and 2:** Improve search functionalities and interface design based on users feedback

2.2 Research and analysis

RO-RIO's Function 2 "Research and analysis" should enable the identification of Romanian strengths and weaknesses in R&I through:

- (i) An analysis of resources for R&I, encompassing R&I expenditure, R&I personnel (including the monitoring of research careers), and research infrastructure (R&I levers)
- (ii) An analysis of enabling factors of R&I (R&I structural conditions)
- (iii) An analysis of R&I performance (R&I performance)
- (iv) Providing a better understanding of the role of R&I investments in the economy (including on productivity) and society (R&I outcomes)

Service 3 "Visual analysis of Romania's R&I and productivity performance" would take the form of an interactive and user-oriented indicator dashboard allowing for international comparison across a selection of key indicators. In the short-term, indicators reflected in the Vision 2030's targets could be prioritized, extending its coverage over time.

Service 4 "Annual reports and in-depth studies on selected topics" consist of in-depth analyses covering (i) to (iv), with conclusions summarized in an annual report guiding the operational activities of mandated R&I Coordination Councils and in knowledge products addressing different needs of levels of depth of the analysis.

Over time, RO-RIO could engage in more complex analyses and sectoral studies and complement existing data by engaging in primary data collection.

To perform Function 2 "Research and analysis," RO-RIO could provide an indicator dashboard and produce in-depth studies on relevant topics. The aim of Function 2 "Research and analysis" is to provide deeper analysis on the performance of the Romanian

R&I system. RO-RIO could perform this function by providing two services. Service 3 "Visual analysis of Romania's R&I and productivity performance" aims to facilitate the identification of strengths and weaknesses of the Romanian R&I system by visually analyzing Romanian-relevant R&I topics and indicators in an indicator dashboard that serves as a comprehensive tool for assessing various aspects of R&I activities within the country. This service could be complemented by in-depth studies in various publication formats (e.g., reports, policy briefs, infographics) as envisioned in Service 4 "Annual reports and in-depth studies on selected topics," which focuses on producing more in-depth analysis through comprehensive reports on identified topics. Further details on the benefits and operations of these services are elaborated in the subsequent sections.

Definition of the services

Function 2 "Research and analysis" encompasses R&I levers, performance, and effects. The research and analysis function of RO-RIO should explore topics aligned with the SNCISI's nomenclature of indicators, capturing essential dimensions of interest on R&I. These indicators could, for instance, be categorized into three groups: (i) R&I levers, encompassing the resources for R&I, i.e., R&I expenditure, R&I personnel, and research infrastructure; (ii) R&I performance, covering knowledge production, internationalization, research organization performance, and innovation in enterprises; and (iii) R&I outcomes, focused on socio-economic outcomes such as employment and exports.

To reach a comprehensive overview of the R&I system, RO-RIO could extend the analysis to R&I structural conditions, knowledge transfers, the impacts of R&I on productivity, and on the society. We propose adding to the topics covered by the SNCISI's nomenclature of indicators a section on R&I structural conditions, informing on the context in which R&I is performed. While public-private partnerships are partly covered by knowledge production (with an indicator on public-private co-publications), we recommend adding knowledge transfer to the analysis of innovation in firms to address the current lack of focus on knowledge transfer indicators in Romania, as noted in one stakeholder interview. We further recommend expanding the analysis of R&I outcomes to the topic of productivity[19], as well as conducting a dedicated analysis of the R&I effects within smart specialization domains (including indicators of competitiveness and exports) and of the societal outcomes of R&I. Table 4 summarizes RO-RIO's thematic analyses and suggestions of relevant data sources, while additional background information on each topic listed in the table (its rational, key resources and the proposed added-value of RO-RIO) is provided in Appendix 6.

Table 4 Data sources for RO-RIO's thematic analyses

Area	Topics	Examples of data sources
R&I levers	R&I expenditure	Public funds: PNIM, Eurostat/INS, EC's Cohesion Data Platform (on ESIF), EC Recovery and Resilience Scoreboard, OECD Tax Incentives etc.
		Private funds: PNIM/Eurostat/INS, EC Industrial Investment Scoreboard, Community innovation survey (CIS), venture capital (VC)

[19] Although MCID has no legal mandate over productivity data, an analysis of the links between R&I and productivity, as one of the main expected outcomes of R&I, is essential to better understand the effectiveness of R&I investments. Data on productivity indicators can be obtained by MCID from INS. In the future, this data could be complemented by firm-level data from the MoF through a permanent collaboration with MEET. In addition to the analyses performed by RO-RIO, this comprehensive dataset could be used in the evaluation of the impacts of public R&I policies without increasing firms' reporting burden.

		Funds databases (e.g., PitchBook, Dealroom), OECD, Invest Europe
	R&I personnel	PNIM/Eurostat/INS, UNESCO, OECD, EC's Observatory of Research Careers, ERA (European Research Area) Talent Platform
	Research infrastructure	PNIM/EERTIS, European Strategy Forum on Research Infrastructures (ESFRI), European Research Infrastructure Consortium (ERIC), EC's Cohesion Data Platform etc.
R&I structural conditions*	Economic performance*	PNIM – INS/Eurostat, World Bank, OECD
	Labor*	PNIM – INS/Eurostat
	Demography*	PNIM – INS/Eurostat
	Business*	PNIM – INS/Eurostat
	Digitalization*	Eurostat/INS
	Use of information technologies*	Eurostat/INS
R&I performance	Knowledge production (publications and intellectual property rights)	PNIM/Web of Science, PNIM/Eurostat, Scimago, State Office for Inventions and Trademarks (OSIM), WIPO, European Union Intellectual Property Office (EUIPO), OECD, Observatory of Patents and Technologies of the European Patent Office (EPO)
	Internationalization	PNIM/e-CORDA, EC Transparency Register
	Leading research organizations	PNIM/ Academic Ranking of World Universities (ARWU)/Scimago, Horizon Europe Dashboard, 1000 EU top R&D Investors etc.
	Knowledge transfer and innovation in firms Overall innovation performance	PNIM/Eurostat/INS, CIS, EUStartUp, OECD; Global Innovation Index, European Innovation Scoreboard, Regional Innovation Scoreboard
R&I outcomes	R&I related productivity outcome*	INS/ Eurostat/ World Bank/ OECD/ productivity statistics
	Evolution of Smart Specialisation Strategy (S3) domains* (including competitiveness and exports)	INS/Eurostat, EC's S3 Community of Practice, EU Monitor of Industrial Ecosystems, OECD, Global /European /Regional Competitiveness Indexes, Atlas of Economic Complexity etc.
	R&I related societal outcomes*	INS/Eurostat, United Nations/EC SDG monitors (STI for SDGs), EC Resilience Scoreboard etc.

Note: * Topics not covered by the nomenclature of SNCISI indicators.
Source: World Bank.

2.2.1 Service 3 "Visual analysis of Romania's R&I and productivity performance"

What value does the service add?

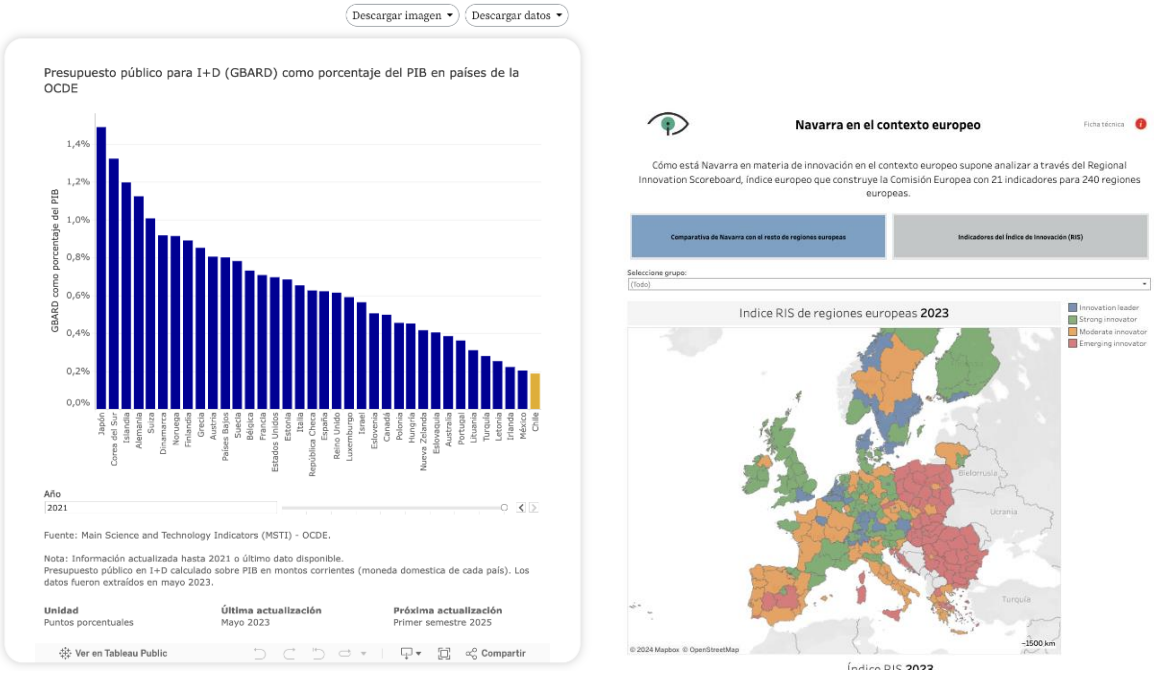
By mapping Romania's best R&I strengths in an international context and analyzing trends in Romania's R&I performance, a dashboard facilitates the guidance for future

policy decisions and investments while contributing to greater transparency. The Romanian R&I system lacks robust policy-relevant evidence on how Romania performs and evolves over time compared to its peers to prioritize investments in R&I. As an emerging innovator, it is important to study Romania's R&I developments considering EU and international trends. The interactive features of an indicator dashboard allow users to drill down into specific disaggregation and aggregation levels according to their interest, answering a need for accessing data at more granular levels expressed during stakeholder interviews. For example, policymakers might be interested in Smart Specialization Strategy (S3) priorities, gender, Strategic Research Agenda, and regions, and firms in specific sectors or industries where opportunities for productivity enhancements or investment may lie. Through customizable views, users of the indicator dashboard could explore relationships between different variables facilitating the comparison of relevant R&I related indicators over time and with other countries. Such analysis could guide future R&I policy and investment decisions to shape strategic priorities and foster collaborations on a global scale. Such insights empower decision-makers to explore opportunities for international partnerships, exchange programs, and joint research initiatives that align with the country's R&I goals and aspirations. By providing easy-digestible information to the public, the dashboard promotes transparency of public administration towards citizens.

How will the service be operated?

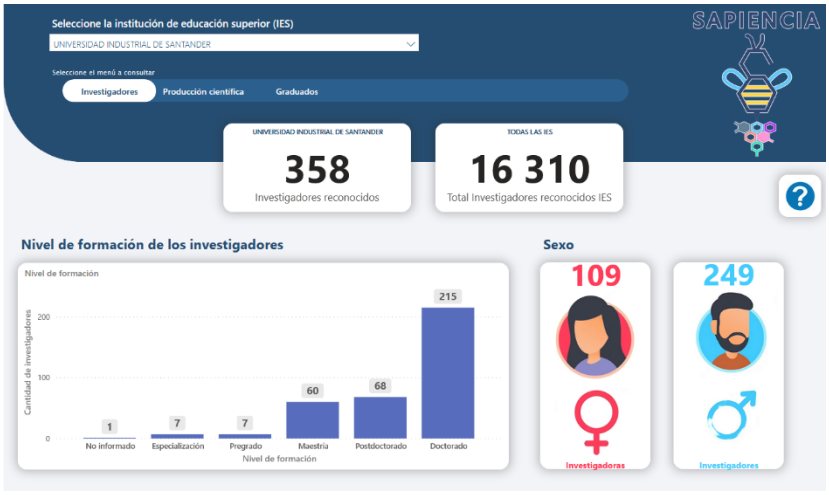
Multiple reviewed observatories utilize visualizations on their websites to enable better assessment of the country's or region's R&I performance. Some observatories, such as the Chilean observatory or the Innovation Observatory of Navarra (Figure 11), have visualizations of indicators incorporated on their website to ease the comparison of R&I performance of the respective country or region with other countries or regions. The Chilean observatory uses bar charts to compare indicators such as government budget allocations for R&D (GBARD), number of researchers and percentage of companies that innovate in products new to the market with other OECD countries. The Innovation Observatory of Navarra combines a map and bar charts to display the results of the regional innovation scoreboard. Other observatories, such as the Colombian observatory, focus on displaying indicators by specific topics, for example gender in science (Figure 12).

Figure 11 Examples of indicator dashboards, the case of the Chilean (left) and Navarra's (right) observatories



Source: https://observa.minciencia.gob.cl/indicadores/comparacion-internacional/presupuesto-publico-para-id-como-porcentaje-del-pib; https://observatorioinnovacion.navarra.es/en/web/observatorio-de-innovacion/navarra-in-the-european-context, consulted on 3/26/2024.

Figure 12 Example of a thematic dashboard on gender in science, the case of the Colombian observatory



Source: https://sapiencia.ocyt.org.co/, consulted on 3/26/2024.

To expedite the functionality of the dashboard, the indicators of the Vision 2030 reported in the SNCISI could be prioritized to be displayed in the indicator dashboard. The indicators reflected in the Vision 2030's targets could be selected as subset of KPIs to lay the initial groundwork for the dashboard, facilitating swift development and deployment of essential features (Table 5). We suggest a few additional indicators on R&I related productivity and societal outcomes. Additional data sources and indicators can then be gradually integrated over time as needed. Notably, indicators for the monitoring of research careers should be added to fulfil RO-RIO's responsibility in monitoring the application of national and European provisions regarding to the recruitment, placement and promotion of RDI personnel.

The prioritization and selection of (suggested) indicators for the dashboard necessitates careful consideration of relevance and feasibility by MCID and other key R&I stakeholders. This process involves addressing key questions: What information is crucial for users? Which data and indicators are readily available through automation? What is the reliability and accuracy of the data and indicators?

Table 5 Suggestion of prioritized indicators for the indicator dashboard

Area	Topics	Key Performance Indicators
R&I levers	R&D expenditure	R&D expenditure by sectors of performance (%GDP)
		R&D expenditure by type of R&D activity (%)
	R&I personnel	Percentage increase in the number of graduates of doctoral studies compared to the number of higher education graduates
		Number of researchers per thousand employed persons
		Number of “leader” researchers (in the sense of the EU framework for research careers)
R&I performance	Knowledge production (publications and intellectual property rights)	Number of articles (indexed in Web of Science) proportional to the number of researchers
		Proportion of articles in the top 10% most cited and in the top 1% most cited
		Percentage increase in the number of triadic or dyadic patents
	Internationalization	Funds attracted from Horizon Europe Program in relation to the funds attracted from Horizon 2020
		Annual number of international scientific co-publications per million inhabitants
		Share of national public funding for R&D allocation for joint programs and for European partnerships, including interregional investments in EU projects
		Number of bilateral collaborations
	Knowledge transfer and innovation in firms	Share of companies introducing new innovative products for the market
		Share of innovative enterprises collaborating with research organizations
		Number of public-private co-publications per 1 million inhabitants
		Share of employment in innovative enterprises
		Share of high-growth enterprises[1]
		Number of startups and spin-offs[1]
	Overall performance	Rankings in the European and Regional Innovation Scoreboards
R&I outcomes	R&I related productivity outcomes	Labor productivity[1]
		Growth rate (%) of Total Factor Productivity[1]
	Evolution of S3 domains	Growth rate of employment associated with the S3 domains
		Value added associated with S3 domains
		Exports (% GDP) associated with S3 domains

	R&I related societal outcomes	Government budget allocations for R&D in environment[1]
		R&D expenditure in the agri-food sector (an SDG target for Romania)[1]
		Patents in environment-related technologies[1]

Note: [1] Additional indicators suggested by the World Bank.
Source: World Bank.

To maximize effectiveness, the indicator dashboard needs to adhere to the principles of simplicity, clarity, user-targeting, interactivity, and consistency. Dashboards should prioritize simplicity and clarity, presenting information in a way that is easy to understand at a glance. They should be tailored to the needs of their audience, providing relevant insights and metrics that align with their objectives. Customization options, such as the ability to filter or drill down into specific data subsets, can enhance usability and utility. Additionally, dashboards should ensure data accuracy and reliability, with clear labels and sources provided for all information presented. It is crucial to maintain consistency in design and layout throughout the dashboard to facilitate intuitive navigation and interpretation. Lastly, dashboards should promote interactivity, allowing users to explore data dynamically and derive actionable insights. More information on the principles of dashboards, available software, and guidance for visualization options can be found in Appendix 7.

The backbone of the indicator dashboard could be an extension of the PNIM dataset. This centralized database serves as a behind-the-scenes foundation simplifying data management and maintenance tasks, facilitating updates, and ensuring data accuracy over time and data confidentiality. Data from international sources, for example OECD, could be obtained via APIs.[20] An extension of the PNIM dataset, hereafter the RO-RIO dataset, could get access to raw data on the most granular level if this is authorized by data sharing agreements with the relevant national agencies (for example, INS or MoF).[21] In the longer run, the RO-RIO dataset, or parts of it, in accordance with data sharing agreements, could be made publicly available contributing to the evolution of an effective and collaborative Open Science environment in Romania (see Box 5 above).[22] The RO-RIO dataset and the connected indicator dashboard will be most effective if updated as soon as new data is available.

Setting up and maintaining an indicator dashboard requires IT and data analysis skills. In the best-case scenario, one person having both skills should be responsible for setting up and maintaining the dashboard. However, sharing responsibilities among two persons, one with IT and one with data science skills, is also possible if close cooperation among the two can be guaranteed. While the IT skills are needed to cover the technical aspects of the dashboard, the data scientist decides on which indicators are displayed using which visualization element.

[20] If APIs are not possible data might need to be downloaded manually from the specific statistical database. In the latter case, an operational manual should be developed summarizing the steps to download the data and update the dashboard with this data.
[21] Accessing the microdata has the advantage that RO-RIO could use the preferred methodology for indicator computation, and that deeper insights can be gained by a more granular analysis.
[22] The access to RO-RIO's dataset or parts of it could also be granted based on requests, like the approach used by the Italian observatory.

In the medium term, RO-RIO could add indicator dashboards for the visual analysis of the monitoring of Romania's national and regional R&I policies. The initial indicator dashboard included in RO-RIO focuses on international comparison and trends, by providing visual analysis of selected KPIs. In a next step, the dashboard of RO-RIO should target to go beyond this and provide visual analysis of the monitoring data of national and regional R&I instruments and policies. Output and outcome indicators could then be linked to specific instruments if disaggregation levels allow. These dashboards could be initially based on monitoring data gathered on the PNIM.

2.2.2 Service 4 "Annual reports and in-depth studies on selected topics"

What value does the service add?

The annual reports and in-depth studies produced by RO-RIO will benchmark Romania's performance on R&I in international comparison. The legislation in force[23] asks for annual reports and in-depth studies to inform on the evolution of the R&I system and of progress in SNCISI implementation, but such reports have not yet been produced. Some positive changes came with the establishment of the PNIM and the reinforced commitments of MCID and of the R&I Coordination Councils to produce periodic reports and in-depth analyses, whose preparation could be supported by RO-RIO. With the production of annual reports and in-depth studies, RO-RIO will support policy makers, R&I actors and interested stakeholders observe the long-term benefits of R&I and understand Romania's investment needs, challenges, and opportunities in the world of science and technology.

How will the service be operated?

RO-RIO could conduct in-depth analyses encompassing R&I levers, structural conditions, performance, and related outcomes. Table 6 summarizes the types of analysis that can be performed by RO-RIO's researchers. Detailed description of these areas and topics can be found in Appendix 6.

Table 6 Suggested types of analysis for RO-RIO

Area	Topics	Suggestions of types of analysis
R&I levers	R&I expenditure	In-depth analyses of R&I expenditure and of progress towards the R&I investment targets, in international comparative perspective. For **public** expenditure, decomposition by: – source of funds (various public funding sources, direct vs indirect support) – sectors of performance (government, higher education, business enterprise, private non-profit) – type of R&D activity (basic research, applied research, experimental development) – type of expenditure – field of R&D – socio-economic objectives – type of beneficiary
		For **business** R&D expenditure, decomposition by:

[23] Governmental Decision no 933/2022 on the approval of SNCISI.

		– economic activities – industry orientation – size class – concentration of personnel
	R&I personnel	Analysis of stocks and flows of **Ph.D. students** and **researchers** by: – sectors of performance – domains – educational attainment – age class etc. Analysis of incentives and framework conditions to support research careers Monitoring the application of national and European provisions regarding to the recruitment, placement and promotion of RDI personnel
	Research infrastructure	Mapping performance of Romania's major/ flagship research infrastructures Analysis of participation in ESFRI/ERIC consortia and in major international infrastructures programs
		Developing customized tools for the M&E of research infrastructure
R&I performance	Knowledge production	Produce Research and Technology Specialization Indices based on scientific publications and patents
	Internationalization	Analysis of Romania's participation and performance in Horizon Europe and other European and international R&I programs, by program
	Leading research organizations	Mapping the position of Romanian research organizations and of the country in international R&I-related rankings and scoreboards (i.e., ARWU, Scimago, Global Innovation Index, European Innovation Scoreboard, Regional Innovation Scoreboard)
	Knowledge transfer and innovation in firms	Mapping Romanian unicorns, technology startups, deep tech companies and business champions
		Analysis of business innovation performance, of start-up and spin-off dynamics and of high-growth enterprises
		Analysis of knowledge transfer based on the European-wide set of harmonized indicators
R&I outcomes	R&I related productivity outcomes	Firm-level analysis of productivity growth (Iootty et al., 2019)
		Analysis of changes in labor productivity by: – industry – S3 domain – Region
	Evolution of S3 domains (including competitiveness and exports)	Analysis of complementarities between national and regional Smart Specialization
		Mapping of indicators of employment, value-added and exports by S3 domains
		Analysis of competitive advantages and participation in global value chains, by S3 domains
	R&I related societal outcomes	Tracking progress of R&I related targets and indicators from the sectoral strategies (i.e., agriculture, industrial strategy, energy, climate change, health etc.)
		Track Romania's progress in meeting the R&I-related sustainability targets

Source: World Bank.

RO-RIO can conduct in-depth analyses, presenting thematic reports and comprehensive studies, with conclusions summarized in an annual report guiding the operational activities of mandated R&I Coordination Councils. The publications of RO-RIO should combine visualizations with clear narratives for non-technical audiences. A good example of such reports is the EC's bi-annual report on the state of R&I in Europe (European Commission, 2022b), whose outline is provided in Figure 13.[24] Other examples include the Austrian Research and Technology Report[25], the Belgian Report on Science, Technology and Innovation[26] and Colombia's Science, Technology and Innovation indicators book.[27] In addition to comprehensive reports, RO-RIO could produce policy briefs, brochures, factsheets (Figure 14), or infographics, addressing different needs of levels of depth of the analysis. Combining all thematic reports produced within a year into a comprehensive annual report would facilitate distribution to MCID and R&I Coordination Councils. Additionally, it is suggested for RO-RIO to establish its own logo and visual identity manual.

Figure 13 Outline of the EC report on the Science, R&I performance of the EU

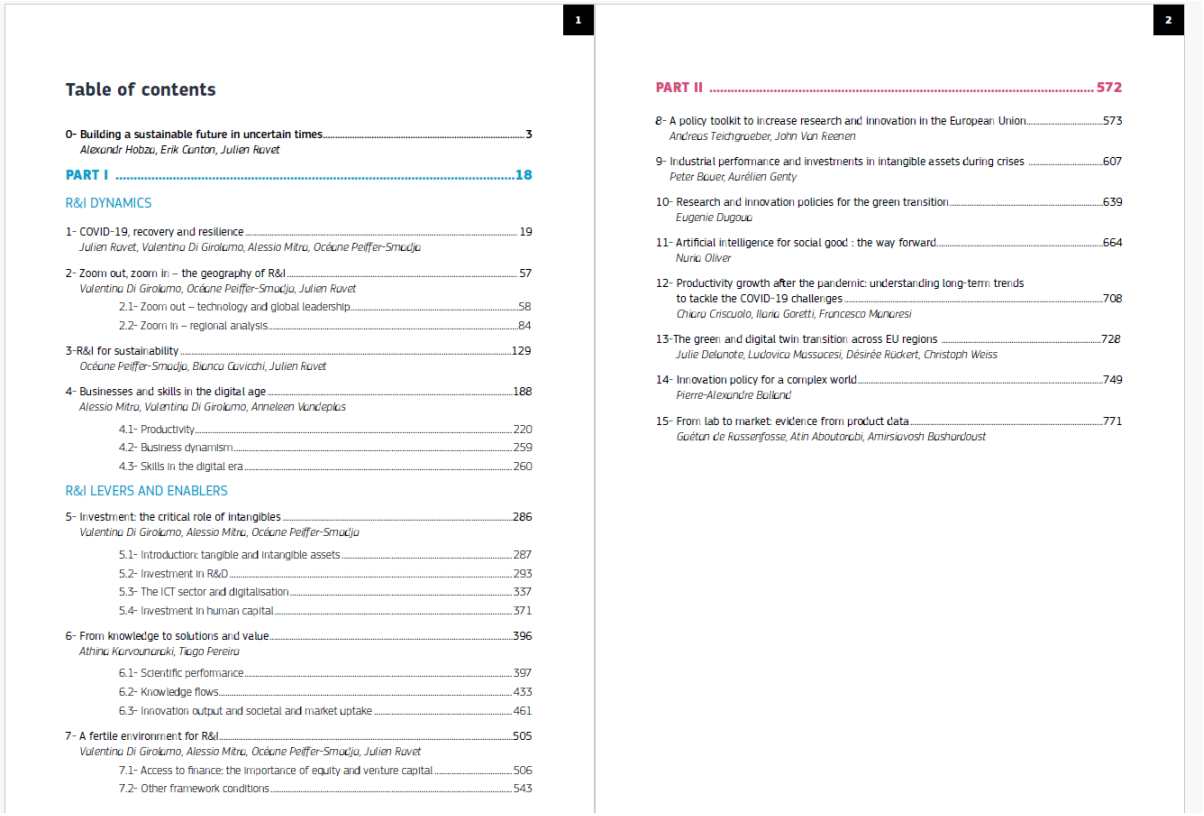
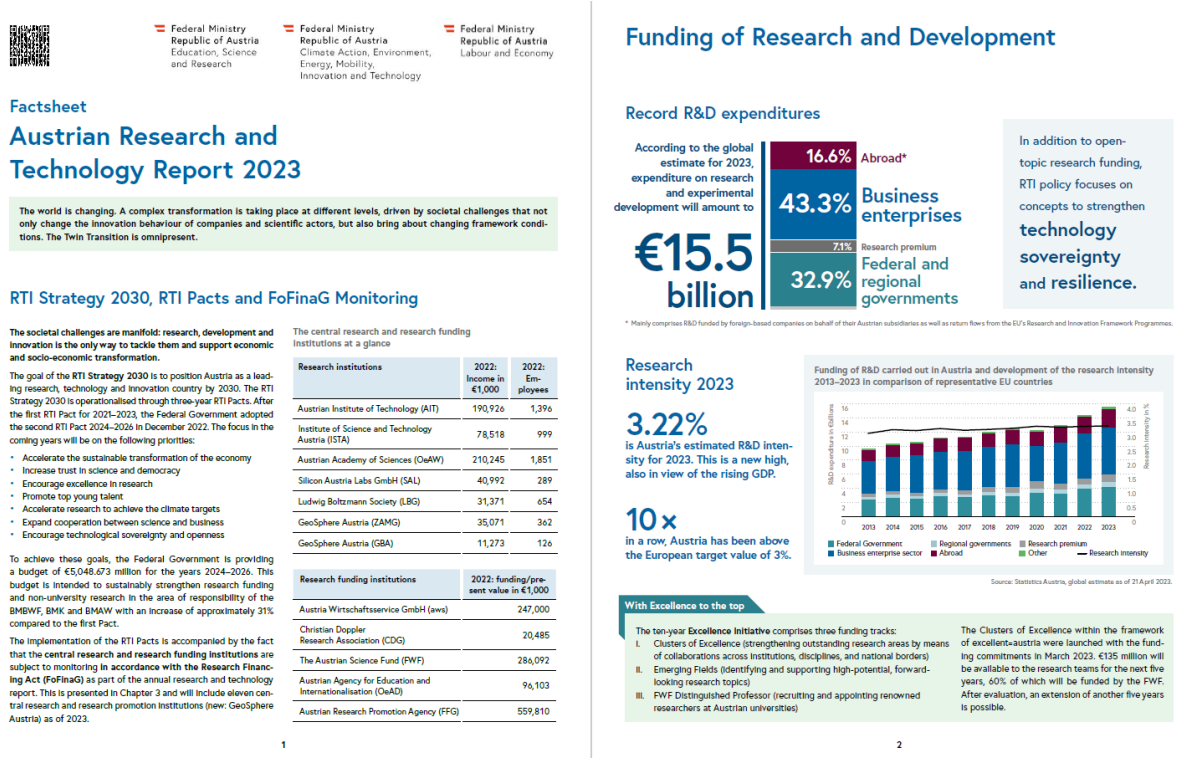


Table of contents

Source: (European Commission, 2022b)

[24] See Appendix 7 for multiple examples of visualizations used in this report.
[25] https://www.bmk.gv.at/en/topics/innovation/publications/technology_reports.html?
[26] https://www.belspo.be/belspo/organisation/publ/pub_ostc/BRISTI/FWB_rapport_2021_en.pdf?
[27] https://ocyt.org.co/wp-content/uploads/2023/06/Informe_indicadores_OCyT_2021.pdf?

Figure 14 Example of factsheet on national R&I performance



Federal Ministry Republic of Austria Education, Science and Research
Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology
Federal Ministry Republic of Austria Labour and Economy

Factsheet

Austrian Research and Technology Report 2023

The world is changing. A complex transformation is taking place at different levels, driven by societal challenges that not only change the innovation behaviour of companies and scientific actors, but also bring about changing framework conditions. The Twin Transition is omnipresent.

RTI Strategy 2030, RTI Pacts and FoFinaG Monitoring

The societal challenges are manifold: research, development and innovation is the only way to tackle them and support economic and socio-economic transformation.

The goal of the RTI Strategy 2030 is to position Austria as a leading research, technology and innovation country by 2030. The RTI Strategy 2030 is operationalised through three-year RTI Pacts. After the first RTI Pact for 2021–2023, the Federal Government adopted the second RTI Pact 2024–2026 in December 2022. The focus in the coming years will be on the following priorities:

- Accelerate the sustainable transformation of the economy
- Increase trust in science and democracy
- Encourage excellence in research
- Promote top young talent
- Accelerate research to achieve the climate targets
- Expand cooperation between science and business
- Encourage technological sovereignty and openness

To achieve these goals, the Federal Government is providing a budget of €5,048.673 million for the years 2024–2026. This budget is intended to sustainably strengthen research funding and non-university research in the area of responsibility of the BMBWF, BMK and BMAW with an increase of approximately 31% compared to the first Pact.

The implementation of the RTI Pacts is accompanied by the fact that the central research and research funding institutions are subject to monitoring in accordance with the Research Financing Act (FoFinaG) as part of the annual research and technology report. This is presented in Chapter 3 and will include eleven central research and research promotion institutions (new: GeoSphere Austria) as of 2023.

1

The central research and research funding institutions at a glance

Research institutions	2022: Income in €1,000	2022: Employees
Austrian Institute of Technology (AIT)	190,926	1,396
Institute of Science and Technology Austria (ISTA)	78,518	999
Austrian Academy of Sciences (OeAW)	210,245	1,851
Silicon Austria Labs GmbH (SAL)	40,992	289
Ludwig Boltzmann Society (LBG)	31,371	654
GeoSphere Austria (ZAMG)	35,071	362
GeoSphere Austria (GBA)	11,273	126

Research funding institutions	2022: funding/present value in €1,000
Austria Wirtschaftsservice GmbH (aws)	247,000
Christian Doppler Research Association (CDG)	20,485
The Austrian Science Fund (FWF)	284,092
Austrian Agency for Education and Internationalisation (OeAD)	96,103
Austrian Research Promotion Agency (FFG)	559,810

Funding of Research and Development

Record R&D expenditures

According to the global estimate for 2023, expenditure on research and experimental development will amount to €15.5 billion

16.6% Abroad*
43.3% Business enterprises
7.1% Research premium
32.9% Federal and regional governments

* Mainly comprises R&D funded by foreign-based companies on behalf of their Austrian subsidiaries as well as return flows from the EU's Research and Innovation Framework Programmes.

In addition to open-topic research funding, RTI policy focuses on concepts to strengthen technology sovereignty and resilience.

Research intensity 2023

3.22% is Austria's estimated R&D intensity for 2023. This is a new high, also in view of the rising GDP.

10× in a row, Austria has been above the European target value of 3%.

Funding of R&D carried out in Austria and development of the research intensity 2013–2023 in comparison of representative EU countries

Source: Statistics Austria, global estimate as of 21 April 2023.

With Excellence to the top

The ten-year Excellence Initiative comprises three funding tracks:

I. Clusters of Excellence (strengthening outstanding research areas by means of collaborations across institutions, disciplines, and national borders)
II. Emerging Fields (identifying and supporting high-potential, forward-looking research topics)
III. FWF Distinguished Professor (recruiting and appointing renowned researchers at Austrian universities)

The Clusters of Excellence within the framework of excellent=austria were launched with the funding commitments in March 2023. €135 million will be available to the research teams for the next five years, 60% of which will be funded by the FWF. After evaluation, an extension of another five years is possible.

2

Note: Only the first two (out of six) pages are displayed.
Source : Republic of Austria, (https://www.bmk.gv.at/en/topics/innovation/publications/technology_reports.html).

To facilitate the production of summary reports in the short-term, RO-RIO could generate automatic reports based on its indicator dashboard. Incorporating automatic report generation into RO-RIO provides an efficient method for delivering quick insights into Romania's R&I performance, leveraging the latest available data. Once set up by an IT professional, automatic reports require no additional work from RO-RIO, as done in Stip Compass.[28] Clicking on "Generate Country Overview" produces a PDF document compiling relevant webpage content. For RO-RIO, this would involve consolidating all indicators published on its website, accompanied by brief explanations of each indicator's significance and observed trends. Additionally, a summary table could be included, listing all available indicators, their most recent values, and average values across different innovation categories. Comparisons could be facilitated using a traffic light system to highlight differences, with trends illustrated by arrows. An example of a similar table can be found in Figure 30, Appendix 7.

Over time, RO-RIO could enhance its reporting, beginning with an initial annual report covering essential R&I topics and gradually incorporating more complex analyses and sectoral studies. In addition to synthetic automatic reports, RO-RIO could develop an initial version of its annual report to provide deeper insights into the topics covered by the automatic reports. Leveraging its analytical role within the R&I system, RO-RIO can produce comprehensive background reports on the evolution of the R&I system, fulfilling a statutory obligation currently identified as lacking in stakeholder interviews. This initial report would offer basic coverage of essential topics in R&I analysis, with the potential for further expansion by exploring additional disaggregation levels, incorporating additional indicators, and utilizing additional data sources. The prioritization of topics for in-depth and sectoral studies should be determined by the needs of R&I governance agencies. For instance, the first in-depth study of RO-RIO could focus on an analysis of R&I funding (e.g., by sources, types of expenditures, scientific domains), answering a need for information also expressed in stakeholder interviews.

[28] https://stip.oecd.org/stip/interactive-dashboards/countries/Romania

To ease this process, RO-RIO could collaborate with external researchers for the production of in-depth studies. Over time, RO-RIO's reports could also include sectoral studies. Looking ahead, RO-RIO may consider developing capabilities conducting more complex impact analyses and studies as part of its long-term development.

In the long-run, RO-RIO could play a role in complementing existing data on R&I by engaging in primary data collection. With its expertise in analyzing different data sources related to R&I and the monitoring of international best practices, RO-RIO is well-placed to identify existing data gaps. Over time, it could conduct its own surveys or partner with other institutions to address these knowledge deficiencies, as suggested in multiple stakeholder interviews.

2.2.3 Implementation phases

Function 2 could be implemented in three phases in parallel with the implementation of Function 1. Box 7 shows how services 3 and 4 might evolve over the course of this phased implementation. In Phase 3, it might be possible to provide additional services, including providing open access to data and identifying data gaps.

Box 7 Implementation phases for Function 2 "Research and analysis"

Phase 1: Deployment (0-12 months)

- **Service 3:** Select of KPIs for the indicator dashboard
- **Services 3 and 4:** Conclude data sharing agreements with relevant data and information providers
- **Service 3:** Set up the indicator dashboard
- **Services 3 and 4:** Implement automation techniques for data gathering (in line with data sharing agreements)
- **Service 4:** Enable automatic report generation based on indicator dashboard
- **Service 4:** Produce an initial report

Phase 2: Assessment and strengthening (12-24 months)

- **Services 3 and 4:** Conclude additional data sharing agreements with new data providers as necessary
- **Services 3 and 4:** Improve services design and functionalities based on user feedback
- **Service 3:** Extend number of KPIs for the indicator dashboard, including indicators from the monitoring of Romania's national and regional R&I policies
- **Service 4:** Deepen the coverage of the annual report
- **Service 4:** Conduct in-depth studies on priority topics

Phase 3: Scale up (24-36+ months)

- **Services 3 and 4:** Improve services design and functionalities based on user feedback
- **Service 4:** Incorporate more complex analyses in in-depth studies
- **Additional service:** Provide open access to data and indicators related to R&I and productivity

- **Additional service:** Identify data gaps and conduct own surveys or partner with data collection institutions to fill these gaps

2.3 Disseminate knowledge and information

- RO-RIO's Function 3 "Disseminate knowledge and information" would improve the reach of evidence on R&I performance, the visibility of the observatory and increase skills of R&I actors in generating and using rigorous evidence for decision-making.
- Service 5 "Dissemination workshops and capacity building" could consist of annual (or bi-annual) dissemination conferences to present RO-RIO's key products and results, and of regular (e.g., every two months) capacity building workshops on R&I evidence generation and use.
- Service 6 "Knowledge base for evidence-based decisions in R&I" can take the form of a digital library centralizing (i) training material on R&I evidence generation and use and (ii) policy documents (e.g., evaluations, methodological documents and surveys, studies) related to R&I.
- Service 7 "News and updates on topics related to R&I" could involve a newsfeed on RO-RIO's website and/or a digital newsletter shared via email, providing a comprehensive list of news and updates on topics related to R&I (for example, key innovation brought to the market, research findings or happening of an event) and on new RO-RIO functions and services.

The aim of Function 3 "Disseminate knowledge and information" is to disseminate knowledge and information by providing three services: i) organizing events for dissemination and capacity building, ii) maintaining a repository of training material and policy documents, as well as iii) gathering and sharing of R&I-related news. Service 5 "Dissemination workshops and capacity building" consists of the organization of events for knowledge and information dissemination produced or compiled by RO-RIO. Service 6 "Knowledge base for evidence-based decisions in R&I" targets to create a comprehensive repository centralizing and providing open access to training material and policy documents related to R&I. Service 7 "News and updates on topics related to R&I" aims to inform, via newsfeeds and newsletters, RO-RIO users and other interested individuals about news and updates on topics related to R&I and RO-RIO.

2.3.1 Service 5 "Dissemination workshops and capacity building"

Definition of the service

RO-RIO could organize events for knowledge and information dissemination. One of the services of RO-RIO could consist of events, in the form of capacity building workshops and dissemination conferences, with video connection to accommodate stakeholders outside of Bucharest**.**

What value does the service add?

The events organized by RO-RIO would improve RO-RIO's visibility and increase skills of R&I governance agencies, and R&I performers; both promoting the importance of R&I in general. As a newly introduced initiative, efforts would need to be invested in raising

awareness on RO-RIO and the services it would provide to the Romanian R&I ecosystem and beyond. The organization of dissemination events could contribute to improving RO-RIO's visibility and strengthen the observatory's relevance and position in the R&I system. The capacity-building workshops could increase the skills and capabilities of R&I governance agencies and R&I performers in topics related to evidence-generation and evidence-use, creating a sustainable knowledge community.

How will the service be operated?

RO-RIO could implement an annual (or bi-annual) conference to present its work to a broad range of R&I actors and interested citizens, as well as regular workshop series on evidence generation and use. RO-RIO could organize an annual (or bi-annual) conference to present relevant reports (for example, its annual report and selected in-depth studies on priority topics) RO-RIO has produced, functions or services that were added to the portfolio or improved based on user feedback, and an outlook for the upcoming year. The annual conference is a good forum to receive immediate feedback on RO-RIO's activities from R&I actors and RO-RIO users. RO-RIO could implement a series of capacity building workshops for interested individuals, R&I governance agencies and R&I performers. These workshops could cover topics in the policy cycle related to the production and use of evidence (for example, programming a survey questionnaire, planning a data collection, setting up an M&E system, or conducting an impact evaluation). It is important to implement the workshops regularly (for example, every two months) to gradually increase skills and capacities. The training can be delivered by the observatory's own staff or by selected external experts in the specific topic. The target audience could cover all interested R&I actors and can also expand to interested citizens.

The content for the annual conference and the capacity building workshops stems mostly from RO-RIO's activities. RO-RIO's activities, outputs, and reports from the previous year (or 6 months) will serve as a basis for the content of the annual (or bi-annual) conference of RO-RIO. The capacity building workshops are based on knowledge produced by RO-RIO itself and include material produced by other knowledge organizations, e.g., the World Bank. Notably, reports, tools and capacity-building events developed in collaboration with the World Bank could serve as a basis to develop RO-RIO's initial capacity-building workshops.

2.3.2 Service 6 "Knowledge base for evidence-based decisions in R&I"

Definition of the service

The knowledge base is a comprehensive repository centralizing and providing open access to training material and policy documents related to R&I. The knowledge base could take the form of a digital library where RO-RIO's users could access: i) training material for building capacities on how evidence on public policies is produced and used (for example, webinars, showcases, guides, and handbooks on how to set-up M&E systems or how to conduct impact evaluations); and ii) policy documents related to R&I. Policy documents could be categorized into evaluations, methodological documents and surveys, studies, reports, and other documents. Data sources for the knowledge base is RO-RIO itself complemented with international, national, and regional sources. All material available in the knowledge base is open access for the users.

What value does the service add?

The centralization of relevant policy documents at one place increases accessibility of information for the public administration. Due to limited centralization of relevant policy documents from different sources, public administration needs to invest additional efforts to access the material, i.e., to stay informed on the results of the performance of policy instruments managed by other agencies or improving their skills in evidence-production and evidence-use. Instead of searching through multiple sources or databases, RO-RIO users from the public administration can conveniently access a wide range of important policy documents and reports, such as monitoring or evaluation reports of R&I policies or EC's publications on R&I performance in Europe, from one platform. This saves time and effort, making it easier for the public administration to find the information they need.

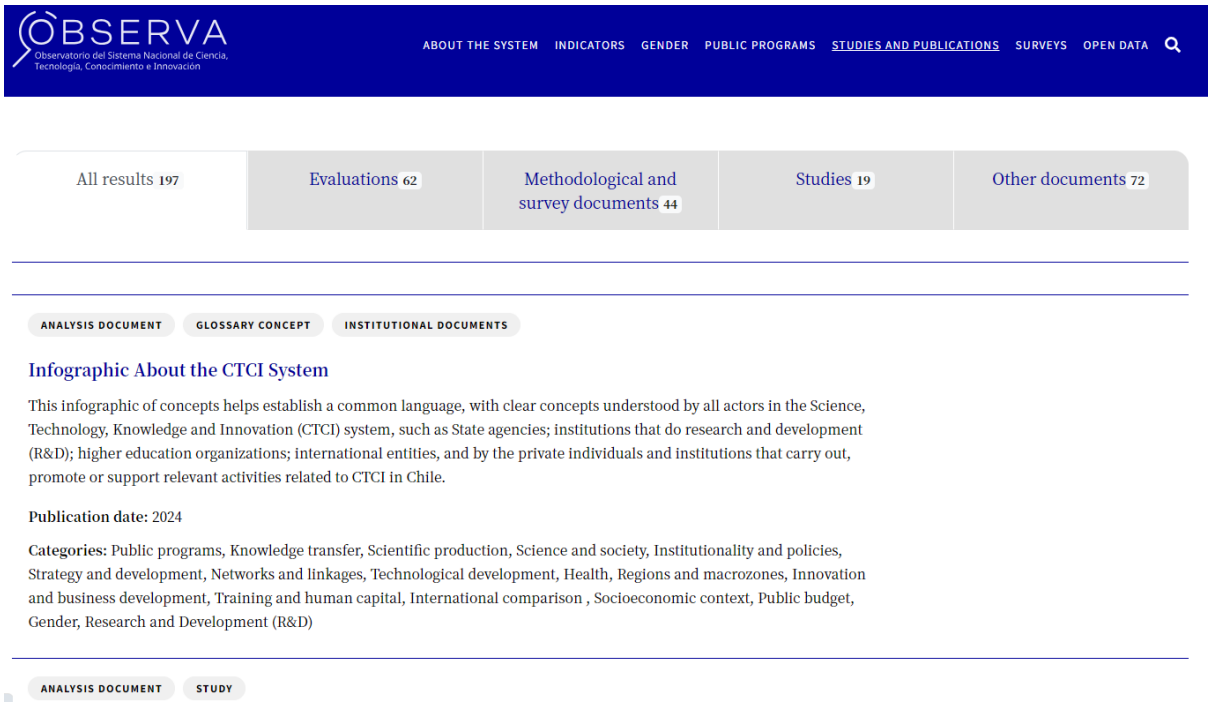
Access to a centralized repository of training material on evidence generation and policy documents supports evidence-based decision-making. Public administration and program funders can increase their capacities and skills related to evidence-production and -use by accessing a large amount of training material in RO-RIO. Policymakers and program funders can also draw upon a wealth of policy documents such as case studies, and policy analyses. The combination of training material on evidence-production and -use, and R&I policy documents allows public administration and program funders to make more informed, evidence-based decisions in the development and implementation of R&I policies. This helps to ensure that policies are grounded in rigorous evidence and have a greater likelihood of success.

RO-RIO's centralized knowledge repository facilitates the visibility of the material to reach a broader audience. Researchers and policymakers can increase the visibility of their studies and reports by having this material published on RO-RIO's platform. By making documents easily accessible through RO-RIO, researchers and policymakers can showcase their work to actors from diverse backgrounds. This broader reach can lead to greater collaboration and knowledge transfer between R&I actors and policymakers.

How will the service be operated?

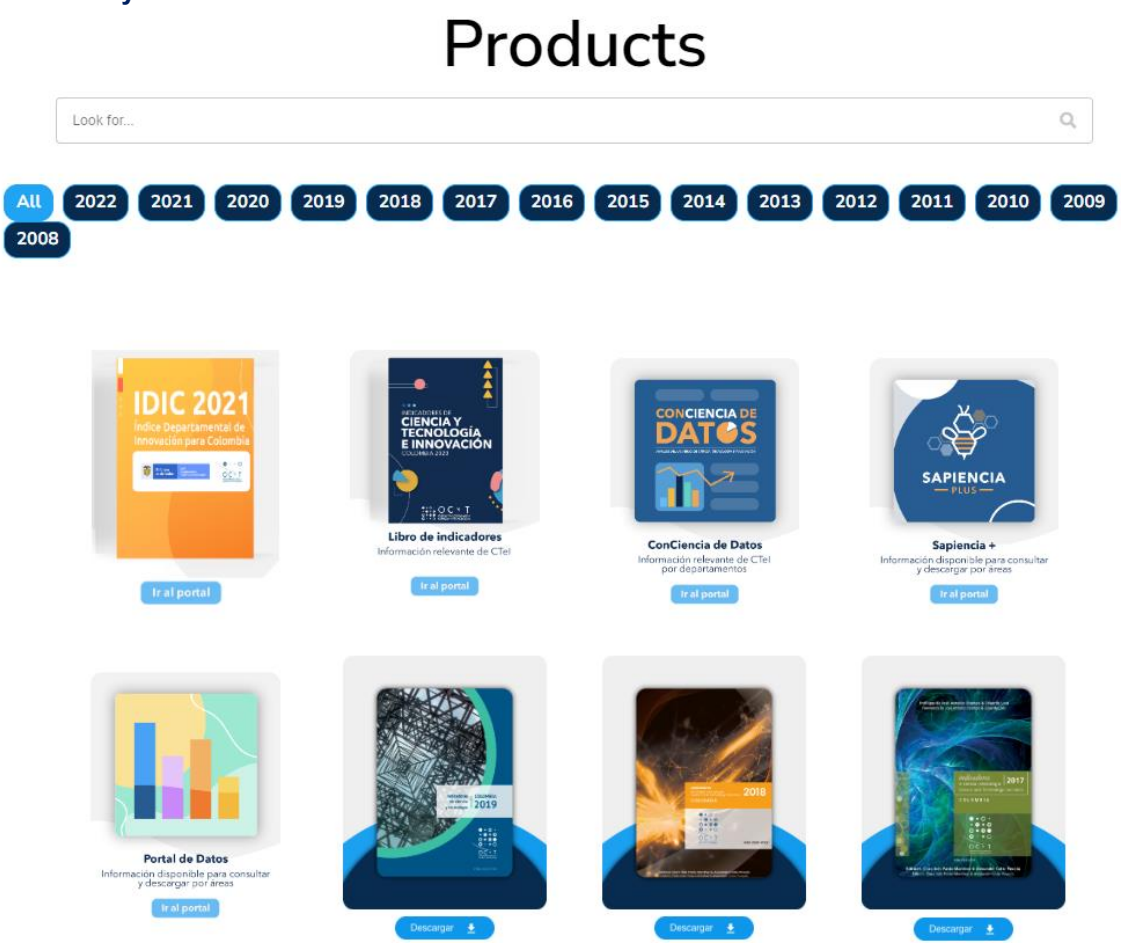
Both the Chilean and Colombian observatories offer dedicated webpages for publications and studies, featuring various filtering options (for example, year) with search functions for easy access to relevant documents. The Chilean observatory dedicates an own webpage with different tabs ("All results", "Evaluations", "Methodological and survey documents", "Studies", "Other documents") to publications and studies (Figure 15). The results can be filtered by year, topic (for example, gender, health, science, and society), and publication type (for example, design evaluation, impact evaluation, analysis document). The Colombian observatory provides all its products, including reports on the analysis of R&I indicators, on a webpage (Figure 16). Results can be filtered by year. Both observatories include search features allowing users to quickly find relevant documents.

Figure 15 Example of a webpage for publications and studies, the case of the Chilean observatory



Source: https://observa.minciencia.gob.cl/estudios-y-publicaciones, consulted on 3/26/2024.

Figure 16 Example of a webpage on the observatory's products, the case of the Colombian observatory



Source: https://ocyt.org.co/productos2/, consulted on 3/26/2024.

RO-RIO can publish its own reports and in-depth studies on a dedicated webpage and centralize links to policy documents of external sources. The in-depth studies and reports produced in RO-RIO's analysis function could be published in the knowledge base of RO-RIO. This could be complemented with links to external webpages and policy documents. Table 7 summarizes a prioritized list of data sources for policy documents covering publication databases from international organizations such as the EC, OECD, and World Bank (for example, the Romania country profile of the EIS, Frascati and Oslo Manuals), national entities such as MCID, UEFISCDI, and the INS (for example, PNCDI IV, sectoral R&D plans, R&I activity reports, statistical methodologies[29]), and regional agencies, such as RDAs (for example, monitoring reports of the regions' ROPs). Once the prioritized policy documents are compiled in RO-RIO's knowledge base, links to other types of documents could be added. For each link, RO-RIO could provide a brief description including information on the publication year, the authors, and the thematic focus. The webpage should include a robust search and filter options (for example, by author, year, or topic) that allow users to quickly find relevant materials.

Table 7 Key data sources for policy documents of RO-RIO's knowledge base

Organization	*Type of document*	*Link to publications*
MCID	Public periodical reports	Link
UEFISCDI	Activity reports	Link
	Publications	Link
INS	Statistical products & publications	Link
World Bank	Publications	Link
World Bank in Romania	Data, research	Link
OECD	Policy papers	Link
OECD in Romania	Reports & studies	Link
EC	Publications	Link
	European Semester Documents for Romania	Link

Source: World Bank.

RO-RIO can enhance its knowledge base by incorporating training material sourced from its own production and relevant material from other knowledge institutions. RO-RIO's knowledge base could complement the policy documents with training material related to evidence-production and evidence-use. The main source of the training material could be made available by RO-RIO itself, i.e., knowledge and methodologies produced directly by RO-RIO. Workshop and showcase recordings and knowledge products (e.g., handbooks, survey templates) produced in collaboration with the World Bank, as well as relevant material produced by other knowledge institutions could also be integrated in the knowledge base.

[29] Notably, stakeholder interviews revealed a need for detailed and clearer information on the production of indicators used for international comparisons.

2.3.3 Service 7 “News and updates on topics related to R&I”

Definition of the service

RO-RIO can share news and updates on topics related to R&I with users of RO-RIO. The sharing of news and updates can take the form of a newsfeed on RO-RIO’s website and/or a digital newsletter shared via email. The newsfeed should be intended to be a comprehensive list of news and updates on topics related to R&I (for example, key innovation brought to the market, research findings or happening of an event) and on new RO-RIO functions and services. The digital newsletter compiles the most important news and shares them regularly with subscribed individuals.

What value does the service add?

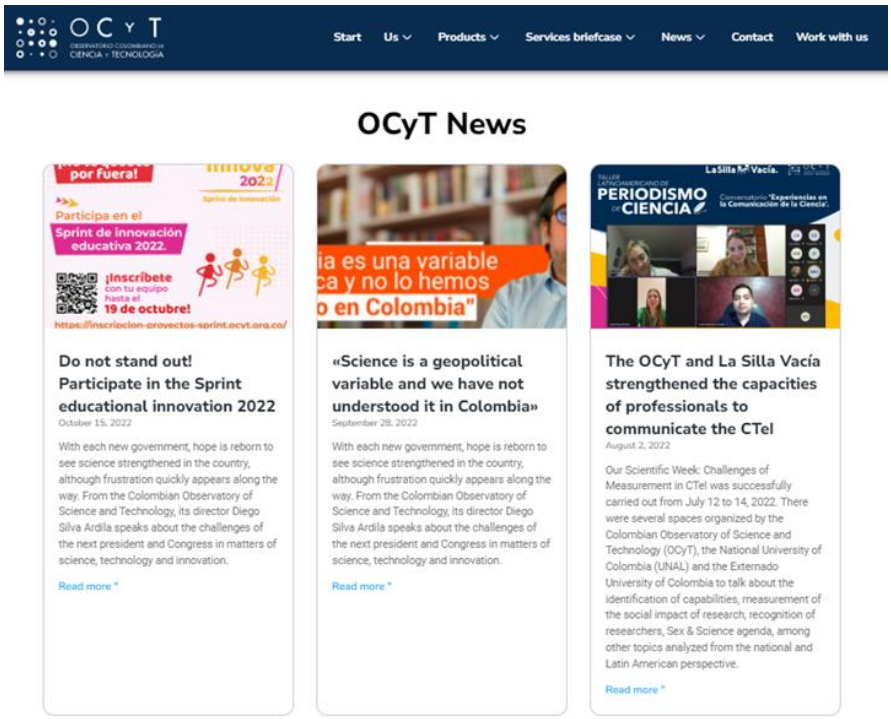
The centralization of news and updates makes the receipt of information for R&I actors more efficient, increasing their visibility. Presently, staying updated on R&I news, including new proposal calls, requires consulting the websites of various government agencies and research organizations. R&I actors might focus on news and information from fewer relevant sources (for example, MCID and UEFISCDI), and citizens may struggle to locate reliable and pertinent information on R&I related topics.[30] The newsfeed and newsletter centralize information from various sources. Thus, R&I actors visiting RO-RIO’s website or subscribing to the newsletter can see all news and updates related to R&I at one glance. Improving access and visibility of information on R&I related topics can contribute to the Objective 8 “Involving Citizens in Science” of the White Book of the transition to Open Science 2023-2030.

How will the service be operated?

News and updates can be published via a newsfeed on RO-RIO’s website. A newsfeed is a continuously updating stream of news articles, updates, posts, or content from various sources presented in a chronological order. Such a newsfeed could appear on the landing page of RO-RIO’s website, so that users can immediately see news and updates related to R&I. The Colombian observatory displays news by the date of publication, beginning with the latest. Each piece is complemented by a picture or infographic, along with a title and summary details (Figure 17). Additionally, there is a link to the original source for further information. The website should have a search feature and filters (e.g., by domain and by type) to make navigation easier and help users quickly find news related to specific sectors like agriculture or health. Types of news could include a distinction between RO-RIO-related news, innovation and research findings, and types of specific events (e.g., conferences, public debates, call launch). In Finland, science and research news can be sorted based on the originating organization. Research.fi automatically refreshes data sourced from universities, universities of applied sciences, research institutes, university hospitals, and research funders.

[30] The experience of the Italian observatory of science in society in monitoring public attitudes towards science for more than 20 years demonstrate a real interest of citizens in the development of science and technology and of its incidence on the society.

Figure 17 Example of a newsfeed, the case of the Colombian observatory



Source: https://ocyt.org.co/noticias-ocyt/, consulted on 03/26/2024.

A newsletter could compile the most important news and updates and be shared regularly with subscribed users. Besides the newsfeed, another option for keeping interested individuals up to date is newsletters. For instance, the focus could lie on new R&I instruments, new functions and services added to RO-RIO, and new outputs produced by RO-RIO. The Colombian observatory develops a thematic newsletter monthly to raise awareness on R&I statistics and specific services provided by the observatory.

Data sources and implementation details

The initial newsfeed and newsletter could start with the internal RO-RIO news and updates, gradually increasing the amount of information. Initially, the newsfeed could focus on including internal news and updates from RO-RIO only, for example about new services added to RO-RIO's website, new indicators added to the indicator's dashboard, new documents added (for example, study or methodological publication), and/ or new funding opportunities added to the mapping of instrument. Once the initial version of the newsfeed and newsletter is operational, R&I news and information already published on websites, newsfeeds, and newsletter within the R&I system (for example, MCID, UEFISCDI, RDAs and other ministries) could be added to the newsfeed and newsletter, preventing any extra work for information providers.

RO-RIO could automate news collection and implement a systematic classification system. RO-RIO could automate the collection of news and updates from various sources, like the approach in Finland. Media monitoring tools facilitate gathering information from publicly accessible media sources. Simultaneously, efforts could be directed towards establishing a meaningful classification system to enhance user navigation within the news. To streamline information sharing on RO-RIO's website, a designated staff member could be tasked with prioritizing news, defining criteria that determine eligibility for inclusion in RO-RIO.

2.3.4 Implementation phases

Function 3 could be implemented in three phases in parallel with the implementation of Function 1 and Function 2. Box 8 shows how services 5, 6, and 7 might evolve over the course of this phased implementation.

Box 8 Implementation phases for Function 3 "Disseminate knowledge and information"

Phase 1: Deployment (0-12 months)

- **Service 6:** Implement an initial knowledge base, with RO-RIO's first annual report, reports and knowledge products produced under the World Bank and MCID's cooperation
- **Service 7:** Operationalize newsfeed sharing RO-RIO's updates
- **Service 5:** Organize RO-RIO's launch event

Phase 2: Assessment and strengthening (12-24 months)

- **Services 6 and 7:** Improve services design and functionalities based on users feedback
- **Service 5:** Start annual (bi-annual) conferences
- **Service 5:** Organize regular capacity-building workshops
- **Service 6:** Extend knowledge base with documents and training material from RO-RIO production and other knowledge institutions
- **Service 7:** Extend newsfeed to include news from relevant R&I actors
- **Service 7:** Implement newsletter

Phase 3: Scale up (24-36+ months)

- **Services 5, 6 and 7:** Improve services design and functionalities based on user feedback
- **Service 7:** Extend newsfeed to include information on key research findings and new innovations brought to the market

SECTION 3

KEY SUCCESS FACTORS FOR RO-RIO

3. Key success factors for RO-RIO

- Existing RIOs share a common objective of filling information and knowledge gaps concerning the current stage and development of R&I.
- RIOs take different forms, with differing scope, governance, and funding models, and services. In some instances, a RIO does not exist as a singled-out entity, but its functions may be dispersed among other existing institutions.
- Common patterns were identified in the review of international case studies, grouped into eight key success factors of a RIO: a clear mission, user-driven functionalities and on-going development, continuous data provision, effective governance, highly skilled personnel, strategic partnerships and networks, sustainable funding, and gradual implementation.

The observatories identified for this report seek to address the needs for information of the R&I ecosystem as a whole, with a notable focus on public administration and citizens. These RIOs primarily contribute to a deeper understanding of the performance of investments in R&I, while answering a growing demand from citizens for more visibility on the use of public funds. As highlighted during the interview with the Innovation Observatory of Navarra, the observatory should not merely observe but rather empower everyone to engage in the observation of R&I trends.

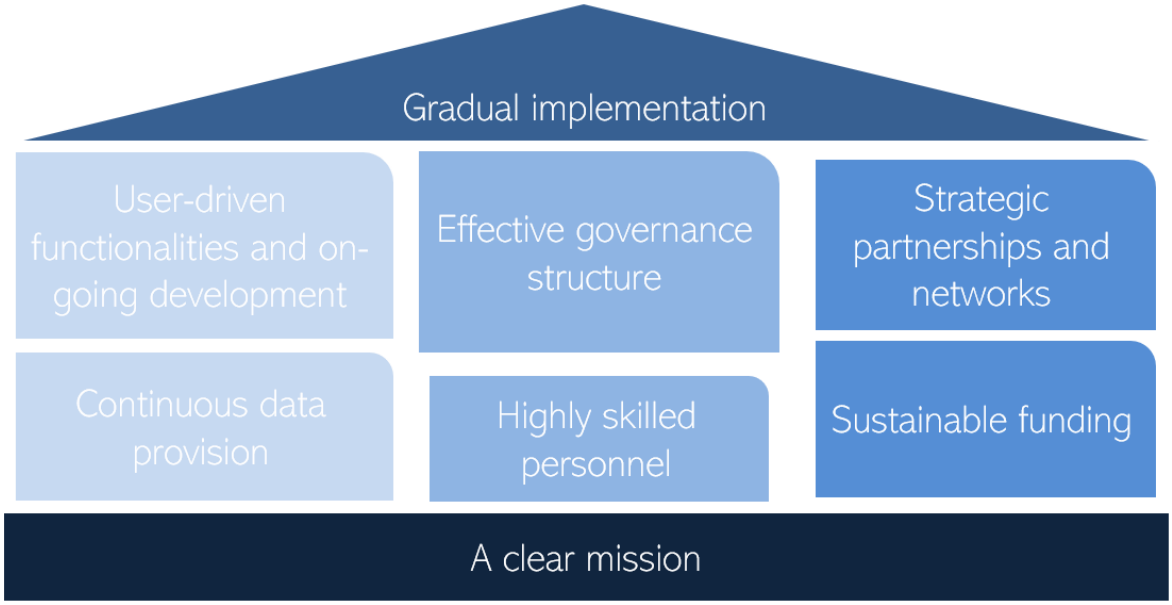
The functions performed by a RIO may be dispersed among other existing institutions. Not every country has a RIO. In some cases (including Portugal and the United States), other institutions (such as ministries, universities, or statistical agencies) perform some of the primary functions of an observatory. This emphasizes the need to ensure the aim to fill R&I information and knowledge gaps is met for an effective management of information on R&I and productivity, and policy development, even if this role is shared by different organizations. For instance, the National Center of Science and Engineering Statistics in the United States fulfills a role closely related to that of a RIO, as does the Directorate General for Education and Science Statistics (DGEEC), a delegated agency of the National Statistical Office, in Portugal. However, the establishment of a dedicated observatory becomes especially beneficial when there is a larger need for information and coordination, as it is the case in Romania.

There is no single model that all observatories follow as they adapt to local needs and context. RIOs differ in terms of scope, governance, and funding models, as well as in the services they provide. These decisions are driven by the characteristics of the local context in which the RIO is established, including existing services and the specific needs of the R&I ecosystem. For instance, the French observatory has specialized itself on the scientometric analyses of scientific publications due to the focused need of producing reliable indicators for the monitoring of the performance of research organizations. In contrast, the Innovation Observatory of Navarra covers a wide range of services (e.g., international comparison of the region's R&I performance in an indicator dashboard or annual reports) to support M&E of the regional STI plan. The observatory benefits from a user-friendly website directing different types of users to the most relevant information and services.

Despite the differences observed, common patterns emerge. Several key lessons were derived from the experiences of the identified RIOs and related institutions. For a more comprehensive overview of the RIOs and Research Information Systems interviewed for this report, stand-alone case studies are provided in Appendix 8. Key lessons learned were

grouped in eight key success factors for establishing and operating a RIO, aiming to enhance their sustainability and impact within the R&I ecosystem (Figure 18). Having a clear mission is the foundation of a RIO. Once the mission is defined, a RIO needs to work on demand-driven products (through user-driven functionalities and on-going development, as well as ensuring a continuous data provision to the observatory), its core organizational structure (including an effective governance structure and highly skilled personnel) and its sustainability (through strategic partnerships and networks, and sustainable funding). Finally, a gradual implementation of the RIO's services is essential for an effective and realistic implementation of a RIO.

Figure 18 The eight key success factors of a RIO



Source: World Bank.

3.1 A clear mission

- A RIO needs a clear mission directly addressing specific needs for well-defined target groups and clarifying the added value of the observatory to the existing R&I system.
- A good understanding of the needs for information and functions of the R&I system, through the consultation of representatives of key R&I actors or the conduct of surveys, is the starting point of a RIO.
- A mission for RO-RIO could be to promote the production and use of rigorous evidence in policy decision-making by centralizing, analyzing, disseminating statistical data from national and international databases and information on R&I and productivity, and building capacities of R&I and productivity stakeholders.
- Through its role of knowledge producer and its capacity-building function, RO-RIO can contribute to Romania's objectives of improved monitoring of the whole R&I system and of strengthened institutional capacities in ministries and agencies.

3.1.1 Lessons learned from international case studies

An effective observatory requires a clear mission. A clear mission directly addresses *specific needs* for *well-defined target groups*. As illustrated by Box 9, the RIO's mission indicates its primary functions. In Chile, Observa's mission includes four primary functions: collect, standardize, analyze, and disseminate. In France, OST's mission comprises two primary functions: produce scientometric indicators and analyze R&I systems. These two examples also specify the intention of the observatory (what are they doing this for) and (in Chile) for whom ("citizens and relevant actors of the system"). By specifying the "*what*" and "*what for,*" the RIO's mission clarifies the observatory's added value to the existing R&I system.

Box 9 Examples of RIOs' missions

Observatory of the National System of Science, Technology, Knowledge and Innovation (Observa) in Chile: "seeks to collect, standardize, analyze and disseminate in a safe, responsible, fluid and friendly manner all the information that concerns the National System of Science, Technology, Knowledge and Innovation, to support public policy decision-making based on evidence and to inform citizens and relevant actors of the System."

Source: Observa's website

Observatory of Science and Technics (OST) in France: "Produce scientometric indicators and analyses of R&I systems in order to contribute to: the knowledge of R&I activities in France and around the world; the evaluation of research and transfer activities; the evaluation of R&I policies."

Source: Hcéres' website

Defining the observatory's mission demands a good understanding of the needs for information and functions of the R&I system. Designing an observatory starts with identifying what information is missing and for whom, and what may prevent the proper use of this information. In the scenario of Finland, the Research Information Hub, from which Research.fi is the public interface, arose from needs of both the government and researchers. The government required a unified system to faciliate the collection and processing of data used for the production of reliable indicators on research publications as one of the funding allocation criteria for higher education institutions. On the side of researchers, there was a need to easily find relevant research output and to reuse the research information in different systems (Nikkanen & Puuska, 2022). The Colombian observatory originated from the need to produce R&I indicators required for reporting to international institutions. Over time its role evolved from indicators production towards advanced data analysis.

Assessing needs can be done in two complementary ways: i) a collaborative formulation of the observatory's objectives and ii) surveys. Most of the institutions interviewed for this report mentioned assessing the needs of the R&I system through collaborative processes, involving technical groups or steering committees comprising representatives from key target groups (see examples in Table 8). In Chile, this process was supplemented with an initial survey with experts and key target users (Box 10). The survey results were used to guide the definition of their observatory's activities.

Table 8 Examples of a collaborative formulation of the observatory's activities

Institution	Members
Innovation Observatory of Navarra (Spain)	Technical advisory group made of: • Regional statistical office (Navarra Institute of Statistics) • Smart Specialisation Strategies for Sustainability (S4) Strategic Projects Service • Regional social reality observatory • RDI funding agency (SODENA) • Coordinator of the RDI eco-system (ADItech)
Observa (Chile)	Technical committee made of technical experts from institutions providing data and reports to the observatory, including: • National statistical office • National institute of intellectual property • Higher education information service

Source: World Bank, based on interviews with representatives of Innovation Observatory of Navarra and Observa.

Box 10 Case Study: the use of a stakeholder survey for the design of Observa, Chile

WHOM?

- Conducted **11 interviews** involving 35 individuals over one month.
- Diverse respondents included**:** public sector representatives, research groups, consultancy firms, academicians, members of the civil society, education and gender specialists, international organizations.

WHAT?

- **Survey topics covered:**
  - Preferences for observatory content and format.
  - Desired features on the observatory website.

KEY RESULTS

- **Demand for information:**

Real interest expressed in assessing the country's weaknesses in STI.

- **Need for guidance for STI system clarification:**

Emphasis of the need to clarify the STI system and guide users to relevant services.

- **User-centric design for varied audiences:**

Recognized the need for several layers of depth of information catering to different target users:

  - Entry level for citizens (organigram of the STI system and key indicators).
  - Intermediate level for the public sector and journalists (additional indicators, interpretation, and reports).
  - Granular data for researchers.

- **Enhanced Comparability:**

Highlighted the importance of comparability:

  - International performance benchmarking.
  - Comparison between country's regions.
  - Cross-sector analyses.
  - Inclusion of a gender lens.

Source: World Bank, based on the interview with representatives of Observa.

3.1.2 Implications for RO-RIO

The key objective and target groups of RO-RIO are defined within the PSF report, providing a starting point for the formulation of RO-RIO's mission. A prior assessment of information and functional gaps was conducted by the PSF country review expert panel in 2022, which led to the formulation of a need for a R&I Observatory (European Commission, 2022a). The key objective of RO-RIO is stated in the PSF report, providing a starting point to the formulation of its mission: "map Romania's best R&I strengths in an international context and study national developments in light of EU and international trends" (p.27). The report further highlights the three primary functions of a RIO identified in our review of case studies: the centralization of data and information ("collect statistical data from international databases"), research and data analysis ("analyze them in the Romanian context, and map Romania's position"), and dissemination ("The information should be shared"). This document also identifies two key target groups, "policy makers and the public," which should be at the core of RO-RIO's mission.

RO-RIO's mission should go beyond the PSF's recommendation by directly addressing Romania's needs for evidence on R&I and productivity. A mission statement for RO-RIO is proposed in Box 11 based on this report's background work. RO-RIO should provide analysis of the R&I system covering the economic context, main actors, funding trends, human resources, policies to address R&I challenges, and R&I in national and regional strategies. It should seek to improve the understanding on the performance of R&I public and private funds invested in Romania in an international perspective, its visibility for the society as a whole and to build capacities of public administration.

Box 11 RO-RIO's proposed mission statement

A mission for RO-RIO could be to provide a rigorous evidence-base and promote its use in policy decision-making in R&I by:

(i) **centralizing**;

(ii) **analyzing**;

(iii) **disseminating** statistical data from national and international databases and information on R&I and productivity, and;

(iv) **building capacities** of R&I and productivity stakeholders.

RO-RIO will identify Romania's areas of excellence in R&I that can guide investments in R&I and Romania's internationalization strategy.

Source: World Bank.

The proposed mission of RO-RIO encompasses RO-RIO's contribution to the achievement of other PSF recommendations. The PSF recommendation on the establishment of RO-RIO should not be considered as a stand-alone initiative, but as part of a comprehensive strategy to promote the use of evidence in decision-making. Two other recommendations accompany that of a RIO. These are Recommendation 3.1. on the implementation of a monitoring system for the whole Romanian R&I system,[31] and

[31] "Design and implement the envisaged all-encompassing monitoring system for R&I, based on the interoperability of national and Cohesion Funds systems." (European Commission, 2022a) p.59).

Recommendation 3.3[32] on strengthening institutional capacities in ministries and agencies. As demonstrated by international experience, a RIO can contribute to both initiatives. A RIO can partly mitigate the lack of analysis capacity of monitoring data within public administration.

As indicated in the PSF Report, smart monitoring data and evaluation results are insufficiently used to inform policy decisions. A RIO requires state-of-the-art scientific methods for data analysis and advanced technologies for efficient processes. This involves equipping its future staff with the necessary skills. In addition, a RIO can actively contribute to building capacities in strategy planning, monitoring, evaluation, data collection, and data analysis as part of its activities, in the form of workshops and by constituting a knowledge base. Facilitating RO-RIO's processes will promote up-to-date digitalization of data sourced from entities contributing inputs. Finally, RO-RIO is also expected to guide MCID's internationalization strategy (Recommendation 9.1[33]) by identifying areas of excellence. The contribution of RO-RIO to these other objectives is part of its proposed mission.[34]

The proposed mission of RO-RIO emphasizes the added value of incorporating productivity within its focus. Private investments in R&D and the proportion of innovative firms in Romania are below the European average (Eurostat), indicating untapped potential to increase firm-level productivity because R&I is fundamental to the productivity and competitiveness of an economy (European Commission, 2022b). RO-RIO can offer a better understanding of the factors that drive innovation within firms, and those affecting the effective diffusion of innovation across the economy. This knowledge can better guide R&I policies contributing to their larger impacts on productivity and related economic outcomes.

A complementary assessment of the specific needs of the public administration can help define RO-RIO's activities and their prioritization. Beyond its mission, RO-RIO should define how this mission will be operationalized. As an initial key target group, assessing the needs of policy makers of different ministries and agencies can guide this stage of the observatory's development. For this purpose, the World Bank team engaged in interviews with 12 public institutions (see a full list in Table 17 and the interview guide in Appendix 3), with the intention to elicit main needs and concerns for the observatory (see Box 4 for a summary of key takeaways). This initial assessment could be complemented by organizing a round table where stakeholders from the public administration come together to reach a consensus on RO-RIO's mission, ensuring a collective understanding of the mission's objectives.

An assessment of R&I performers and enablers' needs for information, data and analysis on the R&I system could guide RO-RIO in reaching out to these groups in the future. A similar exercise to the one with institutional stakeholders could be repeated with other target groups as the mission of the observatory expands over time to address the needs of data and information of other R&I and productivity stakeholders. If the initial priority of RO-RIO is to address the needs of policymakers and citizens, there is an opportunity to gradually expand this focus to include other target groups. Researchers may stand to gain from a better understanding of societal challenges, increased access to micro-data, and improved identification of potential collaborators. They, in turn, can contribute valuable knowledge to the observatory. Innovative firms may also benefit from this orientation, and from gaining easier access to information on researchers and research and technology infrastructure. In

[32] "Strengthen institutional capacities, by investing more resources for capacity development and ensuring good performance-related working conditions, including effective delegation of authority and up-to-date digitalisation." (European Commission, 2022a), p.59).
[33] "Develop an internationalisation strategy with indicators and realistic quantified targets, aligned with national priorities (Strategic Research Agendas and S3 priority domains), which is more selective in terms of countries and topics for international cooperation/EU partnerships and builds on policy intelligence for a better understanding of Romanian areas of excellence." (European Commission, 2022a), p.128).
[34] RO-RIO's services also contribute to other recommendations of the PSF report, as discussed in Appendix 5.

exchange, these firms may support the observatory by funding specific studies aligned with their interests. Enablers, such as those within the start-up and Small and medium-sized enterprise (SME) ecosystems, may enhance their visibility and contribute to the implementation of policy instruments by being identified and recognized for their key roles and services. Conducting interviews with representatives from different R&I performers and enablers would help validate the relevance of these services and uncover additional needs of services and information.

Checklist

- ✓ Adapt the proposed mission for RO-RIO to national priorities
- ✓ Define clear target groups
- ✓ Reach consensus on RO-RIO's specific objectives among R&I governance agencies

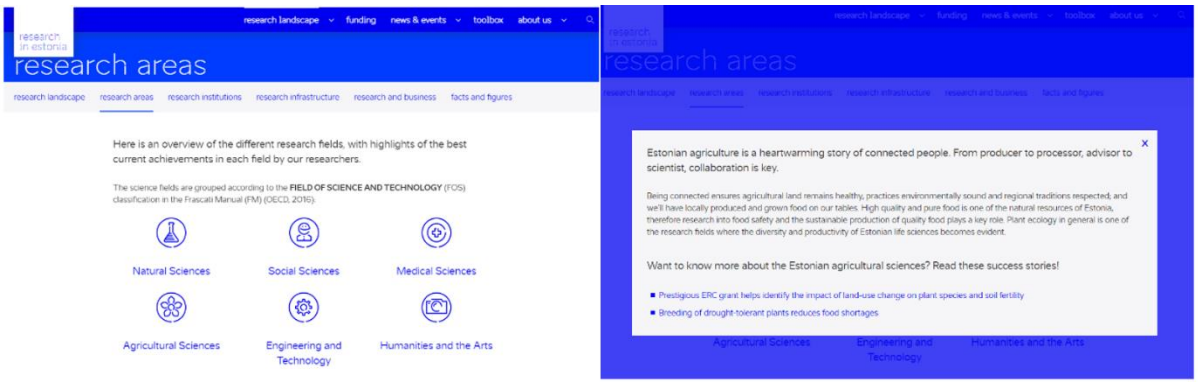
3.2 User-driven functionalities and on-going development

- Services provided by a RIO derive from its mission and its initial needs assessment.
- Their format is tailored to their target audience and aligns with how information is intended to be used. This requires conducting initial user tests and regular consultations with intended users of the observatory.
- A RIO requires continuous improvement to gradually incorporate the needs of its users and emerging demands, as well as to take advantage of new technology to improve the efficiency of its services.

3.2.1 Lessons learned from international case studies

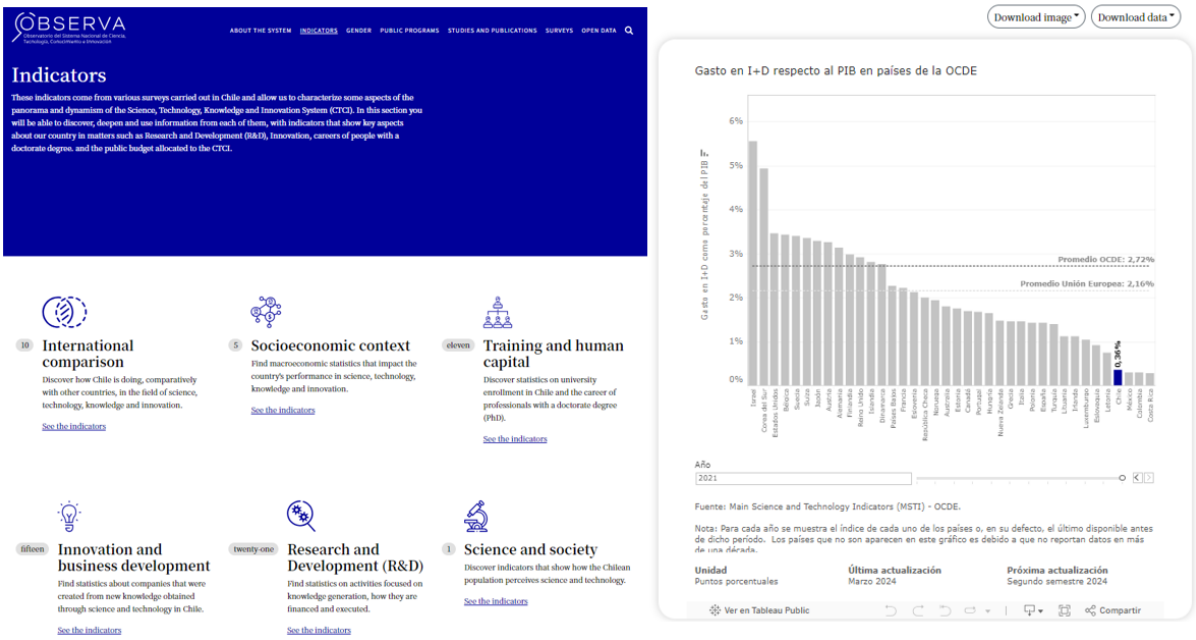
Tailoring the outputs to target audience and user-friendliness of the platform is crucial for the success of the observatory. For it to be effective, a RIO must generate valuable outputs on their website that engage its users. This means tailoring the format of the outputs to appeal to the target audience and aligning with how they intend to use the information. *Research in Estonia*, a platform that promotes Estonian research internationally, focuses on delivering concise messages and values using short narratives and success stories to connect with their target audience of international researchers (Figure 19). In Chile, a key objective is the effective dissemination of R&I results through engaging visualizations (Figure 20). To make their platform user-friendly for different types of users, Navarra has created distinct entry points based on user types (companies, citizens, public administration, Navarra RDI system agents) (Figure 21). This allows users to easily find services, whether internal or external to the observatory, that are most relevant to them.

Figure 19 A combination of visuals and success stories to promote Estonian research



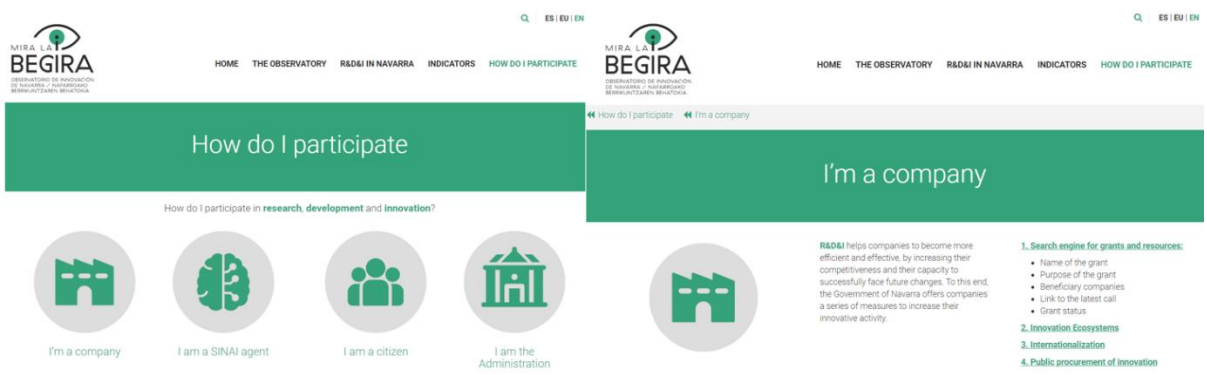
Source: https://researchinestonia.eu/research-landscape/research-areas/, consulted on 3/26/2024.

Figure 20 Interactive indicators visualization, the case of Chile



Source: https://observa.minciencia.gob.cl/indicadores; https://www.observa.minciencia.gob.cl/indicadores/comparacion-internacional/gasto-en-id-respecto-al-pib, consulted on 3/26/2024.

Figure 21 Guiding users to relevant services, the case of Navarra



Source: https://observatorioinnovacion.navarra.es/en/how-do-i-participate; https://observatorioinnovacion.navarra.es/en/web/observatorio-de-innovacion/im-a-company, consulted on 3/26/2024.

Ensuring the observatory is user-friendly involves conducting initial user tests and regularly consulting with the intended users. Once the website is set up, monitoring its usage and collecting feedback are valuable for ongoing improvements. Quantitative data, such as visits and unique user numbers from Google Analytics, can give insights into the observatory's reach. Qualitative feedback can come from a diverse steering committee representing the observatory's target users. External inputs can complement this, either passively through dedicated feedback sections on the observatory's website, as done in Colombia, or actively through consultations and user surveys. While some institutions we spoke to lack a systematic approach to collecting and analyzing the observatory's performance data (due to e.g., budget constraints), demonstrating efforts on the monitoring of the observatory's reach was emphasized as a contributing factor to building trust with data providers and to showing continuous efforts to enhance the observatory's relevance for its users.

An observatory is a living initiative whose activities and website's functionalities will never be either complete or final. In Estonia, new needs are identified through the Estonian Research Information System's (ETIS) steering committee and through direct requests from users, notably funding bodies. At the time of the interview, ETIS' team was working on two novel features: (i) adding information on research infrastructure; and (ii) browsing the applications of the ethical committee. In Finland, Research.fi's objectives are updated annually based on identified needs, focusing last year on improving researchers' profiles and this year on incorporating better information on research infrastructure, including defining what data should be collected and reported on. There is a noticeable trend towards integrating services for private companies, notably through a better mapping of the services provided by research infrastructure, as mentioned by Estonia, Finland, and Navarra. Another example is that of the Colombian observatory, which mentioned working on developing new indicators to better capture emerging topics such as Open Science and gender.

3.2.2 Implications for RO-RIO

The insights gained from international case studies highlight the importance of designing the observatory's website to be user-friendly right from the outset. The structure of each of RO-RIO's services should be tailored with a user-oriented approach, necessitating direct involvement from its target users. Appendix 7 outlines various recommendations for implementing best practices in designing a user-friendly indicator dashboard. Following this report, the World Bank will support MCID in shaping the design of core services and of a mock website (that could be integrated with the PNIM). This mock website will serve as a tool for engaging institutional stakeholders through a live demonstration of the observatory, allowing for the collection of valuable feedback on its format. Subsequently, the World Bank, in partnership with MCID, will provide inputs to an initial template for RO-RIO's annual report and to a first draft report to determine the optimal format for this critical output.

Once RO-RIO is launched, regular consultations with representatives of target users should be set up to guide MCID on the continuous improvement of RO-RIO design and functionalities. In the initial year of RO-RIO implementation, MCID should organize quarterly meetings with representatives of key institutional users, holding separate sessions for each institution. These meetings will assess the frequency of their visits of RO-RIO's website, how they utilize its services, identify any perceived complexities or uncertainties, and determine the need for additional services. These qualitative insights will be valuable for making RO-RIO more relevant to its target users and encouraging its use. This practice could be repeated annually in the subsequent years of RO-RIO's implementation. When relevant, user tests may

involve A/B testing of specific functionalities of the RIO.[35] Another source of feedback involves fostering discussions on RO-RIO's website operated in the form of a digital forum for continuous feedback collection.[36] This interactive approach allows stakeholders to share their opinions and insights regularly, contributing to an ongoing dialogue and improvement process. To complement this initiative, an annual online survey could be implemented to gather more extended feedback from non-institutional actors. This survey would inquire about how they learned about RO-RIO, the frequency of their visits of the website, the specific services they use and their purposes, any perceived complexities or uncertainties, the need for additional services, and their overall assessment of RO-RIO. The survey results should be summarized, actionable and published on RO-RIO's website, and presented during an annual conference to demonstrate a commitment to ongoing improvement and transparency, as well as embedded within the M&E strategy of the RIO, mentioned in Section 4.3.2 "Management practices".

Checklist:

✓ Reach consensus on RO-RIO's core services within key R&I governance agencies
✓ Design a user-friendly website involving target users of RO-RIO
✓ Conduct regular consultations with target users:
- Quarterly feedback meetings with representatives of key R&I governance agencies in the first year, and then on a yearly basis
- Develop a digital discussion forum on RO-RIO's website to collect feedback and foster discussions
-Yearly online surveys with institutional and non-institutional actors
✓ Present survey's results on the webpage and during an annual conference

3.3 Continuous data provision

- Access to relevant data represents one of the key challenges of existing RIOs, demanding a combination of normative and grassroot support, and effectively addressing concerns of additional workload and data security while emphasizing the gains of contributing to this initiative.
- Data on public expenditures on outputs, outcomes and impacts of R&I policies that will be centralized by the PNIM represents a key information source for the work of RO-RIO.
- Continuous efforts may be required to convince data providers to make their data available at more granular levels. This requires emphasizing the added value of a RIO in Romania,

[35] A/B testing, also known as split testing, is a method of comparing two versions of a webpage to determine which one performs better. In an A/B test, two versions, A and B, are shown to separate groups of users. The goal is to identify which version results in better outcomes, such as higher conversion rates, click-through rates, or user engagement.

[36] In addition to collecting feedback, the forum could progressively play the role of an inclusive discussion forum dedicated to R&I and productivity. BrainMap, managed by UEFISCDI, has initiated thematic communities, such as Eureka for public-private collaboration on R&I projects and the NCP Horizon Europe Community for Horizon Europe program support. Although these communities are valuable for fostering dialogue, their discussion scope is limited to specific domains, and the Eureka Community may have restricted outreach to private companies due to BrainMap's researcher-focused nature. Establishing a comprehensive, open forum for all R&I and productivity topics could greatly enhance communication, knowledge exchange, and collaborative efforts, encouraging engagement from R&I experts, performers, enablers, and citizens in public debates. It is also a way to engage RO-RIO users in the research performed by the observatory, contributing to the Objective 8 "Involving Citizens in Science" of the White Book of the transition to Open Science 2023-2030.

explicitly addressing specific needs of data providers within RO-RIO services, and demonstrating the effective accomplishment of initial steps such as hiring dedicated staff and developing a mock website.

3.3.1 Lessons learned from international case studies

The observatory's ability to generate valuable insights hinges on its access to quality data. Aiming to enhance decision-making through strategic intelligence, RIOs rely on rigorous evidence derived from reliable and preferably repeatedly collected data for thorough analyses. However, obtaining the necessary rights to access such data proves to be a notable challenge for the observatory, as emphasized in interviews.

Data security concerns hinder data sharing. In Chile, the ministry took proactive measures against data protection concerns. The ministry first conducted an analysis of the data protection regulations applicable to each entity involved in the observatory to guide the formulation of a standardized set of anonymization protocols. In Estonia, an encryption system was developed to address data protection concerns raised by universities. Additionally, the platform allows each user to decide the level of publicity for their data, providing a tailored approach to addressing privacy considerations. Apprehensions related to data protection may also conceal concerns about the additional workload associated with responding to data requests (Scharle, 2019).

Defining a clear legal basis is a key instrument to secure the continuous provision of data by other institutions to the observatory. Establishing a legal act mandates different actors to contribute data to the observatory, governs data flow, and ensures compliance with General Data Protection Regulation (GDPR). This legal framework should delineate responsibilities, specify data sharing agreements, including API usage, and detail how data will be utilized and published by the observatory. Nearly all institutions interviewed for this report lean on normative support. In Finland, the enactment of the Act on the Finnish Research Information Hub in 2022 facilitated information sharing. In this specific case of a Research Information System, the Act does not oblige information providers but enables them to share information more easily (Nikkanen & Puuska, 2022). It establishes a legal foundation for integrating different existing data warehouses and systems, streamlining processes, complementing existing data, reusing public information via APIs, and transferring information on researchers from research organizations to the hub. Notably, the publication of researchers' data to external parties continues to rely on the researchers' consent. In contrast, Navarra relies on a regional law from 2018[37] and the subsequent STI Plan[38] for normative support, compelling various actors to contribute to the observatory. Another approach, as seen in Portugal, is to provide the observatory with the legal mandate of collecting primary data on R&I.

A commitment from other institutions to contribute to the RIO's resources is essential, necessitating efforts to minimize their costs in contributing to the observatory. While a clear legal basis for data provision to the RIO is necessary, it alone may not guarantee consistent and timely data sharing. In Colombia, despite the country having developed a legal basis for open data, in practice organizations owning data are reluctant to share them with third parties, such as the observatory. As highlighted in multiple interviews, real interest and active participation from other institutions complement the legal framework. Minimizing the

[37] https://www.lexnavarra.navarra.es/detalle.asp?r=50344
[38] https://www.navarra.es/es/web/pctin/

costs for data provision can contribute to larger participation in data-sharing. This involves adapting to institutions' data flow and format, with the observatory investing resources in standardizing data formats. The Estonian case underscores the advantage of aligning with research organizations' workflows and of automating processes. Knowing the formats in which data is shared allows the observatory to set up automatic processes tailored to its requirements, as done in Navarra.

Creating incentives for data provision involves maximizing the benefits for the entities involved. The objectives and benefits of the observatory should be clear to its potential data providers. As highlighted by Scharle in her case study on Hungary's efforts to improve access to administrative data, in a low-trust environment such an initiative requires a clear interest that can be understood by all stakeholders to reduce opposition (Scharle, 2019). Inclusion in the observatory's steering committee aids in tailoring services to their needs. As in Chile, the involvement of data providers in the observatory's steering committee also ensures that they retain control over the data made available to the public. Increased involvement becomes attractive to institutions when the system centralizes data, enabling easy reuse of information and subsequently reducing reporting burdens. This proved to be a compelling factor for universities and researchers to actively contribute to the Research Innovation System in both Finland and Estonia. The data inputted into their system serves multiple purposes, such as calls for applications and reporting, eliminating the need for redundant entries in other systems.

Establishing data sharing agreements is a process that demands considerable time and effort. As explicitly pointed out in Chile and Panama, the time needed to persuade partner institutions about the significance of sharing their data with the observatory should not be underestimated. Initiating discussions well before the observatory's planned implementation time is crucial. Once agreements are concluded, efforts may still be required to ensure continuous data provision. In Finland, an important share of the Research Information System's staff is committed to ensuring effective coordination among all entities involved in the process.

3.3.2 Implications for RO-RIO

The methodological norms governing the M&E of SNCISI establish a legal basis for R&I governance agencies to provide data to the PNIM, which could serve as a basis for RO-RIO. MCID Order no. 21903/2023 outlines the responsibilities of stakeholders involved in the implementation of SNCISI and mandates their responsibility to share information on policy implementation at the project, call, and program level. Data on public expenditures on outputs, outcomes and impacts of R&I policies centralized by the PNIM represents a key information source for the work of RO-RIO, to be complemented by open access international data on indicators of R&I performance, factors and effects - including productivity. Nonetheless, securing RO-RIO's access to this data for analytical purposes may require an amendment of existing data sharing agreements, formally stating that information shared for the PNIM could be used for RO-RIO (see Section 4.2.2 "Legal requirements for RO-RIO").

MCID should seek to minimize the costs of sharing data with R&I governance agencies. Requests to data providers should be limited to incremental changes. When MCID faces data sharing challenges, exploring options to cover data providers' staff costs is essential. This may involve a core staff member working closely with partner institutions or covering the expenses of a newly hired person dedicated to the observatory's tasks. Direct connections between the PNIM, RO-RIO and existing platforms (data interoperability) should be used when feasible, and alternative forms of data sourcing should be automatized as much as possible, minimizing reliance on the staff of other institutions.

The legal framework of the PNIM needs to be enhanced by a recognition of RO-RIO's added value to the Romanian R&I ecosystem. As evidenced by the practices of other observatories, a legal requirement to provide data may not be sufficient for ensuring the active and meaningful participation of institutional stakeholders. R&I governance agencies need to seize concrete incentives to contribute to the PNIM and by that, to RO-RIO. Based on our interviews with institutional stakeholders, interviewees see added value to the three primary functions proposed for RO-RIO (Box 4), notably of its analytical role that should support a greater understanding of the contribution of R&I funds to the economy and society and guide the design or updates of national R&I strategies. Emphasizing that the contribution of institutional stakeholders to the PNIM will contribute to the services provided by RO-RIO may be one convincing factor. By explicitly addressing the needs expressed by institutional stakeholders in RO-RIO, institutional actors may be more willing to contribute to the PNIM.

Concerns about the human and financial capacities of MCID to implement RO-RIO and ensure its sustainability may pose initial challenges in engaging institutional stakeholders in investing time and efforts for the PNIM and, subsequently, for RO-RIO. In the interviews, institutional stakeholders repeatedly expressed reservations about Romanian ministries' capability to effectively implement and manage an initiative of the scale represented by RO-RIO. Indeed, MCID's activities are constrained by the availability of both staff and budget. The Ministry's salary grids pose a limitation in attracting and retaining qualified personnel. This skepticism is influenced by instances of previous platform failures in the context of Romania, mostly due to a lack of continuous and sustainable funding, and may discourage institutional stakeholders from investing time and effort in providing data to the PNIM and RO-RIO. In Sections 2. "Core services to be provided by RO-" and 4 "Institutional Setup of RO-RIO", we present several tools and recommendations to address some of the risks associated with limited capacities.[39] Clearly communicating this gradual implementation plan may help convince institutional stakeholders of the feasibility of this project. Demonstrating initial steps, such as hiring staff and developing a mock website, can showcase MCID's commitment to this initiative and enhance persuasion. Regular and transparent communication on the progress of the PNIM and RO-RIO is also essential to keep engaging institutional stakeholders and dispel potential misconceptions.

Checklist:

- ✓ Enhance the legal framework of RO-RIO by including clear provisions on data sharing by R&I governance agencies
- ✓ Minimize R&I governance agencies' costs in providing data to the PNIM and RO-RIO
- ✓ Explicitly target some of the keys needs of data and information expressed during stakeholder interviews
- ✓ Reach consensus on a gradual implementation of RO-RIO
- ✓ Demonstrate initial steps in the implementation of RO-RIO, in hiring initial staff members and producing a mock website and template outputs of RO-RIO
- ✓ Clearly and regularly communicate on the progress of RO-RIO

[39] These include practical guidance for a gradual implementation of RO-RIO, discussions on short-term, easily implementable solutions leveraging existing systems and advanced technology, suggestions for securing complementary funding, and advice on recruiting qualified staff while developing their capacities over time.

3.4 Highly skilled personnel

- A RIO requires complementarity of balanced job profiles, including a blend of skills in IT expertise, data analysis and visualization, and science communication.
- An initial team of RO-RIO may include seven staff members: the manager of RO-RIO, a research and analysis leader, a science communications and outreach, a data manager, a researcher, a data scientist, and an IT technician.

3.4.1 Lessons learned from international case studies

The number of employees needed for a RIO is influenced by various factors such as its stage of development and its functions. The RIOs and related institutions interviewed for this report varied in terms of staff size and composition, ranging from one to 20 permanent staff members (see Table 9). Staff size depends on the implementation stage of the RIO, the observatory's services, the staff's expertise, the internalization of IT processes, and the role played by institutions in the steering and advisory committees. A strategic approach involves initiating a RIO with a smaller team that can expand as the observatory's functions evolve. Some observatories commission part of their work to external staff. For the Colombian observatory, this approach allows them to adapt to unpredictable workloads depending on the demand generated by current projects. The Innovation Observatory of Navarra is coordinated by a single person but involves the direct contribution of the 12 members of its technical group (see Table 8), based on the commitment of these agencies in the RIO's work. Specific services, such as the newsletter, are also externalized to third parties.

Table 9 Overview of RIOs and related institutions' staff composition

Institution	Number of staff	Main background	Main roles
Observa (Chile)	4 persons	Multi-disciplinary:	Visualization design
		Economists, sociologists, journalism, visualization professional, IT	Data management
OCyT (Colombia)	10 to 20 persons based on workload	Scientists with expertise on statistics and innovation	Statistics
			Bibliometrics
			Management
ETIS (Estonia)	3 internal staff and 2.5 external programmers	Multi-disciplinary:	Helpdesk
		Psychology, physicist, historian	Checking and approving data entries
		Experience with data	Collect needs and coordinate new developments
			Complement data
OST (France)	16 to 20 persons	Social sciences with a dominant from economics	Statistics
		Expertise in science and innovation	Bibliometrics
		Experience with data	Data science
Research.fi (Finland)	11 to 16 persons	Multi-disciplinary:	Coordination among involved entities and goals definition
		Physics, humanities and arts	Developers

		Experience in research metadata and in science communication	
Observa — Science in Society (Italy)	4 persons (part-time)	Sociology, political science	Data analysis
			Dissemination
Innovation Observatory of Navarra (Spain)	1 person	Sociology	Coordination
	Work complemented by the technical committee and consultancies		Collection of information
			Website updates

Source: World Bank, based on interviews with RIOs and related institutions

A RIO requires complementarity of balanced job profiles, including a blend of skills in IT expertise, data analysis and visualization, and science communication, with high levels of qualifications (Table 9). Skills highlighted in the interviews include IT expertise, statistics, data visualization, and the translation of information for non-technical audiences. Having a proficient and reliable IT/software developer is crucial for on-going developments of the RIO's website and for promptly resolving technical issues, especially when IT matters are outsourced. While RIOs' staff profiles are mixed, one common thread is the high level of education among staff, often holding a master's degree or higher qualification. In France, approximately half of the staff members possess a Ph.D.

3.4.2 Implications for RO-RIO

RO-RIO should rely on a team of skilled individuals possessing a mix of analytical, IT, and communication skills. To map Romania's strengths in R&I and study national developments, RO-RIO must act as a vital hub responsible for closely following and understanding trends, breakthroughs, and advancements across various areas, and effectively communicate on these results in a variety of formats, ranging from indicator dashboards, infographics, short narratives, and reports to webinars. To fulfill this role, RO-RIO requires a combination of analytical thinking, IT proficiency, and effective communication. Several stakeholders consulted for this report highlighted the current lack of sufficient analytical skills within MCID, underscoring the necessity of recruiting individuals with specialized expertise from outside the ministry. An initial team of RO-RIO may include seven staff members:

- the manager of RO-RIO,
- a research and analysis leader,
- on science communications and outreach,
- a data manager,
- a researcher,
- a data scientist,
- an IT technician.

A proposition for staff's specific skills and the organizational structure of RO-RIO is discussed in Section 4.3 "Management and human resources of RO-RIO".

Checklist:

✓ Hire staff covering a combination of analytical thinking, IT proficiency, and effective communication skills as well as with experience with large datasets and quantitative analysis, and expertise on R&I

3.5 An effective governance structure

- Good governance ensures easy data access by the observatory, consistent data provision, its independence, scientific integrity and financial stability, and guards against control by a single entity or user group.
- Four main governance models of a RIO were identified: a ministerial unit, a governmental agency, an academic structure, or a non-profit organization. Each model presents presumed advantages and risks that need to be assessed in the local context.
- Several gains arise from including representatives of primary R&I stakeholders in the management of the observatory, fostering ownership and enabling greater synergies and complementarities with existing entities.

3.5.1 Lessons learned from international case studies

Four main governance models of RIOs were identified: ministerial unit, government agency, academic structure, and non-profit organization (see Table 10). Each of the models comes with advantages and risk regarding factors that constitute good governance such as easy data access, consistent data provision, independence, scientific integrity, financial stability, and guards against control by a single entity or user group:

- Locating a RIO **within a ministerial unit** presents the advantage of an easier access to information and data that the ministry oversees. In Chile and Spain, interviewees mentioned an easier access to funds, being secured a share of the ministry's budget. However, it was also reported that RIOs located within a ministry face the risk of lower independence and that a lack of independent budget can render the observatory vulnerable to shifts in political interest.
- A **governmental agency** partly addresses these limitations by benefitting from greater autonomy, which facilitates its access to data and information from various ministries and agencies, and from an independent budget. However, the agency's budget continuation remains contingent on political backing.
- **Non-profit organizations** offer potential advantages such as greater independence, greater rapidity of action, and efficient processes, but may struggle obtaining the necessary authorizations to access relevant data. Another limitation of this model is the need of continuous fundraising efforts, as evidenced by the experience of Colombia, France, and Italy.
- Another model involves hosting the observatory within an **academic structure**. This is the model followed by the observatory of Quebec in Canada, potentially attracting highly skilled personnel and supporting the use of cutting-edge analytical methods. However, this approach carries the risk of a disconnect between the observatory's services and the needs of other institutions and actors. It also requires a unified academic system to ensure equal coverage of all universities and research institutions in the observatory's work.

Table 10 Overview of RIOs' main governance models

Governance model	Strengths	Weaknesses	Examples
Ministerial unit	•Easier access to the ministry's data and information on R&I policies •Facilitated access to ministerial funds	•Risk of less autonomy •Risk of vulnerability of financial and human resources	**•Observa (Chile)** Observa was designed in 2020, two years after the establishment of the Ministry of Science, Technology and Innovation, which involved the consolidation of various agencies from different ministries. The creation of one ministry department to oversee the observatory aligned with the broader ministry objective of consolidating information and services in a unified location. This institutional arrangement affords them convenient access to resources and budget flexibility, maintaining a distinct space with its own regulations. This format was chosen for its ease of implementation in the short term and minimized associated risks. However, it bears limitations, including the potential vulnerability to budget reductions from the observatory and a possible short-term perspective. **•Innovation observatory of Navarra, Region of Navarra (Spain)** The observatory was implemented in 2022 as part of the Government of Navarra.
Governmental agency	•May have greater autonomy •May better include various institutions •Easier access to data from different public institutions •Benefits from an independent budget	•Responsibilities may be diffused across involved entities •Vulnerability of financial resources	**•OST (France)** At its creation in 1990, OST was a separate public entity, governed by different ministries together with stakeholders, universities and research organizations. Since 2015, OST has been integrated to the publicly funded independent agency in charge of evaluating research and higher education institutions, as one of their department. This integration allowed OST to benefit from greater financial security as part of a larger agency, while OST's skills contribute to the agency's mission. **•ETIS (Estonia)** ETIS was established in 2001. It is owned by the Ministry of Education and Research but managed by the Estonian Research Agency. Its back up by the ministry is considered as an advantage of this institutional set up. **•Research.fi (Finland)** Since 2020, Research.FI is a service commissioned by the Ministry of Education and culture but launched and operated by the IT Center for Science (CSC), a Finnish center of expertise in information technology owned by the Finnish state and higher education

			institutions. The ministry benefits from the high technical expertise of CSC. One person within the ministry is responsible to follow this project. **•OPCyT (Panama)** Commencing its operations in 2022, the observatory is currently housed within the National Secretariat of Science, Technology and Innovation (SENACYT), an autonomous public institution. This decision was made to overcome existing capacity limitations within the innovation system. However, there are plans for the observatory to transition into its own autonomous entity in the future. Presently, the observatory benefits from SENACYT's expertise, network, and established position within the R&I system.
Academic structure	•May better attract topical experts •More autonomy •Greater scientific quality	•Services may be less relevant outside an academic audience •May face challenges in accessing data from public institutions	**•Technology and Science Observatory (State of Quebec, Canada)** This regional observatory was set up in 1997 and is hosted by a regional research unit based on the campus of the university of Quebec.
Non-profit organization	•May have greater autonomy •Larger variety of funding sources may support financial stability •May better address the needs of the private sector	•Need to balance interests of the public and private sectors •Risk of disengagement of the public sector •May face challenges in accessing data from public institutions	**•OCyT (Colombia)** Created in 1999 at the initiative of the ministry, OCyT was formed by a consortium of institutions, universities, and national and local administrations. From its onset, it has been governed by a board of directors, including representatives from various ministries and institutions, designed to prevent undue influence from a single ministry. Operated as a private non-profit organization, this legal structure facilitates streamlined administrative procedures and ensures organizational independence. However, the primary drawbacks of this model revolve around challenges related to data access and the financial instability it may encounter. **•Observa – Science in Society (Italy)** Operating since 2005 as an independent non-profit organization, Observa – Science in Society benefits from political neutrality and freedom in topics coverage. Their independence allows them to react fast and openly on emerging topics, which could not have been achieved is the observatory would have been hosted within the Italian government.

Source: World Bank, based on interviews with RIOs and related institutions

.**Ensuring a good representation of the observatory's primary national R&I stakeholders within its governance structure establishes a solid foundation for the observatory's sustained relevance and impact within the national R&I landscape.** During the interviews, the collaborative process of defining the observatory's objectives and annual plans among stakeholders was emphasized as a key success factor. This inclusive approach fosters ownership among key users and enables greater synergies and complementarities between the observatory and existing entities. A collaborative approach may contribute to the observatory's sustainability with other institutions and actors pushing for its retention.

3.5.2 Implications for RO-RIO

This report examines four potential positions for the mid-term placement of RO-RIO, stemming from diverse governance models observed in international case studies of RIOs. Initially developed and operated by MCID, RO-RIO could either continue within MCID or transition to a location closer to the central government in the medium and long term. Informed by insights from international case studies, three options were deliberated with institutional stakeholders, and key findings from these discussions are outlined in Table 11. In Section 4.5 "Positioning of RO-RIO within the Romanian R&I System", the report considers four alternatives for the medium-term operation of RO-RIO: first, as a service within DPSCDITT in MCID; second, as a permanent unit reporting directly to the Minister in MCID; third, as a unit within an independent agency focused on R&I; and fourth, as a service under a directorate at GSG. The strengths and weaknesses of each alternative are assessed alongside the eight key success factors presented in this report. Section 4.3 "Management and human resources of RO-" also provides recommendations on the governance structures (a steering committee and an advisory committee) of RO-RIO and their composition.

Table 11 Feedback from stakeholder interviews on RO-RIO's governance models

Governance model	Strengths	Risks
Service within MCID	-Entity in charge of the monitoring of the SNCISI and of the PNIM -Currently develops data sharing agreements with R&I governance agencies -Ensures technical coordination between regional national levels -Hosts the secretariat of CCSI -Involved in the development of RO-RIO from the start	-Some R&I governance agencies face reluctance in sharing data or participating to RO-RIO's efforts -Vulnerable to changes in policy leads of R&I governance agencies -Lack of data analysts within the ministry -Lack of interest in analytical tasks -Salaries constrained to the ministry's salary grids -MCID may face difficulties in accessing sustained financial resources for RO-RIO -Lack of operational capacity (slow processes)

Unit within an independent agency focused on R&I	-Larger salaries can be proposed -Its legal status (for instance, as a research institute) could grant a wider access to research-specific data -Existing councils (such as CCSI) or networks (such as Europe network) could be considered as they present the advantage of being already connected to a broad range of R&I actors. Alternatively, a research institute dedicated to research on R&I could be created. -Analytical and technical skills may be already present -More proactivity and interest in analytical tasks -Can be positioned as knowledge brokers at the intersection of public administration and the scientific community	-Thinner links with policy making -Risk of partiality and competition with other agencies -Costs implied by the creation of a new agency are too high
Service under a directorate at GSG	-Its central position provides an easier access to information and facilitates coordination across various ministries and agencies -Greater ability to bargain for financial resources	-Lack of topic (R&I) expertise

Source: World Bank, based on stakeholder interviews.

Checklist:

✓ Consider the benefits and risks of various governance models for RO-RIO and reach consensus on its medium-term location

3.6 Strategic partnerships and networks

- A partnership and networking strategy complements a RIO's activities, promoting its platform use, fostering collaboration for additional knowledge production and knowledge exchange on best practices. Such a strategy involves regular interactions with four levels of partnerships and networks: the data providers of the RIO, its target users, R&I experts, and local and international working groups working towards similar goals.
- RO-RIO may benefit from partnerships with all R&I governance agencies, as well as with the Ministry of Economy, Entrepreneurship and Tourism (MEET) to better encompass the topic of productivity, and with local initiatives advocating for evidence-based decision-making.

3.6.1 Lessons learned from international case studies

A complementary partnership and networking strategy promotes collaborations and outreach. The observatory's website serves as its public face, yet the role of the observatory extends beyond centralizing and generating knowledge. A partnership and networking strategy

should complement its activities, promoting platform use, fostering collaboration for additional knowledge production and knowledge exchange on best practices. The experiences of RIOs reviewed for this report point to four levels of partnerships and networks: (i) with data providers; (ii) with target users; (iii) with experts; (iv) with local and international working groups working towards similar goals.

Partnering with institutions that provide direct inputs, like data, helps understand their needs of data and information, define relevant services for the observatory, and strengthen complementarity. Most observatories emphasized a close collaboration with institutional partners—suppliers of data, but also primary beneficiaries—as a key success factor. These partners (e.g., other ministries and governance agencies, funding agencies, research organizations, National Statistical Offices (NSO), other national or regional observatories) can engage through various means, such as formal decision-making or participation in working groups. For instance, NSO can contribute expertise in data collection and analysis. In Panama, collaboration with NSO involves contribution to the planning of data collections and to their quality assurance. The Innovation Observatory of Navarra formalized its partnership with the Regional Statistical Office in the observatory's legal framework. Missed opportunities can stem from a lack of formal collaboration, as seen in the cases of Estonia and Colombia, posing risks of misalignment of indicators published by the observatory with those produced by NSO.

Building a user community contributes to raising awareness about the observatory's activities and to its sustainability. The user community not only attracts attention to the observatory's services but also acts as a protective layer, creating a real demand for the observatory. This contributes to making the observatory more resilient against potential dismantling following political changes. The case of Chile exemplifies a successful networking strategy that actively engaged target users through various dissemination events. They targeted specific users (e.g., researchers, civil society) and journalists, inviting them to test Observa's platform and contribute to its outreach efforts, amassing over time around 2,000 email addresses for the observatory's newsletter. However, Observa in Chile faces a challenge in extending its outreach beyond the capital city. Recognizing this challenge, the observatory of Panama is proactively organizing training sessions in regions to encourage broader utilization of observatory data and surveys, which also promotes the use of the information provided by the observatory.

Establishing a network of experts can support the observatory's work and the quality of its knowledge production. Several observatories interviewed used a network of experts from academia, industry, and research institutions for guidance on the prioritization of services, indicators, and in-depth analyses, as well as on analytical methods. In Portugal, DGEEC worked closely with an external advisory board, comprising internationally renowned experts in relevant fields, for its five first years of operation. The advisory board played a role in understanding the scientific community's needs and improving the DGEEC's methods and approaches. This collaboration allowed DGEEC to develop strong ties with the scientific community, and improved data access for external researchers to conduct their own research (see Box 12). In France and Italy, both observatories benefit from the guidance of national and international experts through experts' involvement in observatories' scientific committees. A network of experts can also support the observatory's activities by contributing to specific topics and studies. This is the case of Colombia, where the observatory calls upon experts of its network to work on specific projects based on demand. Actively seeking experts through networking activities contribute to enhancing the observatory's research quality, keeps it informed about the latest advancements, and solidifies its position as a leading authority in the fields of R&I.

Box 12 DGEEC's collaboration with external researchers, the case of Portugal

Since 2014, DGEEC has been collaborating with external researchers to grant them secure access to the data it collects. Protocols were developed to share anonymized data with researchers and Ph.D. students, leading to the establishment of a secure data center announced in late 2023, built with the support of researchers. This facility enables researchers to work with protected microdata, gradually expanding its outreach to more researchers. As a result, DGEEC now receives numerous data requests, which are granted solely for research purposes. Additionally, DGEEC has established a statistical forum where researchers can present and discuss their findings with DGEEC staff and other researchers.

Source: World Bank, based on the interview conducted with representatives of DGEEC.

RIOs and related institutions gain insights from discussions with similar initiatives, both nationally and internationally. Participation in forums of discussion to debate and share lessons was one of the key recommendations shared by the Portuguese case study. DGEEC participates in seven international working groups, including groups with OECD and EC, to work on specific thematic areas of the DGEEC's work. Other observatories follow a similar approach. The Innovation Observatory of Navarra involved another regional observatory in their technical group to benefit from their own experience. In Finland, Research.fi is part of two European networks, euroCRIS—a network of European Research Information Systems—and Open Researcher and Contributor ID (ORCID), within which they deliberate on technical aspects, covering topics such as interoperability, data sources, and data quality. In Colombia, the long-established observatory now plays an active role in knowledge sharing with other observatories and governments, within and beyond Latin America. This connected approach was reported as valuable for sharing ideas and experiences.

3.6.2 Implications for RO-RIO

RO-RIO would benefit from formal partnerships with key institutional users through the legal framework of the PNIM and their planned inclusion in RO-RIO's steering committee. As previously discussed, key institutional users of RO-RIO[40] are mandated to share data on the monitoring of public funds allocated to R&I to the PNIM. This legal foundation establishes a formal relationship between institutional users and RO-RIO. Current plans for RO-RIO also involve the inclusion of the National Committee for Science, Technology, and Innovation and of the CCSI in its steering committee. Presently, the legal framework of the PNIM explicitly defines the role of the CCSI concerning the PNIM. However, enhancing this framework would be beneficial by providing clarifications on the committee's role in relation to RO-RIO and formally recognizing the role of the National Committee for Science, Technology, and Innovation.

In the short-term, the collaboration between RO-RIO and INS may be confined to INS providing data to the PNIM, with the potential for RO-RIO to serve as a technical adviser to INS in the long run. Following discussions with INS, their role would be more focused on providing occasional external advice to RO-RIO rather than being an integral part of its management structure. In the long run, RO-RIO's expertise in R&I data can be leveraged to offer guidance to INS on potential improvements in data collection and measurement methodologies, as well as identifying and addressing knowledge (data) gaps. As illustrated by

[40] This includes MIPE, RDAs, UEFISCDI, IFA, the Romanian Academy, the Academy of Romanian Scientists, and institutional actors related to sectoral topics (agriculture, internal affairs, defense, economy, health, energy, environment).

the experience of Portugal (Box 12), RO-RIO could work together with INS to enhance researchers' access to firm-level data, contributing to knowledge production on R&I**.**

RO-RIO can profit from establishing a partnership with MEET to better encompass the topic of productivity. Extending the observatory's focus beyond R&I to encompass an analysis of productivity can provide a more nuanced comprehension of how the innovation system's performance is achieved. This comprehensive perspective contributes to breaking existing barriers in information dissemination and funding allocation concerning the promotion of innovation and competitiveness. Consequently, a strategic collaboration between the observatory, MCID and MEET, currently not represented in the National Committee for Science, Technology, and Innovation nor in the CCSI**,** may facilitate a more coordinated approach towards advancing innovation and competitiveness. Working closely in formulating competitiveness strategies using the evidence produced by RO-RIO will ensure a coordinated approach that maximizes the impact of these initiatives. In addition, this collaboration could be extended by granting MCID access to firm-level data, enabling in-depth analyses of the links between R&I and economic performance, notably productivity, without increasing firms' reporting burden.

RO-RIO should aim to form partnerships with local initiatives focused on enhancing governance, particularly those advocating for evidence-based decision-making. The World Bank team has identified three relevant Romanian initiatives for RO-RIO: the National Productivity Committee, the Romanian Innovation Lab, and the Digital Policy Lab. RO-RIO should seek to take advantage of these initiatives' expertise and services to complement its own (see Box 13). RO-RIO can benefit from regular consultations with these initiatives, as well as other similar national initiatives, exchanging insights on the design and implementation of their respective platforms, as well as discussing networking and outreach strategies.

Box 13 Recommended partnerships with Romanian initiatives

The **National Productivity Committee** is a planned independent structure supported by the OECD. Key themes would include demographic developments, labor productivity, wage policy, technology assimilation, competition quality, and external competitiveness.

- *Possible collaboration with RO-RIO:* RO-RIO could seek to collaborate with this Committee for in-depth analyses of the links between R&I, competitiveness, labor markets, and productivity.

The **Romanian Innovation Lab**, also supported by the OECD, initiated in March 2023, strives to improve governance in public administration. Its objectives include researching, testing, and disseminating innovative solutions to streamline public services and processes. Additionally, the Lab focuses on developing innovative skills in public administration like design thinking and agile project management through capacity building.

- *Possible collaboration with RO-RIO:* RO-RIO, as an innovation for the public sector, could benefit from the support of the Romanian Innovation Lab, especially during its initial phase by receiving training on innovative solutions for government institutions. In return, RO-RIO could assist in promoting the Romanian Innovation Lab's capacity-building activities, aligning with its goal of enhancing governance within public administration. Given the Romanian Innovation Lab's established network, which includes public servants and stakeholders from various sectors, RO-RIO could leverage this network for increased outreach. The Romanian Innovation Lab's strategic position within GSG makes it an ideal partner for RO-RIO, with the potential of contributing to expanding its reach.

The **Digital Policy Lab** was launched in September 2023 by the Authority for the Digitalization of Romania. The Digital Policy Lab is a platform designed as a laboratory supporting prototyping and experimentation across various stages of the public policy cycle, utilizing deep technologies. It also focuses on developing standards and methodologies tailored to the national and international contexts for incorporating innovative technologies into public administration.

- *Possible collaboration with RO-RIO:* Collaborating with the Digital Policy Lab could enable RO-RIO to channel the Digital Policy Lab's services to complement RO-RIO's capacity-building efforts.

Source: World Bank, based on https://www.bursa.ro/comitetul-national-pentru-productivitate-infiintat-cu-sprijinul-ocde-in-ciuda-expertizei-comisiei-europene-67607943, https://sgg.gov.ro/1/laboratorul-de-inovare/ and https://www.adr.gov.ro/comunicat-de-presa/

RO-RIO should leverage the expertise of international working groups in which MCID is involved. MCID actively participates in OECD working groups and initiatives led by the EC. These international connections may be mobilized to better inform the technical and analytical activities of RO-RIO. Specifically, the Digital Economy and the NESTI of the OECD, along with the joint EC-OECD project ReICO, represents potential forums of discussion for guiding RO-RIO's automatic processes and the selection, update, and definition of relevant R&I indicators.

Elaborating an effective outreach strategy is crucial to the success of RO-RIO. To promote awareness and use of RO-RIO's activities, it is recommended to assign a dedicated staff member responsible (the science communication and outreach specialist) for establishing and nurturing partnerships while building a community of RO-RIO users. This involves active engagement through various channels. The launch of RO-RIO should be announced through a public event, accompanied for example by a concise video for social media platforms. This video could convey the mission and benefits of RO-RIO. This should be followed by consistent communication efforts, including for instance bi-annual releases to national press, monthly updates on social media platforms initially, transitioning to a weekly

frequency later, and bi-annual postings on R&I governance agencies' websites. Alongside these activities, regular webinars (e.g., bi-monthly) could be organized to highlight RO-RIO's activities and gather users' feedback, and to fulfill part of its capacity building role. RO-RIO could consider involving partners to lead some of these webinars, especially in the early stages, to diversify perspectives and expertise while easing the workload of RO-RIO.

Checklist

- ✓ Formalize RO-RIO's relationship with National Committee for Science, Technology, and Innovation and CCSI
- ✓ Establish a partnership with MEET to better encompass the topic of productivity
- ✓ Form partnerships with local initiatives focused on enhancing governance, among which the National Productivity Committee, the Romanian Innovation Lab, and the Digital Policy Lab
- ✓ Leverage the expertise of international working groups and initiatives managed by OECD (e.g., NESTI) and the EC (e.g., ReICO) in which MCID is involved
- ✓ Elaborate an effective outreach strategy including active engagement with RO-RIO users through various communication channels and regular engagement

3.7 Sustainable funding

- Most of the funding of RIOs comes from national funds, sometimes complemented by European funds and consultancy services.
- Encouraging initial commitment with longer-term funding is crucial to cover the upfront investments required for the implementation of a RIO.
- The primary areas of expenditure include staff costs and technological infrastructure.

3.7.1 Lessons learned from international case studies

All observatories reviewed in the case studies depend, to varying degrees, on national public funding, thus necessitating political backing. Most of the funding of RIOs comes from national public funding. As highlighted in the interviews, the sustainability of public funding hinges on political support, which can be fostered by demonstrating the observatory's benefits to national R&I stakeholders.

A few observatories supplement their budgets through consultancy services, but this source is reportedly unstable. While consultancy services represent an attractive source of additional income for RIOs, they require constant efforts to secure new funds. In France, this challenge was eventually addressed by integrating the observatory with a governmental agency, thereby eliminating its dependence on external funding. At the time of the interview, consultancy services were representing less than 10% of the French observatory's total budget. While the Colombian observatory initially received all its funds from the Ministry, currently government funds represent only 30% of their budget, demanding significant efforts

to attract revenue from commercial activities.[41] The Italian case stands out by also collecting funds through membership fees and private foundation donations.

EU funds represent another potential source of funding for observatories. EU grants provide financing opportunities to RIOs that can be used either directly or indirectly, whether through proprietary projects, collaborative partnerships, or by serving as a consultancy services provider for external entities. Many European countries mentioned using EU funds to complement national budgets for their observatories. Finland and Estonia used European structural funds for specific platform development, while Italy initially relied on the funds of a larger organization involved in EC-funded projects to finance their observatory.

Additional financial investment is required during the observatory's inception. The implementation of a RIO requires upfront investments. Some institutions benefited from external funds at this stage, for example Chile who received funds from the Inter-American Development Bank for conducting its need assessment survey. Encouraging initial commitment with longer-term funding is crucial, especially since the real benefits of the observatory will take time to materialize.

The primary areas of expenditure include staff costs and technological infrastructure. Operational costs encompass staff salaries, office space, IT support for maintaining and updating the observatory's website functionalities, potential expenses for data acquisition, and required software for data analysis and visualization. The annual budget varies across institutions, ranging between 500,000 and 1 million USD for those sharing this information.

3.7.2 Implications for RO-RIO

This report provides initial estimates of the budget required for the RIO. The budget required for RO-RIO was calculated based on the anticipated tasks, staff requirements, and the planned gradual implementation of RO-RIO, aiming to minimize budget constraints. Section 4.4 "Estimation of the RO-RIO budget" presents the cost model used to estimate the budget for the RIO under two alternative scenarios: (i) market salary rates; (ii) salaries in accordance with Law no. 153/2017. These estimations lead to a suggested annual budget of EUR 400K (scenario 1—around EUR 3m for 5 years) or EUR 270K (scenario 2—around EUR 1,8m for 5 years). The disparity between these two scenarios highlights the gap between salaries offered by public administration and market rates. Concerns were raised by several stakeholders regarding the ministry's ability to attract highly skilled staff within its salary framework. Therefore, exploring options to provide competitive market-based salary rates may be essential for the success of RO-RIO.

In the near future, RO-RIO could seek to attract extra funding from ESIF programs, such as from programs dedicated to strengthening the administrative capacity and/or technical assistance. Stakeholders repeatedly raised concerns about the risk of an unsustainable budget for RO-RIO, stressing the importance of both political support and seeking additional funding sources. Like experiences with other European RIOs and related institutions, ESIF programs represent as a potential complementary funding source. The

[41] This share of government support amounted for 25% of OCyT's budget in 2020, representing 150,000 euros out a budget of 613,000 euros (see https://ocyt.org.co/wp-content/uploads/2022/03/INFORME-DE-GESTION-OCyT-2020-VF_.pdf). The rest of its budget comes from consultancy services. In 2020, the Colombian observatory realized various projects, for example updating the Departmental Index of Innovation (National Planning department), producing technical studies for the development of a district strategy for S&T (Bogota's District's Secretary of Education), or realizing the evaluation of research products, projects and proposals submitted to higher education institutions (HEIs) and Universities.

creation of the PNIM has also been initially supported with ESIF resources from the Operational Program Administrative Capacity 2014-2020 (SIPOCA 592); this was also the case for other platforms developed by UEFISCDI, such as BrainMap or Accelerate Romania. In the same vein, RO-RIO could also seek to apply for additional funding to strengthen its institutional capacities and to professionalize its staff and services.

Checklist

- ✓ Review RO-RIO's estimated budget
- ✓ Secure RO-RIO's funding for its first five years of implementation

3.8 Gradual implementation

- The activities of a RIO need to be implemented gradually, taking advantage of existing systems and capabilities in the short run while expanding its focus and activities over time.

3.8.1 Lessons learned from international case studies

The success of establishing a new observatory is closely tied to the functions and capabilities within the R&I ecosystem. Countries having set up a Research Information System seem to have benefitted from sufficient digital readiness, together with international movements towards a centralized digital repository of research outputs (e.g., publications, patents, funded projects), allowing them a quicker implementation of a unified system, as illustrated by the case of Finland described in Box 14.

Box 14 The long road from early collaborative efforts to Research.fi's implementation

In Finland, efforts that have contributed to the development of Research.fi can be traced back to the early 2000s. During this period, working groups were established involving the Ministry of Education and Culture, universities, and other interest groups to deliberate on publication repositories. However, it was not until 2017 that the concept of a centralized repository materialized, leading to the establishment of the Research Information Hub project, led by the Ministry. The initial phase of implementing this project spanned three years, culminating in the launch of the hub's portal, Research.fi.

Source: World Bank, based on interview with representatives of Research.fi.

A practical approach to implementing the observatory involves gradually advancing its activities. This staged implementation is illustrated by the case of Navarra in Box 15, where they initially focused on prioritizing indicators for its indicator dashboard. To define the observatory's roadmap, different implementation phases should be determined ahead of time with clear targets, a success factor illustrated by the observatory of Panama (see Box 16). During its first phase of the observatory's implementation, they held a prioritization workshop on uses and functions with R&I stakeholders to understand which were the most relevant topics, the missing information that could be supplied by the observatory, the regional priorities within Panama, and the national or international issues that the stakeholders saw as relevant for the observatory to analyze.

Box 15 The two-stage development of the innovation observatory of Navarra

The roadmap of the innovation observatory of Navarra was shaped by the collaborative efforts of all members of its technical group. Its operationalization unfolded in two key phases. In the first phase, the focus was on designing the indicator dashboard. This stage demanded a meticulous identification of relevant and robust metrics. These indicators were to be grounded in credible, accessible, and regularly updated data for annual monitoring. The subsequent phase concentrated on the automation of the observatory's processes. The observatory remains dedicated to improving its procedures and expanding its scope. During the interview, plans were disclosed for incorporating additional indicators, implementing the automation of grant evaluations, launching a newsletter, and exploring tools more suited for companies. Future aspirations, potentially constituting a third developmental phase, involve improving the measurement of the impacts of the region's R&I policies.

Source: World Bank, based on interview with representatives of Innovation Observatory of Navarra.

Box 16 The three implementation phases of Panama's observatory

Phase 1—Institutional framework: definition of agreements and strategies

Phase 2—Required structure: nodes that would be formed with the entities that have statistics, alliances, strengthening of personnel.

Phase 3—Monitoring and follow-up: when the observatory is up and running, it will be verified what needs to be corrected and improved.

Source: World Bank, based on interview with representatives of the Panama's observatory.

3.8.2 Implications for RO-RIO

The recommendations in this report, rooted in the Problem-Driven Iterative Adaptation (PDIA) method, advocate for a gradual implementation of the RIO, emphasizing iterative improvements based on existing capacities and structures. As highlighted in Section 3, the recommendations put forth in this report align with the PDIA method advocated by the World Bank to enhance government capacity in developing its national innovation system (Cirera & Maloney, 2017; Pritchett et al., 2012). A distinctive aspect of this method lies in its "iterative" nature, signifying that implementation should build upon existing capacities and effective structures, fostering incremental improvements over time. In the short-term, RO-RIO should focus on tasks within existing capabilities. A smaller scale system also presents the benefits of being more manageable. The capacities of RO-RIO's staff can be complemented by those of strategic partner institutions within the country. In the medium and long-term, there should be a strategic expansion of activities, along with developing capacities for additional responsibilities. In accordance with this principle and drawing insights from international case studies, the report outlines several recommendations for the gradual implementation of RO-RIO. This encompasses a phased approach to the introduction of its services (Section 2. "Core services to be provided by RO-") and recruiting RO-RIO's staff (Section 4.3.1 "Gradual implementation, HR structure and skills"), ensuring a measured and effective progression. Section 5. "Workplan" outlines an action plan for the phased implementation of RO-RIO across three key stages: (i) a deployment phase (12 months); (ii) an assessment and strengthening phase (second year); and (iii) a scale up phase (year 3 onwards).

Checklist

- ✓ Elaborate a strategy for the gradual implementation of RO-RIO, including a phased recruitment and the prioritization of its services and outputs

SECTION 4

INSTITUTIONAL SETUP OF RO-RIO

4. Institutional Setup of RO-RIO

- Building RO-RIO and implementing its core services requires technical, legal, administrative, and political considerations by MCID, who will initially lead the institutional setup.
- In technical feasibility terms, RO-RIO needs a set of internal IT skills as well as outsourced knowledge.
- In terms of legal procedure, MCID's current norms and methodological guidelines on PNIM serve as a basis for the observatory, but there are further legal procedures that could be followed for its establishment, including the promulgation of an article within an innovation law and a Ministerial Order from MCID on the specific functions and responsibilities for RO-RIO.
- As for administrative considerations, this report includes a gradual approach to the buildup of RO-RIO. In the short term, RO-RIO is envisioned to operate as a unit consisting of three staff members, in the medium term, RO-RIO can grow to seven staff members, which can support the introduction of new services.
- RO-RIO's annual budget is presented in two scenarios: one at market rate salaries of EUR 400.000 for the first year and increasing to EUR 621.000 from the second year onwards, and one at the salary grid for MCID of EUR 274,000 for the first year and increasing to EUR 362,000 from the second year onwards.
- For its medium-term expansion, RO-RIO could be located in different positions within the Romanian Government. This section analyzes the implications, strengths, and risks of four alternative locations of the observatory.

4.1 Guiding framework for the institutional setup

MCID will develop and operate RO-RIO initially, which requires that the ministry addresses the following technical, administrative, and political considerations for the initial setup. As mentioned in Section 1.4.3 "Romania's policy mandate for improved oversight of R&I performance", the PSF Open Report focuses part of its recommendations on the monitoring of the R&I system and, in turn, the NRRP created a policy mandate for MCID to establish an R&I Observatory that maps Romania's R&I strengths in an international context, as part of a route to a permanent system for designing, monitoring, and evaluating R&**I** policies. In consequence, MCID will be responsible for founding and running RO-RIO in the short term (that is, in the first year of implementation), handling the technical, administrative, and political considerations of the institutional setup. In the medium term (that is, beginning in the second year of implementation) it could evolve either within MCID or spin-off to a location closer to the center of the Romanian Government, and these alternatives will be analyzed in Section 5. "Workplan".

First, MCID needs to assure that technical requirements for RO-RIO are met, including legal aspects of the institutional setup. The implementation of RO-RIO is dependent on the technical requirements for its data management platform, website, staff, and functions. Therefore, RO-RIO's ability to build on top of the PNIM, and the IT systems and data requirements that arise from this structure, are foundational elements of RO-RIO and need to be designed from the outset. Finally, these requirements also include legal aspects of public

administration and budget, as well as the policy and legal guidelines that will norm the functions and responsibilities of RO-RIO and the institutions that host its source databases.

Second, RO-RIO's design needs to be administratively feasible given MCID's budget, capacities, and limitations. RO-RIO's design should have management practices that allow it to function in a feasible manner given MCID's budget limitations, building on existing capabilities, and bringing novel methods of administration such as *Agile* management to implement more effectively, iterate and adapt. Also, the use of new technologies needs to be prioritized to minimize the administrative burden that arises from data collection and processing, as well as the tasks that will be required for RO-RIO.

Third, the success of RO-RIO in providing valuable services and engaging with its stakeholders also depends on its political viability. The implementation of RO-RIO involves the distribution of data from sources to new users, the creation of new functions that will provide the administrator of RO-RIO with visibility to different stakeholders, and the setup of a novel responsibility, initially at MCID. All these elements affect the policy interests and administrative incentives—both positive and negative—of different actors within the government. This balance of interests and incentives is key to propose a design of RO-RIO that is politically viable.

The fulfillment of these three conditions leads often to institutional solutions that are sometimes referred to as "second-best" solutions. Even though some institutional solutions are technically optimal (or first-best), perhaps their administrative feasibility or inability for political consensus mean that they are not the optimal solutions in reality. Therefore, solutions that strike a balance between technical, administrative, and political considerations are sometimes referred to as "second-best" solutions. This report seeks to explore both best practices and "second-best" proposals that could turn out to have higher probabilities of implementation and success.

One approach to this type of institutional work is the PDIA method, which has been recommended by the World Bank to foster government capacity in developing national innovation systems (Cirera & Maloney, 2017; Pritchett et al., 2012). PDIA is a methodology for creating and developing institutional capacity, based on specific features: (i) solutions should be problem-driven, that is, centered on the needs and problems of users, not on adopting international "best practices" that are perhaps not relevant in the local context; (ii) solutions should be iterative, that is, the implementation should be based on existing capacities and structures that already work well, and have gradual improvements and constant monitoring of its progress; (iii) finally, solutions should be based on adaptation, because they need to adapt to changing needs and to lessons gathered through experience and evaluation.

The institutional setup strategy in this report is presented following each of the technical, administrative, and political dimensions. Section 4.2 "Technical and legal requirements of RO-" below covers the technical and legal requirements, section 4.3 "Management and human resources of RO-" discusses the administrative, managerial, and human resources necessities, section 4.4 "Estimation of the RO-RIO budget" addresses the budget estimations for RO-RIO, and section 4.5 "Positioning of RO-RIO within the Romanian R&I System" presents the political economy considerations associated with the setup and location of RO-RIO within Romanian Government.

4.2 Technical and legal requirements of RO-RIO

- In technical feasibility terms, PNIM could serve as the "back office" for data while the RIO could serve as the "front office" for user interaction with data.
- This means that both platforms need a set of IT requirements that require a specific set of internal IT skills as well as outsourced knowledge.

- Required internal capabilities include data collection and integration, data management, data visualization, and IT performance measuring.
- Outsourced capabilities include user interface and website design, security and data protection services, server maintenance, and scalability features.
- The methodological norms governing the M&E of SNCISI provide the legal definition of an R&I observatory and its purpose, but several elements are still to be determined in legislative terms. Hence, two further legal procedures could be followed for the establishment of RO-RIO:

- MCID should promote the inclusion of a legal setup for RO-RIO in the law, so that it defines the nature, functions, and responsibilities for the observatory, as has been the case in international case studies.

- A Ministerial Order from MCID to act as the policy and methodological guideline for the observatory and its stakeholders.

4.2.1 Technical requirements for IT systems and data

In principle, the PNIM could serve as the "back office" for data while RO-RIO could serve as the "front office" for user interaction with PNIM data and other relevant data. Given the complementarity between the PNIM and RO-RIO (see Section 1.4.3 "Romania's policy mandate for improved oversight of R&I performance"), MCID could position the PNIM as the "back office" for data management, data collection and integration, security, and maintenance and for internal use within MCID and partner organizations. RO-RIO, on the other hand, could serve as the "front office" for external user interaction, data visualization and dissemination; this includes both the interaction and visualization of data from the PNIM and of data from other sources (national and EU).

The development of the features for RO-RIO involves a set of requirements for the IT systems and the datasets centralized in these platforms. To develop the data, scope, and functionalities required by the services RO-RIO will provide, MCID needs to initially fulfill a set of IT requirements on data, security, IT systems for visualization and interface, and scalability. These IT requirements do not necessarily have to be found in house, and some of the technical features could be outsourced from vendors that develop some of the data, software and website needs of RO-RIO. However, the maintenance and deployment of new features means that RO-RIO will have to include staff with proficiency in software development and data management (see next section on HR and skills). A description of the technical requirements for RO-RIO is presented in Table 12.

Table 12 IT systems and data requirements for RO-RIO

	Description	Technical Features	IT Requirements	Internal or outsourced
Data collection and integration *Also applies for PNIM*	How will data be collected and integrated in the Observatory?	▪ Data rules to ensure consistency across data sources. ▪ Data identifiers to ensure system compatibility. ▪ Application Programming Interfaces (APIs) for data exchange with different databases, and interoperability standards according to the requirements of third parties.	▪ API design principles ▪ Extract, Transform, Load (ETL) processes ▪ Query languages like SQL ▪ Data exchange formats such as JSON, XML, or CSV ▪ Data interoperability standards like oData, OpenAPI, or GraphQL	Required internally
Data management *Also applies for PNIM*	How will data be stored and managed?	▪ Capabilities to store, organize, and update the indicators ▪ Data export, including the export of customized statistics	▪ Database management systems like MySQL ▪ Data modeling, indexing, and optimization techniques	Required internally
Security and data protection *Also applies for PNIM*	How will the data integrity be maintained? How will the observatory be protected?	▪ Security measures to protect against unauthorized access, data breaches, and cyber-attacks. ▪ Regular security audits ▪ Compliance with EU data protection regulation	▪ Security protocols such as HTTPS, SSL/TLS, and firewalls ▪ Implementing access controls and authentication mechanisms ▪ Compliance of GDPR	Outsourced
Website and server maintenance *Also applies for PNIM*	How will RO-RIO's website be maintained?	▪ Adequate deployment of web functions ▪ Server stability and maintenance ▪ Software patching and updates	▪ Server-side programming languages such as Python or Java ▪ Server administration and configuration management tools	Outsourced

User Interface and Experience	How will users interact with the RO-RIO website in an effective manner?	▪ Intuitive and user-friendly interface that allows for:
		  ○ Search for indicators
		  ○ Filtering
		  ○ Automation of reports
		▪ Responsive design to allow for access on web and mobile
			▪ Front-end development technologies such as HTML, CSS, or JavaScript
			▪ Query languages like SQL
			▪ Knowledge of UI/UX design principles
			▪ Testing and user-centered design approaches
				Outsourced

Data visualization	How will the data be visualized on the RO-RIO website?	▪ Presentation of indicators in charts, graphs, maps, and other visual formats. ▪ Interactive and responsive visualizations, with principles of storytelling.	▪ Data visualization libraries and frameworks such as Tableau, PowerBI, or Qlik ▪ Experience in HTML5, CSS3, or JavaScript	Required internally
Performance monitoring	How will administrators monitor the use and performance of the RO-RIO website?	▪ Tracking of platform use, engagement metrics and traffic ▪ Use of information to estimate RO-RIO's impact ▪ Capturing user feedback and inquiries	▪ Web analytics tools such as Google Analytics ▪ Experience in monitoring server performance ▪ Knowledge of log analysis and error tracking ▪ Collaboration tools	Required internally
Scalability	How will the website handle a large volume of data and users?	▪ Scalable web architecture principles ▪ Use of cloud computing	▪ Cloud computing platforms such as AWS, Google Cloud Platform, or Microsoft Azure	Outsourced

Source: International interviews conducted, stakeholder interviews and suggestions by the World Bank based on surveyed online resources.

4.2.2 Legal requirements for RO-RIO

The methodological norms governing the M&E of SNCISI establish a legal basis for R&I governance agencies to provide data to the PNIM, which could serve as a basis for RO-RIO. Article 2 of the methodological norms on the M&E of SNCISI (MCID Order no. 21093/2023) outlines the responsibilities of Research and Innovation Strategy for Smart Specialisation (RIS3) experts, as well as programs and sub-programs coordinators and managers involved in the implementation of SNCISI, whose detailed list is provided by the Operational Manual of the PNIM. Article 2 explicitly mandates their responsibility to share information on policy implementation at the project, call, and program level, following a template provided by MCID. Article 3 specifies the type of information that must be shared. MCID also plans on securing access to secondary data necessary to compute the system-level indicators of SNCISI. These indicators represent the Romanian KPI on R&I dynamics. Data on public expenditures on outputs, outcomes and impacts of R&I policies centralized by the PNIM represents a key information source for the work of RO-RIO, to be complemented by open access international data on R&I and productivity. Securing RO-RIO's access to this data for analytical purposes may require an amendment of existing data sharing agreements, formally stating that information shared for the PNIM could be used for RO-RIO. However, the specifics regarding data sharing modalities and the extent of data disaggregation that can be made public on the PNIM are contingent upon the individual data sharing agreements established with each institution. Furthermore, decisions on outputs intended for external users to be published on the PNIM would be determined through a vote within the CCSI. These restrictions may limit RO-RIO's ability to display valuable information to an external audience. That demands continuous efforts of MCID in convincing actors of the importance of providing access to more granular levels of information.

These methodological norms also provide the legal definition of an R&I observatory and its purpose, but several elements are still to be determined in legislative terms. Article 1 of MCID Order no. 21093/2023 sets a definition for the R&I observatory as a "research, innovation and smart specialization data collection system from the entire national RDI system that can provide extensive relevant reports so as to justify evidence-based legislative decisions in the medium and long term". The norm also states that the observatory will follow guidelines set by the PSF Report in its Recommendations 3.1 and 3.2 which suggest that the objective is "to map Romania's best R&I strengths in the international context and study national developments in the light of EU and international trends" (European Commission, 2022a). Even though these norms serve as the basis for RO-RIO efforts, and connect its existence to the PNIM, there are still some foundational elements for the observatory that are still to be determined from a legislation perspective, particularly a clear and comprehensive mission (see 3.1 "A clear mission"), the definition of its legal nature (whether a service, unit, or other entity), its functions (and corresponding services as proposed in this report), and its responsibilities (including data gathering routines and publishing of reports).

Hence, there are two further legal procedures that could be followed for the establishment of RO-RIO. First, RO-RIO could be established by a law proposed by MCID and approved by the Parliament chambers which would give it a foundational legal status, as discussed next. Second, this could be followed by a MCID-issued order to define the methodology and procedural guidelines for RO-RIO and its third-party data sources.

Ideally, MCID should promote the inclusion of a legal setup for RO-RIO in the law, so that it more broadly defines the nature, functions, and responsibilities for the observatory, as has been the case in international case studies. As a first-best, MCID should promote the inclusion of the legal definition of RO-RIO in a related law—for instance, in an Innovation Law proposed by MCID and approved by the Parliament chambers, if it were to be promoted. This more comprehensive legal definition could take the form of an article that sets the mission, the legal nature, the primary functions

and the responsibilities for RO-RIO and for the public administration authorities that can provide data. Even further, the law could set the budget source for sustained funding for RO-RIO. As an example, Box 17 gives a summarized view of the legal definition of the Innovation Observatory of Navarra in Spain.

Box 17 Legal setup of the Innovation Observatory of Navarra (Spain)

The Innovation Observatory of Navarra was formally created through Article 18 of Law No.15/2018 of Navarra, which includes the following foundational legal features:

- **Location within the Government**: The Observatory is attached to an administrative department and must work in coordination with the Institute of Statistics of Navarra.
- **Definition of its objective**: The Observatory is an information system to allow access to the data gathered by the R&I system
- **Obligations to third parties**: Actors in the R&I system are obliged to cooperate with the Observatory in accessing their information
- **Types of analysis covered**: The Observatory must publish news, trends, needs, activities, and projects of the R&I system, as well as a gender focus for R&I.
- **Data categories**: The Observatory must publish information on the performance of the R&I system, including at least: the budget for R&D and innovation in the administrative department of Navarra, and the fiscal benefits for R&D.
- **Annual report and methodology**: The Observatory must publish an up-to-date methodology of data gathering and calculation of indicators, as well as an annual report of its activities.

Source: Ley Foral no. 15/2018 of Navarra.

The initial stage of RO-RIO will require a Ministerial Order from MCID to act as the policy and methodological guideline for the observatory and its stakeholders. Following the legal foundation of the observatory, RO-RIO will require a Ministerial Order from MCID to act as the methodological and policy guideline for stakeholders that are not covered by MCID Order no. 21093/2023 (which already gives guidelines for stakeholders involved in the implementation of SNCISI and RIS3 for PNIM). However, it must be noted that, under the Romanian Constitution and the Administrative Code, the government has the ability to organize the functions within the ministries and could create RO-RIO without necessarily having it created in a law approved by Parliament (European Commission, 2022b).[42] Hence, the proposals in this report regarding the legal approach to the setup of RO-RIO are for MCID's consideration.

In addition, MCID must prepare data sharing agreements with third party institutions that will serve as data sources for PNIM and RO-RIO. In the case of institutions that already have a data sharing agreement for the PNIM, RO-RIO sharing agreement could perhaps be drafted as an amendment that clarifies that the information covered in the platform can also be used for the purposes of the observatory. The sharing agreements should cover the requirements presented in Table 13.

[42] This recommendation is based on this is based on work performed and findings from the RAS on "Strengthening Capacities for an Integrated Approach to Sustainable Development - Deliverable no. 3", which will become public.

Table 13 Minimum requirements of RO-RIO data sharing agreements

Topic	Purpose in the data sharing agreement
Objective and Scope	▪ Outline the objectives of RO-RIO and clearly define that the purpose of the data sharing is its inclusion in a centralized, open, and interactive platform.
Rights and Responsibilities	▪ Define the rights and responsibilities of each institution regarding the handling and management of the data.
Data Ownership and Control	▪ Clarify the ownership of the data being shared and establish control mechanisms to ensure that data is used only for the purposes outlined in the agreement.
Data Security and Confidentiality	▪ Need for measures to safeguard the security and confidentiality of the shared data.
Compliance with GDPR	▪ Specify how personal data will be processed, stored, and protected.
Data Sharing Protocols	▪ Define the format, frequency, and methods of data transfer between institutions and the observatory.
Data Quality and Accuracy	▪ Define standards for data quality and accuracy to ensure that the shared data is reliable, complete, and up to date.
Dispute Resolution	▪ Define procedures for resolving disputes arising from data sharing activities.
Governance and Oversight	▪ Designate responsible parties within each ministry for overseeing the implementation and enforcement of the data sharing agreement.

Source: World Bank.

In the end, legal requirements serve as an enabling condition, but they are not enough to guarantee effective access and continued provision for RO-RIO. As mentioned in Section 3.3.2 “Implications for RO-”, a legal requirement to provide data may not be sufficient to guarantee the active and meaningful participation of institutional stakeholders in integrating their data with RO-RIO. These institutions need to be able to accrue the benefits of the observatory’s functions so that they have real incentives to contribute to the PNIM and, in consequence, to RO-RIO.

4.3 Management and human resources of RO-RIO

- In terms of management of RO-RIO, a gradual approach to the buildup of RO-RIO is recommended. In the short-term, RO-RIO is envisioned to operate as a unit consisting of three staff members, with a Steering Committee that provides oversight and an Advisory Committee for methodological guidance. In the medium term, RO-RIO can grow to seven staff members, which can support the introduction of new services.
- The required skills for each position are derived from the set of core services presented in this report, resulting in a highly specialized set of skills required. Therefore, having competitive salaries is an important element in attracting the right talent pool for RO-RIO.
- An agile management approach for RO-RIO could significantly enhance its operational efficiency and achieve results with limited staff and resources. The iterative cycles used in *Agile management*—which include planning phases, implementation steps through a so-called sprint, and retrospective sessions—can improve efficiency and help gain lessons on how to optimize the observatory’s work.

4.3.1 Gradual implementation, HR structure and skills

RO-RIO can become operational in a gradual manner once it receives initial financial resources for an initial staff composition of three key positions for its first year of implementation. RO-RIO is envisioned to operate in the medium and long-term as a permanent unit consisting of seven staff members, whose structure will be presented below. This full composition of RO-RIO corresponds to the needs for implementing the complete set of proposed services and functions. However, RO-RIO can become operational in a gradual manner, with the recruitment of three key foundational positions that are required for the initial setup. In the short-term (first year of implementation), for example, RO-RIO could prioritize the adapted services listed in Box 18.

Box 18 Adapted list of services prioritized for the first year of operation of RO-RIO

Service 1: A basic overview of the R&I system, including information on R&I governance, R&I enablers and research and technology infrastructure
Service 3: An initial indicator dashboard displaying a selected set of KPI
Service 4: Short automatic reports and a first annual report
Service 5: A launching event of RO-RIO and the presentation of its first annual report
Service 6: An initial knowledge base building on reports and knowledge products produced in collaboration with the World Bank

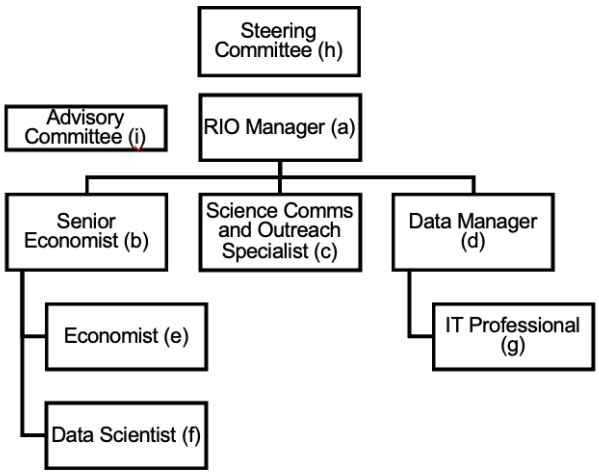
Source: World Bank.

The medium-term organizational structure of RO-RIO includes seven staff members, with a Steering Committee that provides guidance and an Advisory Committee that counsels on methodological matters. The operation of RO-RIO is designed under the model of a permanent unit (akin to a service within a directorate in the public central administration), consisting in the medium and long-term of seven permanent staff, a Steering Committee, and an Advisory Committee. The organizational chart in Figure 22 includes the role of:

- (a) the manager of RO-RIO,
- (b) a research and analysis leader with experience in data science,
- (c) a specialist on science communications and outreach to R&I actors,
- (d) a data manager
- (e) and (f) a researcher and a data scientist who work under the supervision of the research and analysis leader, and
- (g) an IT technician who works under the supervision of the data manager.

This results in a management structure in which the Steering Committee oversees strategic issues of the operation, and the Advisory Committee provides technical guidance. Also, the Manager will have three colleagues that report directly to her/him, and which map relatively clearly to the three primary functions of RO-RIO: the Data Manager leads most of the centralization responsibilities, the Research and Analysis Leader leads most of the research and analysis centralization, and the Specialist on Science Communications and Outreach focuses on the dissemination of information and knowledge. In the short term, the initial recruiting should focus on the three positions of (a) RIO Manager, (d) Data Manager, and (f) Data Scientist once the initial financial resources are guaranteed. In the medium term, the positions (b) Research and Analysis Leader and (g) IT professional become important, followed by the recruitment of (e) Researcher and (c) Science Communication and Outreach Specialist.

Figure 22 Organizational chart of RO-RIO



Source: World Bank.

The Steering Committee (h) oversees the observatory, and the Advisory Committee (i) specializes in methodological and technical guidance, both having representatives of the main stakeholders in RO-RIO, including those that act as data sources. The Steering Committee provides strategic guidance to the manager and the observatory team and oversees its activities and effectiveness. Therefore, it should be composed by a group of senior representatives from the key stakeholders of RO-RIO, including a representative from the National Committee for Science, Technology and Innovation, a representative from the CCSI, senior officials from MCID, UEFISCDI, MIPE and MEET, as well as representatives from RDAs, from the Romanian Academies, and from private sector organizations. On the other hand, the Advisory Committee specializes in giving methodological counsel and guidance on indicator technicalities, in-depth reports, research and outreach strategies for RO-RIO, and therefore should be formed by technical representatives from those same institutions, as well as one or two experts in R&D indicators and statistical methodologies (for instance, a representative from the OECD's NESTI).

The organizational model and chart provided in this report applies—in principle—to the different alternatives of location for the medium-term expansion of RO-RIO. The organizational model functions as a permanent unit that could function either as a service within a directorate at MCID, as a unit that can report to the Minister or State Secretary at MCID, or even as a permanent unit under a center-of-Government institution such as GSG or an independent agency, as will be analyzed in Section 4.5 "Positioning of RO-RIO within the Romanian R&I System".

The required skills for each position are derived from the set of core services presented in this report, coupled with the IT requirements presented in Table 12. A comprehensive review of the services presented in this report, coupled with the IT requirements that arise from each of the technical features of RO-RIO, result in a set of specific skills and experience that are proposed for each of the key positions in the organizational chart. They include the following:

(a) Manager

- Proven track record of leadership roles in technology, product development or consultancy
- Experience in *agile* management or similar methods
- Exposure to data science or quantitative analytics
- Ability to communicate effectively with stakeholders and media
- Bachelor's in sciences, social sciences, economics, statistics, or engineering (required)
- Master's or Ph.D. in management, economics, statistics, engineering, sciences, social sciences, and related fields (ideal)

(b) Research and analysis leader

- Proficiency in data science or quantitative analytics
- Formal training in econometrics or statistical modelling
- Basic proficiency in programming languages (for example, R or Python) and query languages (such as SQL)
- Ph.D. in economics, statistics, engineering, sciences or related fields (required)

(c) Science and Communications and Outreach Specialist

- Proven track record of communication and networking roles
- Exposure to topics related to science, technology, and innovation (R&D, technology, innovation, entrepreneurship, etc.)
- Proficiency in social media management tools, including user feedback methods (ideal)
- Ability to communicate effectively with stakeholders and media

(d) Data Manager

- Proficiency in API design principles and data exchange formats
- Experience in Python or Java
- Experience in data modeling, indexing, and optimization techniques

(e) Researcher

- Proficiency in quantitative analytics
- Formal training in econometrics or statistical modelling
- Basic proficiency in programming languages (for example, R or Python)
- Bachelor's in economics, social sciences, statistics, or engineering (required)

(f) Data Scientist

- Proficiency in data science methods, including formal training in data analysis or management tools (such as data scraping or machine learning)
- Proficiency in programming languages (for example, R or Python) and query languages (such as SQL)
- Bachelor's in economics, sciences, statistics, or engineering (required)

(g) IT Professional

- Proficiency in front-end programming languages (such as HTML, CSS, or JavaScript)
- Experience in server-side administration tools
- Knowledge of log analysis and error tracking
- Knowledge of website maintenance routines and performance optimization
- Knowledge of data visualization libraries and frameworks (such as Tableau, or PowerBi)

Detailed recruiting profiles for each of the key positions are presented in Appendix 9 as a basis for the Terms of Reference (ToR) that the Romanian Government can use for the publication of the vacancies.

A review of market rates for these profiles of highly skilled personnel based in Bucharest results in a range of net salaries that is higher than the remuneration of similar positions in the civil service. The identified skillsets for RO-RIO are more commonly found in private sector

companies and sectors like consultancy, technology, or software development. Therefore, a review of market rates for these skilled staff positions based in Bucharest results in a range of net salaries that is higher than in similar positions within the civil service, whose remuneration is regulated by the standards of Annex VIII of Law no. 153 of 2017.

However, having competitive salaries is an important element in attracting the right talent pool for RO-RIO. Even though the comparable salary levels in the public central administration are lower than the private market rates, having competitive salaries is an important element so that RO-RIO can attract the right talent pool. This implies that the Romanian Government should consider hiring mechanisms like external contracting to recruit and staff RO-RIO, whose implications in the cost model are presented in the following section.

4.3.2 Management practices

An agile management approach for RO-RIO could significantly enhance its operational efficiency and achieve results with limited staff and resources. Through agile management principles—henceforth *Agile*—the observatory could organize its activities into iterative cycles, allowing for frequent reassessment and adjustment of priorities based on emerging needs and insights.[43] *Agile* methodologies can enable the observatory to break down complex tasks into smaller, manageable components, facilitating more rapid responses to evolving data requirements and feedback from users. Moreover, *Agile* practices such as regular sprint meetings and continuous collaboration foster a collective ownership of project outcomes. The application of this type of modern management practices, coupled with feedback and learning mechanisms can help RO-RIO gradually build institutional and administrative capacity.

The Iterative cycles used in *Agile* include a planning phase, a sprint, and a retrospective session at the end of the sprint to reflect on lessons on how to optimize. These iterative cycles typically begin with a planning phase where the team identifies priorities, defines objectives, and outlines specific tasks to be completed within a defined timeframe, often referred to as a sprint. During the sprint, RO-RIO staff would work collaboratively to execute the planned activities. Regular meetings, such as daily stand-ups, would provide opportunities for the manager and the team to review progress, discuss challenges, and adjust plans as necessary. At the end of each sprint, RO-RIO team would conduct a retrospective to reflect on what went well, what could be improved, and how to optimize processes for the next iteration.

The RO-RIO team could carry out sprints for the deployment of services, data management routines, new data sources, or analyses and reports. The use of sprints as a management tool could be valuable for RO-RIO team in a set of different tasks and routines, including the deployment of services discussed in this report, data management routines, introducing new data sources from third parties, or producing in-depth studies and reports. Box 19 presents an illustration of a proposed sprint routine for the deployment of a dashboard for RO-RIO and serves as an example of the application of the *Agile* approach.

Box 19 Illustration of a sprint routine for the deployment of a RO-RIO indicator dashboard

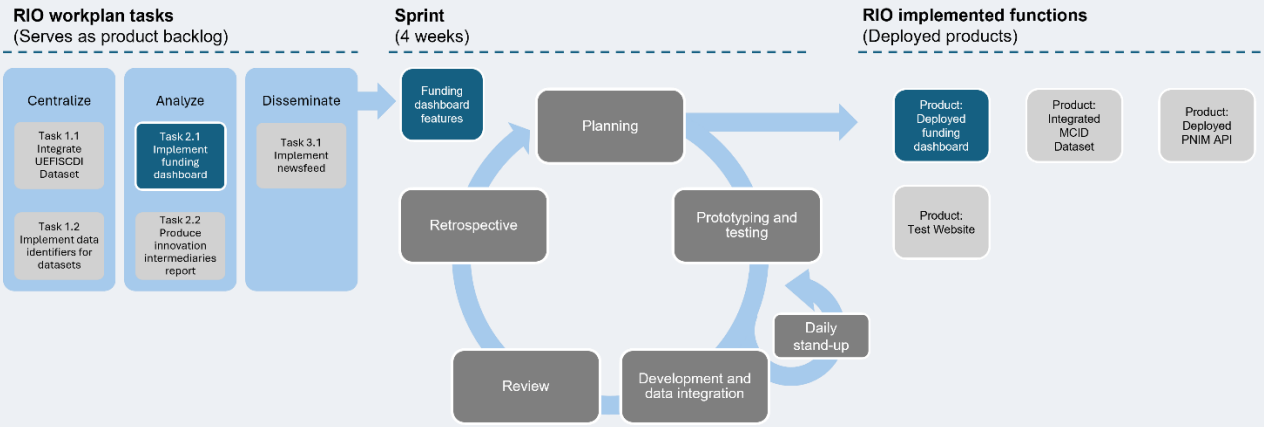
A sprint for building an indicator dashboard for RO-RIO's website could span up to four weeks and be implemented by both the observatory's staff and external contractors. The following is an

[43] See A. Ahmed, S. Ahmad, N. Ehsan, E. Mirza, and S. Z. Sarwar, "Agile software development: Impact on productivity and quality," *2010 IEEE International Conference on Management of Innovation & Technology*, Singapore, 2010, pp. 287-291, doi: 10.1109/ICMIT.2010.5492703.

illustrative guide to its steps and implementation (see Figure 23):

- Initially, the team convenes to do a planning session, marked by the outline of visualization and data requirements and prioritization of features that will be included in the dashboard. This planning phase sets the scope of the project.
- To begin implementation, the data scientist and the outsourced contractors can create dashboard prototypes, iterating based on stakeholder feedback and usability testing together with the outreach specialist.
- Development and integration follow, with the outsourced developer contractors implementing functionality, and the data manager ensuring accuracy and integrity of datasets. Iterative testing and debugging by the IT professional can occur alongside, to enhance user experience and performance optimization.
- Finally, the team prepares documentation on the review of the product, to feed a retrospective meeting led by the manager in which they gather feedback and plan future iterations.
- Throughout the sprint, regular communication with the RO-RIO manager should be maintained through daily scrums or update meetings.
- As a culmination of the sprint, the new dashboard is deployed to the website of RO-RIO.

Figure 23 Example of a sprint process for the deployment of a dashboard for RO-RIO



Source: World Bank based on (Rigby et al., 2016).

Management routines also involve data management and quality assurance, including systematic procedures for data validation, cleaning, and control throughout the data lifecycle. Apart from the development of services, management routines are also needed for data management and quality assurance. For instance, the RO-RIO data manager needs to establish validation protocols to verify the accuracy, completeness, and consistency of incoming data from Ministries, national and international sources. A process to identify and rectify errors, outliers, and inconsistencies needs to also be defined and published, employing automated algorithms when it is possible and manual validation checks when necessary. In addition, regular IT audits and checks can be conducted to monitor data quality over time, addressing issues such as duplication and missing values. Best practice in data quality assurance throughout the data lifecycle involves the documentation of data processing workflows (for example, by using version control), which enhances traceability and allows users to understand the reliability of the data.

Finally, RO-RIO management practices need to embed feedback mechanisms to monitor, evaluate, learn, and adapt. Throughout the different management practices and routines of RO-RIO, the team should embed *feedback loops,* that is, mechanisms to monitor, evaluate, learn, and

adapt its functions based on self-generated evidence and user feedback. On the one hand, these mechanisms include reviews of implementation tasks, retrospective sessions in sprints and user feedback in prototype testing and deployment of products. On the other hand, they entail more comprehensive M&E tools, like recurrent RO-RIO activity reports and operational evaluations. As stated in Section 3.8 “Gradual implementation”, gradual implementation is a key takeaway from international case studies. The use of modern management practices like *Agile* for the development and implementation of functions, coupled with feedback loops and learning mechanisms can help the RO-RIO team build its institutional and administrative capabilities in a gradual manner, increasing the probability of effectively carrying out what is certainly an ambitious project.

4.4 Estimation of the RO-RIO budget

- The budget for RO-RIO initially as a unit under MCID is modeled following the guidelines for a permanent public entity and includes the estimation of recurrent and non-recurrent expenditures.
- RO-RIO’s annual budget is presented in two scenarios: one at market rate salaries of EUR 400.000 for the first year and increasing to EUR 621.000 from the second year onwards, and one at the salary grid for MCID of EUR 274,000 for the first year and increasing to EUR 362,000 from the second year onwards.
- The scenario of basing the staff structure on the salary grid of MCID could be associated with a risk of difficulties recruiting personnel with the necessary skills.

This section provides the budgeting approach for RO-RIO in two alternative settings and presents estimated budget figures for the setup and operation of the observatory, to inform MCID’s decision-making process on the design and implementation of the observatory. The budgetary considerations for the implementation of RO-RIO in this report are aligned with the public finance Law no. 500/2002 and with the functional considerations of EOU no. 57/2019 regarding the Administrative Code. In this context, the budgeting approach could be based on two alternative settings: one in which staff remuneration is estimated at market rates for the required skillset and experience identified in the organizational structure, and another based on the provisions of Framework Law no. 153/2017 for the salaries under the central public administration. Budget figures are presented under a one-year scenario and forecasted over a five-year period using expected inflation figures. The objective of these budget estimates is to inform MCID’s decision-making process on the final design and implementation arrangements of RO-RIO.

The budget for RO-RIO as a unit under MCID is modeled following the guidelines for a permanent public entity and includes the estimation of recurrent and non-recurrent expenditures. The cost model used to build the budget scenarios for RO-RIO is done following guidelines for a permanent public entity. It is structured by economic classification and grouped by budget titles as follows: Title I—Personnel Expenditures; Title II—Materials and Services Expenditures; and Title XV—Capital (non-financial assets) expenditures.[44] According to this approach, the model used for the budget calculation of RO-RIO has four inputs: (i) a deterministic method of calculation for cost per item for staff salaries; hardware, software and IT services; and one-time capital (non-financial) expenditures; (ii) the extrapolation of yearly expenditures on these budget titles and the annual adjustment of their values; (iii) the estimation of the value of hardware, software and IT services based on market prices; and (iv) the estimation of the salaries for RO-RIO

[44] This cost model is based on work performed and findings from the RAS on ”Strengthening Capacities for an Integrated Approach to Sustainable Development - Deliverable no. 3”, which will become public.

staff based on two sources, one at market salary rates and the other at accordance with Law no. 153/2017.

Under the first scenario of market salary rates, the budget of RO-RIO for a five-year period is estimated at EUR 2.98 million, with a first-year budget of EUR 400,000. Under the scenario of market salary rates for the staff compensation, the five-year total budget for RO-RIO is EUR 2.98 million (Table 14), with a budget for the first year of EUR 400,000 which increases to EUR 621.000 in the second year. The main budget title consists of personnel expenditure (Title I), with 67,4% of the total 5-year budget, followed by both recurrent and non-recurrent material and service expenditures (Title II) in software, security, IT audits and management, website, and publication costs (31,9%); and finally capital expenditures (Title XIV) in hardware (0,7%).

Table 14 Scenario 1: 5-year RO-RIO budget with market salaries [EUR]

Breakdown of expenditures by Title	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL 5 Year Period
Title I Personnel expenditure	€ 203,280	€ 429,030	€ 446,191	€ 459,130	€ 471,068	**€ 2,008,699**
Staff compensation	€ 203,280	€ 429,030	€ 446,191	€ 459,130	€ 471,068	€ 2,008,699
Title II Materials and services expenditure	€ 186,600	€ 181,896	€ 189,172	€ 194,658	€ 199,719	**€ 952,045**
Software	€ 13,800	€ 22,684	€ 23,591	€ 24,276	€ 24,907	€ 109,258
Security and recovery costs	€ 18,600	€ 22,260	€ 23,150	€ 23,822	€ 24,441	€ 112,273
IT Audit costs	€ 20,000	€ 21,200	€ 22,048	€ 22,687	€ 23,277	€ 109,213
IT Asset management costs	€ 7,200	€ 7,632	€ 7,937	€ 8,167	€ 8,380	€ 39,317
RIO website project costs	€ 32,000	€ 7,420	€ 7,717	€ 7,941	€ 8,147	€ 63,224
Publications fees and costs	€ 95,000	€ 100,700	€ 104,728	€ 107,765	€ 110,567	€ 518,760
Title XIV Non-financial assets expenditure	€ 10,600	€ 10,176	€ -	€ -	€ -	**€ 20,776**
Hardware	€ 10,600	€ 10,176	€ -	€ -	€ -	€ 20,776
TOTAL RO-RIO BUDGET	**€ 400,480**	**€ 621,102**	**€ 635,363**	**€ 653,788**	**€ 670,787**	**€ 2,981,519**

Source: World Bank.

In the second scenario of salaries in accordance with Law no. 153/2017, the budget of RO-RIO for a five-year period is estimated at EUR 1.77 million, with a first-year budget of EUR 274,000. Under the scenario of salaries in accordance with Law no. 153/2017, the five-year total budget for RO-RIO is EUR 1.77 million, with a budget for the first year of EUR 274,000, which increases to EUR 362,000 in the second year. In this scenario, the main budget title consists of recurrent and non-recurrent material and service expenditures (Title II) in software, security, IT audits and management, website and publication costs which represents 53,8% of the total 5-year budget; followed by personnel expenditure (Title I) with 45,0%; and finally capital expenditures (Title XIV) in hardware (1,2%).

Table 15 Scenario 2: 5-year RO-RIO budget with salaries in accordance with Law no. 153/2017 [EUR]

Breakdown of expenditures by Title	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL 5 Year Period
Title I Personnel expenditure	€ 77,114	€ 170,848	€ 177,682	€ 182,835	€ 187,589	**€ 796,070**
Staff compensation	€ 77,114	€ 170,848	€ 177,682	€ 182,835	€ 187,589	€ 796,070
Title II Materials and services expenditure	€ 186,600	€ 181,896	€ 189,172	€ 194,658	€ 199,719	**€ 952,045**
Software	€ 13,800	€ 22,684	€ 23,591	€ 24,275	€ 24,906	€ 109,257
Security and recovery costs	€ 18,600	€ 22,260	€ 23,150	€ 23,821	€ 24,441	€ 112,273
IT Audit costs	€ 20,000	€ 21,200	€ 22,048	€ 22,687	€ 23,277	€ 109,212
IT Asset management costs	€ 7,200	€ 7,632	€ 7,937	€ 8,167	€ 8,379	€ 39,316
RIO website project costs	€ 32,000	€ 7,420	€ 7,716	€ 7,940	€ 8,147	€ 63,224
Publications fees and costs	€ 95,000	€ 100,700	€ 104,728	€ 107,765	€ 110,567	€ 518,760
Title XIV Non-financial assets expenditure	€ 10,600	€ 10,176	€ -	€ -	€ -	**€ 20,776**
Hardware	€ 10,600	€ 10,176	€ -	€ -	€ -	€ 20,776
TOTAL RO-RIO BUDGET	**€ 274,314**	**€ 362,920**	**€ 366,854**	**€ 377,493**	**€ 387,307**	**€ 1,768,890**

Source: World Bank.

The scenario of basing the staff structure on the salary grid of MCID could be associated with a risk of difficulties recruiting personnel with the necessary skills. Gross salary figures in the guidelines of Law no. 153/2017 are often 30% to 40% of observed market rates for similar skill requirements in technology companies in the private sector in Bucharest.

4.5 Positioning of RO-RIO within the Romanian R&I System

- MCID will be the founding host of RO-RIO in its first stage, but in the medium term the observatory could be either continued to be strengthened internally or be spun-off to a different location of the Romanian Government to fulfill other policy objectives.
- This section analyzes four alternative positions for the medium-term location of RO-RIO, and is based on a comparison of the political viability of achieving the technical and administrative requirements needed to deliver the core services proposed for RO-RIO.
- This comparative analysis confirms that there is no single answer to the positioning of RO-RIO, but it portrays a balance of strengths and risks that could be used by MCID and the Romanian Government to better plan the evolution of the observatory.

MCID will be the founding host of RO-RIO in its first stage, but in the medium term the observatory could be either continued to be strengthened internally or be spun-off to a different location of the Romanian Government to fulfill other policy objectives. Even though MCID will be the founding host of RO-RIO in its first stage—and it is indeed already taking steps in setting up the initial version—there are three reasons why it could be optimal to spin-off RO-RIO to another location in the Romanian Government in the medium term. First, RO-RIO has a broader scope than MCID's policy mandate and should eventually be able to convene and engage with data and actors from sectorial policy spheres and from private actors that perform non-R&D-based innovation (which are both important to productivity growth). Hence, being in a location closer to the center of Government could be an asset to broaden RO-RIO's reach, and it could help break some of the silos that are currently present in the Romanian innovation system. Second, MCID could face budgetary restrictions that could hinder the ability of RO-RIO to grow and fulfill its potential. Therefore, spinning-off RO-RIO to an institution with greater capacity to assign resources for its functioning and its growing features could be desirable. Finally, institutions with more flexibility in terms of recruiting, remuneration and embedding talent in a high-performing environment could have an advantage at securing the right type of skills for RO-RIO as it is envisioned in this report.

This report analyzes four alternative positions for the medium-term location of RO-RIO, which result from the different governance models observed in the international case studies of RIOs. As discussed in Section 3.5 "

An effective governance structure", the international case studies show that there is no single governance model for these types of observatories, and indeed some of the RIOs analyzed have had some sort of evolution in their structure or governance to respond to changing financial or political realities. For the purposes of this report, four alternative positions for the medium-term functioning of RO-RIO are considered: first, as a service within DPSCDITT in MCID; second, as a permanent unit that reports directly to the Minister in MCID; third, as a unit under an independent agency that is

focused on R&I[45]; and fourth, as a service under a directorate at GSG. For this report, only public governance structures are considered, since the purpose of RO-RIO is clearly linked to commitments and policy mandates that arise from the EC's engagement with the Romanian Government.

The analysis of these alternatives is based on a comparison of the political viability of achieving the technical and administrative requirements needed to provide the core services and perform the primary functions proposed for RO-RIO. To objectively compare the benefits and risks of the four proposed alternatives, the following analysis tries to address the question "How politically viable is it for each alternative to achieve the technical and administrative requirements that are needed for it to effectively deliver the services and perform the functions proposed for RO-RIO?" For a clearer view, this exercise is done for each of the eight key success factors identified in this report, as shown in Table 16.

[45] Even though this report does not discuss a specific agency, there have been in the past policy discussions in Romania regarding the convenience of creating an autonomous agency for innovation. This is the type of institution that this report has in mind, and is to serve as a future possibility for the location of RO-RIO if such an institution were to be set up.

Table 16 Analysis of the positioning of RO-RIO in the medium term according to the eight key success factors

	Clear mission	User-centered	Continuous data provision	Highly skilled personnel	Governance structure	Partnerships and networks	Sustainable funding	Gradual implementation
1.Service within DPSCDITT (MCID)								
	- Mission clearly connected with MCID's role in the R&I system	- Aligned with users from research sector and companies that perform R&D-based innovation, but possibly less aligned with academia which is under Ministry of Education - Limited alignment with private sector users (e.g., SMEs) that lie under the Ministry of Economy and MIPE	- Excels at ensuring data from programs led by MCID - Could have difficulty accessing and maintaining datasets from other ministries - Could face barriers to access datasets from private sector actors	- May face barriers to securing top talent due to budget restrictions	- Well- positioned to convene the relevant actors of the National Committee for STI and the CCSI, especially academia - Possible difficulties convening actors in other policy spheres - Risk of having less autonomy than an independent agency	- Ability to engage with stakeholders in the R&I system, including national and regional authorities - May lack engagement power with stakeholders in other policy spheres, especially private sector organizations	- Access to funding since the foundation of RO-RIO - Budget limits cost be more stringent - Difficulty in doing advocacy for resources with the Ministry of Finance - Long term funding could be uncertain	- Initial capabilities are present with the PNIM - MCID will host RO-RIO at its foundation, so gradual implementation is consistent with building on these capacities
2.Unit under Minister (MCID)								
	- Mission clearly connected with MCID's role Overview of the R&I system	As above	- As above	- May face barriers to securing top talent due to budget restrictions - This recruiting difficulty may be partly offset by opportunity to work close to the Minister	- Very well-positioned to convene the relevant actors of the National Committee for STI and the CCSI - Gravitas from the Minister in convening governance structures (Steering and	- As above	- As above - Relatively less difficulty in advocacy for resources with the Ministry of Finance, given a closer location to the Minister's priorities	As above

					Advisory Committees) - Risk of having less autonomy than an independent agency			
3.Unit under an independent agency								
	- Depending on the nature of the agency, mission could be set to be broad in scope to encompass all actors in the R&I system - Could introduce a clear link to productivity and competitive-ness	- Could be aligned with research users, corporations that perform R&D and private sector actors involved in non-R&D innovation and productivity efforts	- Could have a strong position to access and maintain datasets from the overall scope of ministries and agencies	- May have greater autonomy in establishing remuneration - Bonuses on top of salaries funded by EU funds could help secure highly skilled talent - Talent could be embedded into a high performing environment	- More autonomy and independence than a ministerial unit - Well- positioned to convene the relevant actors of the National Strategy for Competitiveness and private sector	- Ability to engage stakeholders more broadly, given its possible reach to actors in the R&I system and actors that take part in the National Strategy for Competitiveness	- Access to funding could be harder in the first stages, but could have larger appropriations in the medium term - Long term funding is uncertain	- Challenges in initial phases if RO-RIO is spun-off from MCID - Medium- and long-term prospects for capability growth may be greater in an independent and specialized agency
4.Service under GSG								
	- Mission could encompass all actors in the R&I system because of center-of government location - But mission could be less clearly connected to R&I and productivity - There could be internal pushback to	- While being at the center of government gives perspective, the lack of connection to beneficiaries of instruments may hinder a grounded user-centered approach	- Its central position could make it excel at accessing and maintaining datasets from all government sources	- May have greater autonomy in establishing remuneration - Bonuses on top of salaries funded by EU funds could help secure highly skilled talent	- More autonomy and independence than a ministerial unit - Very well positioned to convene the relevant actors of both the National Committee for STI and the National Strategy for Competitiveness and private sector	- Ability to engage stakeholders more broadly, given its possible reach to actors in the R&I system and actors that take part in the National Strategy for Competitiveness - May lack engagement power with stakeholders in the STI policy area	- Available funding for the first stages - Greater ability to bargain for resources with the Ministry of Finance - Long term funding is uncertain, and past failures in setting up observatory-type websites are a warning sign	- Challenges in initial phases if RO-RIO is spun-off from MCID - Medium- and long-term prospects for capability growth may be greater within GSG - However, risk of RO-RIO being dropped in the long term due to uncertain changes in priorities

	hosting RO-RIO because of this				- Gravitas from being at the center of Government			

Source: World Bank.

Assessment key

High viability: Well-positioned to achieve the requirements	
Medium viability: May face some challenges to effectively deliver	
Low viability: Difficulty achieving the requirements at the desired level	

This comparative analysis confirms that there is no single answer to the positioning of RO-RIO, but it portrays a balance of strengths and risks that could be used by MCID and the Romanian Government to better plan the evolution of the observatory. First, having RO-RIO continue to be a service within DPSCDITT can have the advantage of building on IT capacities that are already being developed, and in this location RO-RIO can be well-positioned to have a clear alignment with the actors that take part in the SNCISI, and their datasets. Second, having an internal restructuring to have RO-RIO report directly to the Minister could give it a greater overview of the R&I system as well as help in the recruiting of key personnel, which will have enhanced exposure to stakeholders both inside and outside of MCID's policy sphere. Third, having RO-RIO spin-off under an eventual independent agency would have the relative strength of encompassing a broader set of stakeholders and datasets that could link the observatory more closely to topics of productivity and competitiveness, while having more autonomy and flexibility in its ability to recruit and have higher salaries for the type of talent needed; also, a new agency could face less restrictions when assigning the necessary resources for a sustained funding of RO-RIO. Finally, having the observatory as a service under GSG would enhance its ability for outreach with stakeholders in a broad range of policy spheres, it would increase its effectiveness at accessing and maintaining data from diverse actors within government—helping RO-RIO break some of the silos present in the R&I system at the cost of having less clarity in its mission and introducing the risk of uncertainty in the long-term given the changing nature of GSG following the political cycle. This balance of strengths and risks could be used by MCID and the Romanian Government to better plan the evolution of RO-RIO in the medium term.

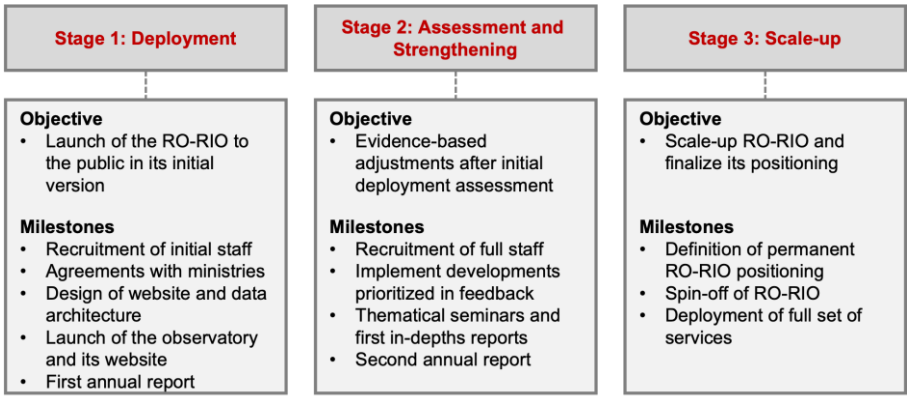
SECTION 5

WORKPLAN

5. Workplan

RO-RIO should be developed in a gradual manner, following a roadmap to implement its services in a sequence of three stages. The gradual nature of the implementation of RO-RIO means that MCID and the stakeholders of the observatory need to follow a roadmap consisting of three stages, as presented in Figure 24. This section of the report suggests a step-by-step guide for each stage, with a more detailed process of activities that are to be initially led by MCID during the foundation of the observatory (first 12 months), and a suggested timeline for the medium-term stage (second year) and the long-term stage (year 3 onwards) to assess, strengthen and scale-up RO-RIO.

Figure 24 Stages in the workplan for RO-RIO

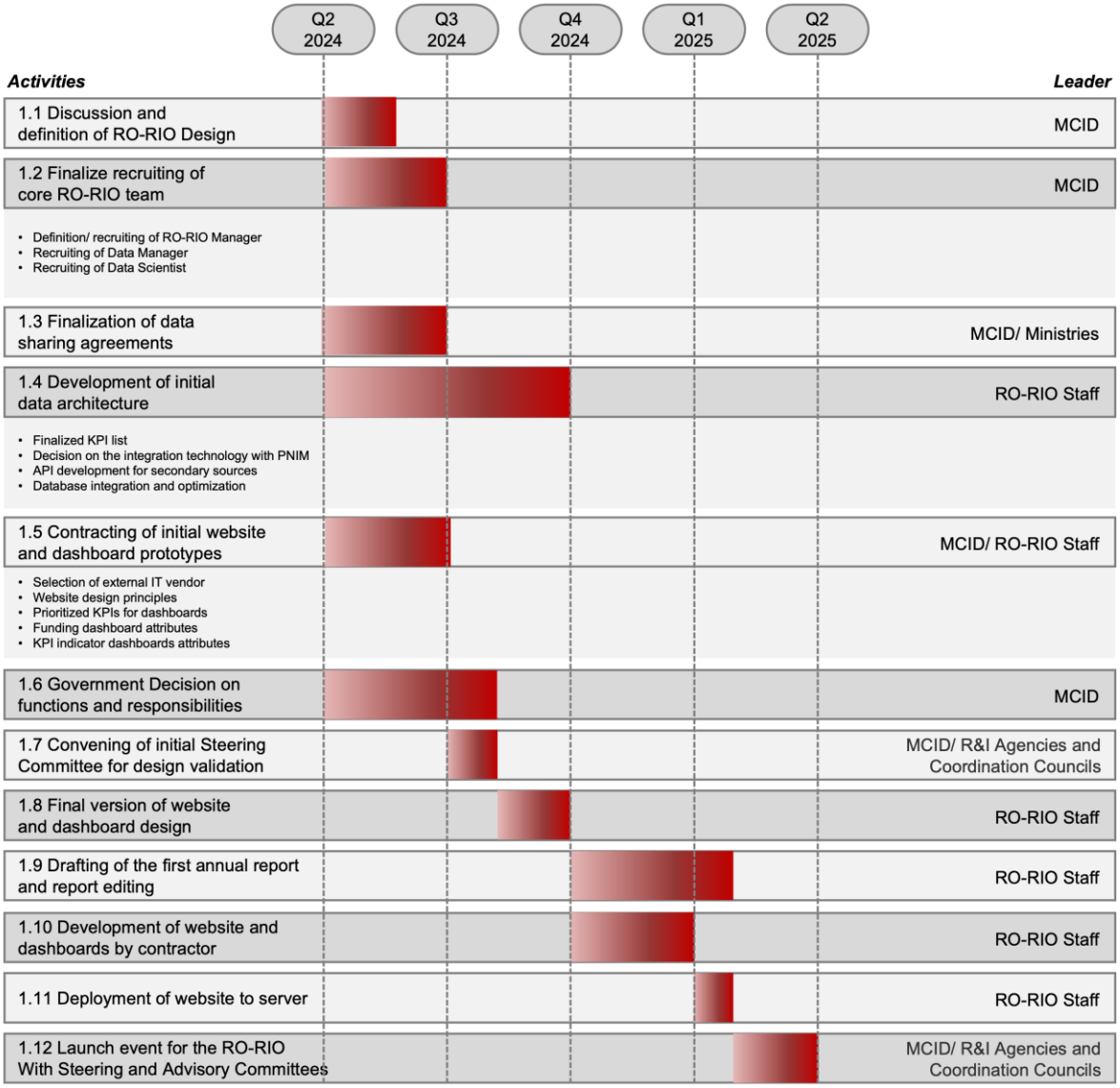


Source: World Bank.

5.1 Stage 1: Deployment (0-12 months)

The objective of the first stage is the launch of RO-RIO to the public in its initial version, including its website and an initial set of services. This report estimates that RO-RIO and its official website could be launched in Q2 2025, with a twelve-month development stage beginning in Q2 2024. Development would be led by MCID, which is also going to lead the foundational decisions on the observatory and the recruiting of its core team. The detailed sequence of activities for deployment, its estimated timeframe, and suggested roles are presented in Figure 25.

Figure 25 Step-by-step guide for stage 1—Deployment of RO-RIO.



Source: World Bank.

This workplan for Stage 1 results in a set of initial services that have been highlighted throughout the report as those that support a strong value proposition for RO-RIO at its launch. As described in Sections 2. “Core services to be provided by RO-” and 3. “Key success factors for RO-RIO”, the review of international case studies for RIOs and the interviews with institutional stakeholders highlighted a set of services that are most valuable to users in the Romanian R&I system, and that should be developed in the short term to give RO-RIO a strong value proposition at its launch. The services that should be built into RO-RIO in this initial version and the key products and events for the first stage, are the following:

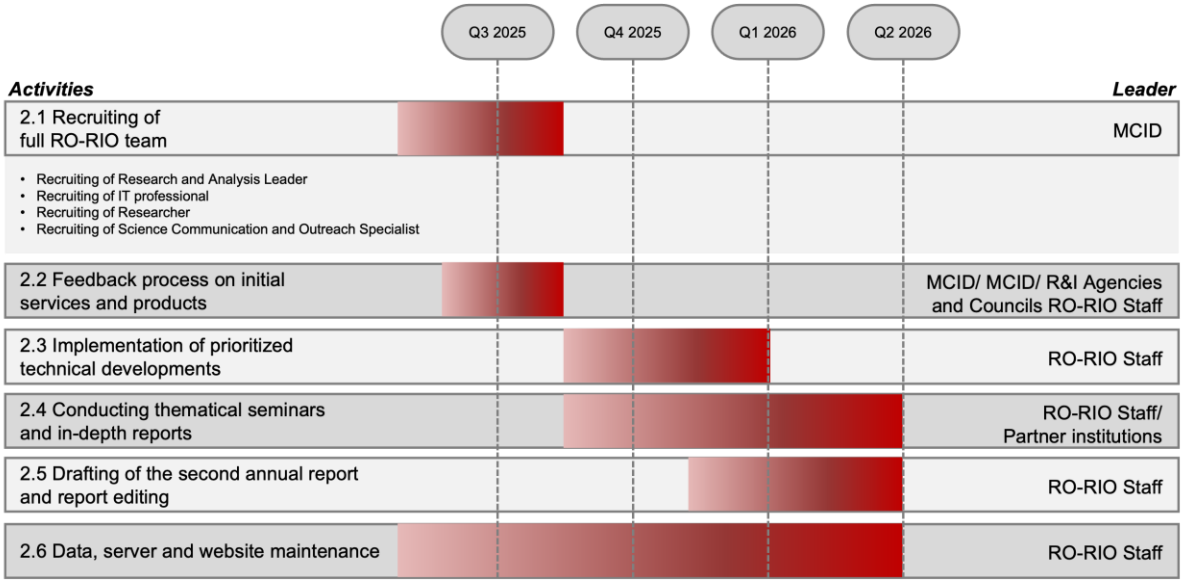
- **Basic overview of the R&I system (Service 1).** This includes initial versions of the tab for R&I governance, the tab for R&I enablers, and the tab for research and technology infrastructure. The value proposition for this service is providing information on the R&I governance to provide sufficient contextual elements and link to important policy documents (such as SNCISI) for potential users that are not yet familiar with the policy context of R&I. In addition, information on R&I enablers, and research and technology infrastructure have been repeatedly mentioned during stakeholder interviews as novel and valuable.

- **Initial dashboard with priority R&I and funding indicators (Service 3)**. The value proposition for this service is providing an efficient way of getting insights on the performance of Romania's R&I in the international context.
- **Reports generated automatically based on the indicator dashboard (Service 4).** The value proposition for this service is providing a quick and structured document that extracts information on several indicators in one place, and which could serve as initial support documentation for discussions in the different R&I Coordination Councils.
- **First annual report (Service 4).** At the launch of RO-RIO, its first annual report should be published using the databases gathered in its deployment stage. The existing legislation mandates the submission of annual reports to update on the development of the R&I system and the implementation progress of the SNCISI, which, as of now, remains unfulfilled. Therefore, RO-RIO can generate an initial version of this report with a basic coverage of topics that are essential to the analysis of the R&I system, which will serve as a supporting and guiding document for the operational activities of mandated R&I Councils.
- **Knowledge base (Service 6)**. This includes selected reports and knowledge products produced in collaboration with the World Bank. The value proposition for this service is giving RO-RIO knowledge products that have not been published before, and a novel view of the R&I system that is not presented elsewhere. This can help increase outreach and an initial positioning of the observatory.
- **A digital forum for continuous feedback collection**. This can take the form of a basic version where comments can be posted or sent to RO-RIO team. The value proposition for this service is having an initial place to collect feedback on the observatory's services.
- **RO-RIO launch event**. The launch of RO-RIO in Q2 2025 should be marked by a public event to advertise RO-RIO's services, present the first annual report and inform on future developments. The event and report could be accompanied by a concise video to be shared on social media platforms.

5.2 Stage 2: Assessment and strengthening (12-24 months)

The second stage seeks to assess the lessons from the initial deployment and strengthen the observatory's services. After launch, the RO-RIO team under MCID should focus on finalizing the recruitment of the full staff for the observatory and engaging its stakeholders by gathering feedback on the initial services and products. Afterward, RO-RIO should prioritize a set of services and technical developments (both front-end and back-end) that need to be put in place and commence a series of sprints to evolve the features on the website according to the lessons gathered from user feedback. This can help consolidate the services implemented in the first stage and set a robust basis for the scaling-up stage. Also, RO-RIO can engage the R&I community by organizing the first seminars on selected topics, which can also be associated with initial in-depth reports produced with external researchers. The second stage will finalize with the launch of the second annual report, which should be more comprehensive given the evolving nature of RO-RIO. Of course, data and website maintenance will be a recurrent task throughout this consolidation stage. A suggested set of steps in this medium-term stage, including general timeframes and suggested roles, are presented in Figure 26.

Figure 26 General guide for stage 2—Assessment and strengthening of RO-RIO

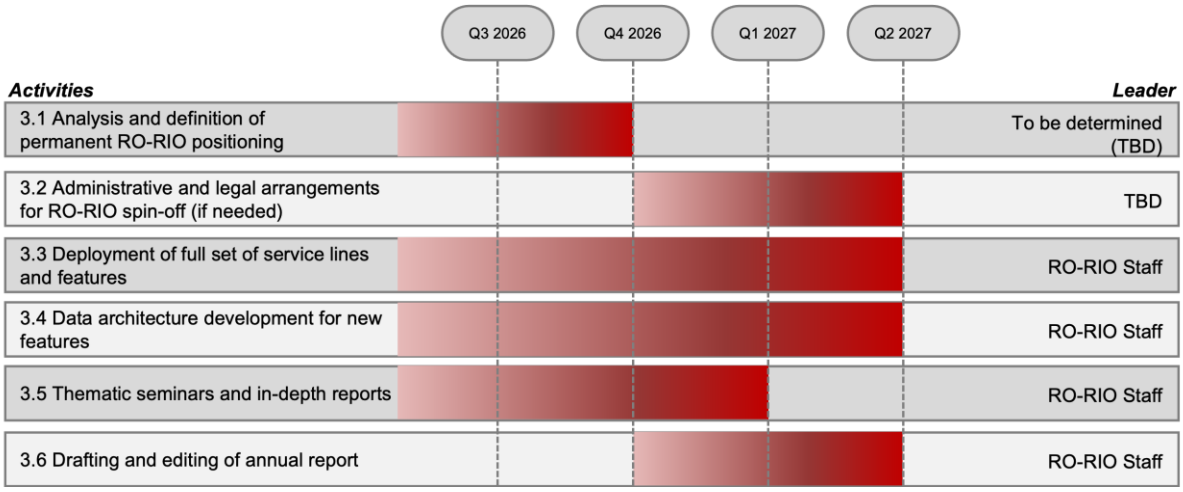


Source: World Bank.

5.3 Stage 3: Scale-up (24-36+ months)

The third stage's objective is to scale-up RO-RIO by developing its complete set of services and finalize its institutional positioning in the R&I system. The first step in this scale-up stage is the analysis and definition of the final institutional positioning of RO-RIO, according to the Romanian Government's assessment of the alternatives presented in this report. Once this decision has been made, the necessary administrative and legal arrangements for the spin-off of RO-RIO need to be carried out in close coordination with MCID. As the spinning-off process occurs, the staff of the observatory can work on the development of the complete set of services, implementing sprints to build the front-end developments in the website as well as the required data management projects that are associated with these new activities. Throughout this stage, RO-RIO can continue to produce in-depth studies and its annual report, learning from the feedback gathered on the first two years of implementation. A suggested set of steps in this long-term stage, including general timeframes, are presented in Figure 27.

Figure 27 General guide for stage 3—Scale-up of RO-RIO



Source: World Bank.

SECTION 6

NEXT STEPS

6. Next steps

This report should be followed by three main activities: (i) a continuous engagement with MCID and key representatives of R&I governance agencies; (ii) the consultation of non-institutional target users of RO-RIO; (iii) the development of templates for RO-RIO prioritized services. This report formulates an initial framework for RO-RIO laying the groundwork for discussions between MCID and other Romanian R&I governance agencies. The World Bank's initial need assessment could be complemented by organizing a round table where stakeholders from public administration come together to reach agreement on RO-RIO's mission, ensuring a collective understanding of the mission's objectives and priority services. This assessment could be extended to additional target groups of RO-RIO, such as researchers, innovative firms and R&I enablers to better guide the operationalization of RO-RIO's priority services. Following this report, the World Bank will support MCID on shaping the design of core services and a mock website, which could be integrated with the PNIM. This mock website will serve as a tool for engaging institutional stakeholders through a live demonstration of the observatory, allowing for the collection of valuable feedback on its format. Subsequently, the World Bank, in partnership with MCID, will provide inputs to an initial template for RO-RIO's annual report and to a first draft report to determine the optimal format for this critical output.

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Appendix 1. Report preparation activities

Domestic review and institutional needs assessment

This report builds on an assessment of information and functional gaps in Romania that could hinder the uptake of evidence in decision-making on the allocation of resources in R&I. We conducted a needs assessment of Romanian R&I actors, particularly focusing on public administration. The aim was to identify information and services needed to enhance the use of evidence on the performance of the Romanian R&I system in decision-making. This assessment builds on consultations with governance agencies conducted as part the World Bank's efforts to support the monitoring of the Romanian R&I system. Additionally, a thorough review of existing national platforms and relevant legislative documentation was undertaken.

Interviews were conducted with key target institutional users of RO-RIO to complement the needs assessment of public administration. Semi-structured interviews were conducted with institutional stakeholders representing key target users of RO-RIO (Table 17). These interviews were designed to uncover institutional needs and challenges related to R&I data. They also sought feedback on proposed functions for RO-RIO, drawing from the examination of international case studies (see section 2). When time permitted, discussions delved into potential institutional setups and governance options for RO-RIO. (Refer to Appendix 3 for the complete interview guide.)

Table 17 List of Romanian institutions consulted for this report

List of institutions interviewed for this report:
Advisory Council for Research, Development and Innovation (CCDI) and National Council for Scientific Research (CNCS)
General Secretariat of the Government / Sustainable Development Department
Executive Agency for Higher Education and Research, Development and Innovation Funding (UEFISCDI)
Ministry of Research, Innovation, and Digitalization: • Directorate of Policies and Strategies for Research Development Innovation and Technological Transfer • Policy Support Facility (PSF) Unit • Internationalization Department • Representatives of the National Committee for Science, Technology and Innovation, and the Coordination Committee for the Strategy of Smart Specialization
Ministry of Education (MEDU)
Ministry of Agriculture and Rural Development (MADR)
Ministry of Economy, Entrepreneurship and Tourism (MEET)
Ministry of Energy
Ministry of European Investments and Projects (MIPE)
National Statistics Institute (INS)
Northeast Regional Development Agency
Northwest Regional Development Agency

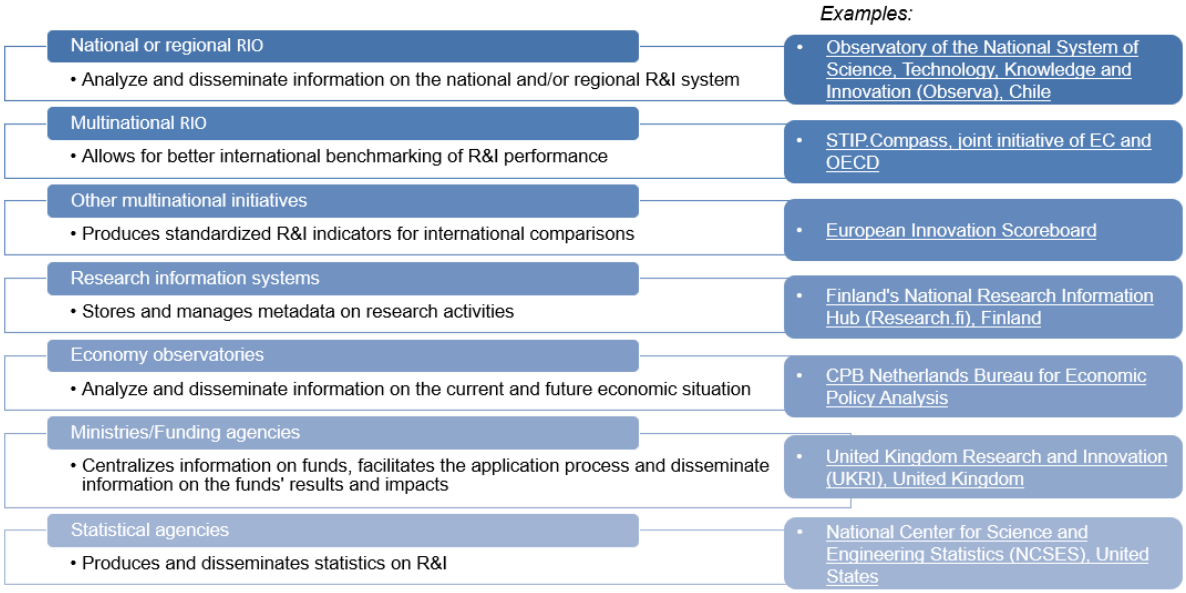
Source: World Bank.

Regular inputs from MCID's divisions responsible for designing and implementing RO-RIO significantly contributed to this report. Starting in February 2024, bi-weekly meetings were initiated with the DPSCDITT and PSF Unit divisions of the Ministry to facilitate discussions and provide feedback on the interim findings of the World Bank's team based on the report preparation activities.

International good practices

To gather international good practices on the establishment and management of a RIO, we first conducted a mapping of examples of existing institutions contributing to the collection and production of evidence on R&I performance. Our goal was to understand how these institutions are managed and to identify the services and features that could inform the design of RO-RIO. The mapping involved identifying institutions that contribute to the collection and production of evidence on R&I performance with a public interface (that is, a website), observatories being one example. These institutions were categorized into seven types, based on their main function (see Figure 28). Our focus was on providing a comprehensive listing of existing RIOs, while we selected examples for other types of institutions. This work was supplemented with a comprehensive desk review on prior and existing experience of RIOs.

Figure 28 Type of institutions mapped



Source: World Bank.

The mapping of 23 institutions informed the list of 13 institutions to contact for semi-structured interviews to gain deeper insights on their origins and evolution. Twenty-five institutions (among which 12 are RIOs) were mapped. Of these, a total of 13 institutions (among which 6 are RIOs) were selected for semi-directed interviews. This sample of 13 interviewed institutions includes:

- **6 RIOs**: all European national RIOs that were identified, one example of a regional RIO and three examples of RIOs outside of Europe.
- **2 Research Information Systems:** they differ from RIOs in that their primary function is to store and manage metadata on research activities. However, several Research Information Systems go beyond this primary role by incorporating additional features, such as statistics on R&I and other information related to the R&I system and

performance. Given that several European countries are adopting this initiative, we deemed it worthwhile to include them in our sample.

- **5 other institutions:** Among other institutions, we considered two examples of think-tanks promoting the use of evidence in policymaking—one at the multinational level (J-PAL) and another at the governmental level (National Planning Department in Colombia). Moreover, an interview was conducted with the Observatory of Science in Society of Italy to shed light on the role of analyzing the evolution of public attitudes on science and technology in informing policy making. We also reached out to the local initiative of the Romanian Innovation Lab, supporting improved governance through innovative approaches in public administration. Additionally, we conducted an interview with the team responsible for managing an interface that promotes Estonian research abroad. This interview provided valuable insights into how such a website contributes to the country's internationalization strategy.

The interviews informed a list of key success factors and the core services proposed for RO-RIO. Semi-structured interviews were conducted between November 2023 and February 2024 with representatives of these 13 RIOs and related institutions (Table 18). The interviews were used to inform our lists of key success factors and core services for RO-RIO. They also served as a basis for stand-alone case studies of international examples of RIOs and Research Information Systems (see Appendix 8). The interviews covered the institution's origins and evolution over time, its position within the R&I system, its core services and target users, its human resources, its governance and funding models, and the key challenges and success factors of this initiative (see Appendix 2 for the complete interview guide).

Table 18 List of RIOs and related institutions interviewed for this report

Region	Country	Type	Institution
Europe	Estonia	Research Information System	Estonian Research Information System (ETIS)
Europe	Estonia	Promotion of research internationally	Research in Estonia
Europe	Finland	Research Information System	Finland's National Research Information Hub (Research.fi)
Europe	France	RIO	Science and Technology Observatory (OST)
Europe	Italy	Observatory of attitudes towards science and technology	Observa Science in Society
Europe	Portugal	RIO	Observatory of Science, Technology and Qualifications (no longer in operation)
Europe	Romania	Observatory of public sector innovation	Romanian Innovation Lab
Europe	Spain	RIO	Innovation Observatory of Navarra – (Mira la i - Begira), region of Navarra
Latin-America	Chile	RIO	Observatory of the National System of Science, Technology, Knowledge and Innovation (Observa)
Latin-America	Colombia	RIO	Colombian Observatory of Science and Technology (OCyT)

Latin-America	Colombia	Governmental agency	National Planning Department
Latin-America	Panama	RIO	Science, Technology and Innovation Observatory of Panama
Multi-lateral	Multiple	Think-tank on policy evaluation	The Abdul Latif Jameel Poverty Action Lab (J-PAL)

Source: World Bank.

The 10 institutions not selected for interviews nevertheless contributed to our understanding of international best practices. We examined these institutions' websites to inform the design of RO-RIO. Table 19 provides information about these institutions.

Table 19 Mapping of other institutions contributing to the collection and production of evidence on R&I performance

Region	Country	Type	Institution or platform/link	Provider	Objective	Overview of R&I System	Overview of R&I policies	Open data repository	Visualization (e.g., dashboards, maps, graphs)	Primary data collection	Studies & publications (e.g., reports)	Knowledge base	News/newsletter
Europe	Netherlands	Economy observatory	CPB Netherlands Bureau for Economic Policy Analysis	Independent in its contents, part of the Ministry of Economic Affairs and Climate Policy.	Provides policy relevant economic analyses and projections. Offers a rational and factual basis by translating scientific insights into everyday policy practice.			■	■		■		■
Europe	United Kingdom	Funding agency	United Kingdom Research and Innovation (UKRI)	Department for Science, Innovation and Technology (but UKRI is a non-departmental public body)	Provides information on R&I public funds designed and allocated by UKRI.		■			■	■	■	■

North America	United-States	Funding agency	Small Business Innovation Research (SBIR)—Small Business Technology Transfer (STTR)	US Small Business Administration	Provides information and support services to apply to the SBIR and STTR programs.H9								
North America	United-States	Statistical agency	National Center for Science and Engineering Statistics (NCSES)	US National Science Foundation (independent federal agency)	Provides accurate, evidence-based information that can be used to understand the STI competitiveness landscapes in the United States and globally.								
Multinational	-	Economy observatory	The Economist Intelligence Unit	Private company	Enables clients to navigate the increasingly complex global environment, to analyze political and economic developments, forecast economic trends, and understand country-specific regulations and business practices.								
Multinational	-	Multinational research and innovation observatories	STIP.Compass	EC and OECD	Centralizes qualitative and quantitative data on national trends in science, technology and innovation (STI) policy.								

Multinational	-	Multinational research and innovation observatories	GO SPIN	UNESCO	Maps national, STI landscapes and analyzes STI policies and implementation.								
Multinational	-	Multinational research and innovation observatories	RICyT	Organización de Estados Iberoamericanos (managed by university staff from Argentina)	Promotes the development of instruments for measuring and analyzing science and technology in Ibero America.								
Multinational	-	Other multinational initiative	European Innovation Scoreboard	European Commission	The European Innovation Scoreboard provides a comparative assessment of the Research and Innovation performance of EU Member States, other European countries, and regional neighbors.								
Multinational	-	Other multinational initiative	Global Innovation Index	WIPO	Measures innovation and provides a rigorous statistical benchmark that attempts to capture national innovation ecosystems is at the core of the WIPO Global Innovation Index team and mandate.								

Source: World Bank.

The interviews informed a list of key success factors and the core services proposed for RO-RIO. Semi-structured interviews were conducted between November 2023 and February 2024 with representatives of 13 RIOs and related institutions. The interviews were used to inform our lists of key success factors and core services for RO-RIO. They also served as a basis for stand-alone case studies of international examples of RIOs and Research Information Systems (see Appendix 8). The interviews covered the institution's origins and evolution over time, its position within the R&I system, its core services and target users, its human resources, its governance and funding models, and the key challenges and success factors of this initiative (see Appendix 2 for the complete interview guide).

Appendix 2. Survey guide for semi-structured interviews with RO-RIO and related institutions

Section 1. Origins and evolution

1. What led to the creation of a R&I observatory? Which entities were involved?
2. How long did it take from the first preparations to the launch of the Observatory?

Section 2. Today's position within the R&I system and mission

3. What specific role does the observatory play in the R&I ecosystem? What gap are you trying to address?

Section 3. Governance structure

4. What is the observatory's governance model?
5. According to you, what are the strengths of this governance model in comparison with alternative ones? What are the weaknesses?
6. Can you tell us about the composition, responsibilities, and background of the observatory's staff?

Section 4. Funding

10. What are the main funding sources of the Observatory?
11. What is the current annual budget of the Observatory? What are your main expenditure areas? How have your finances evolved over time and what led to that?

Section 5. Implementation and functioning

12. What were the main challenges during the implementation of the observatory?
13. According to you, what were the key success factors that led to the Observatory's position today?
14. Based on your own experience, what lessons would you share to current or yet-to-be created Observatories?

Section 6. Referrals and follow-ups

15. Do you know other agencies that may supply valuable information for our current work on the establishment of a RIO in Romania? Could you share contacts?
16. Would you be open to follow-up discussions covering other specific aspects of the implementation and management of your observatory?

(if time allows)

Section 7. Monitoring and evaluation

17. Do you look at the Observatory's usage and reuse of information? If yes, what strategy do you have in place to collect and analyse this information?
18. Have the Observatory's tools and services, functionalities or design evolved over time? If yes, what drove the decisions on these changes?

Section 8. Partnerships and networks

19. Do you have any partnerships with other institutions? Which ones? What is the nature of your collaboration? How was the collaboration started?
20. Is the Observatory part of any network? Which one(s)? What is the nature of your interactions with these networks?

Appendix 3. Survey guide for semi-structured interviews with Romanian institutional stakeholders

Introduction. What does a RIO seek to do?

- Present a slide on what is a RIO and its objectives.

Section 1. Functions and services that arise from the international case studies

- Present a slide on the centralizing function of RO-RIO with example of services, illustrated by international example(s)
    - An overall view of the actors that take part in R&I and productivity policies, including those in the private sector. How do you envision this functionality?
    - A mapping of all current R&I and productivity instruments offered by the national government. How do you envision this functionality?
    - Access to a data bank that centralizes available R&I and productivity indicators. How do you envision this functionality?
    - An eLibrary of reports and publications in R&I. How do you envision this functionality?
- Present a slide on the analyzing function of RO-RIO with an international example
    - A set of dashboards that give a visual analysis of the performance of R&I public funds as well as R&I and productivity performance in international perspective. How do you envision this functionality?
    - Production of an economic outlook for the R&I system and developments on productivity for Romania. How do you envision this functionality?
    - Annual reports on R&I and productivity indicators and in-depth studies on selected topics. How do you envision this functionality?
- Present a slide on the dissemination function of RO-RIO with an international example
    - Dissemination workshops and capacity building. How do you envision this functionality?
    - News and updates on R&I system. How do you envision this functionality?

Section 2. Feedback on these proposed functions and services

- Are there any services that have not been mentioned in the examples given before and you think is missing?
- Do you think any of these examples is not worth developing?

Section 3. Institutional needs and challenges of your institution

- Have you identified a gap in STI indicators—that is, a piece of information or data that would be useful for your institution but that does not currently exist or that is not easy to access?

Section 4. Institutional setup and governance of RO-RIO

- Present different institutional options that arise from the international case studies. What do you think would be the optimal institutional option for the RIO?
- In terms of the overall feasibility of the Observatory, what do you think will be the technical, administrative, and political challenges that will arise?

Appendix 4. **Overview of the Romanian R&I system**

This appendix provides a comprehensive overview of the Romanian R&I system, including information on its key actors (governance agencies, performers, and enablers) and on its public funding schemes, outlined in the national strategy currently in force.

Actors of the Romanian R&I system

The Romanian R&I system involves a variety of R&I governance agencies, R&I performers (e.g., researchers, research organizations) and enablers (e.g., innovation and technology transfer entities, innovation hubs).

Romanian R&I governance agencies

The **Ministry of Research, Innovation, and Digitalization** (MCID) leads R&I policymaking and the National Strategy for Research, Innovation and Smart Specialization 2022-2027 (SNCISI). MCID is also the coordinator of the National Strategy for Artificial Intelligence and has a role in implementation of public policies for digital transformation and information society.

MCID is supported by several **advisory bodies**, including the Advisory Council for RDI (CCDI), the National Council for Scientific Research (CNCS), The National Council for Ethics in Scientific Research, Technological Development and Innovation (CNECSDTI), The Honorary Council for Science, Technology and Innovation (COSIT), The Scientific and Ethical Council in Artificial Intelligence (CSEIA).

The **Ministry of Education** (MEDU) manages the national education and professional training system, as well as scientific research at the university level. “Educated Romania” is the overarching strategy for the national education system in 2030 horizon.

The **Ministry of Economy, Entrepreneurship and Tourism** (MEET) has a wide range of responsibilities in areas related to industrial policies, competitiveness, intellectual property, inventions and trademarks, entrepreneurship, small and medium-sized enterprises (SMEs) etc. “Increasing business-driven innovation” is a specific objective of the National Competitiveness Strategy 2021–2027 (not yet in force), while the National Industrial Strategy 2023–2027 (to be adopted soon) has innovation at the core of its mission.

The **Ministry of Agriculture and Rural Development** (MADR) implements the national strategies in the fields of agriculture, food production, fishing and aquaculture, rural development, as well as in the field of agricultural scientific research. Inter-alia, MADR coordinates the National Strategic Plan 2023-2027 for agriculture and rural development, the National Strategy for the Agri-food, and the Sectoral R&D Plan for Agriculture (ADER 2023-2027).

The **Ministry of Energy** is the coordinator of the National Strategy for Energy (2022-2030) and of the National Integrated Plan in the field of Energy and Climate Change 2021-2030 (PNIESC). Research, innovation, and competitiveness are instrumental for both strategic documents.

The **Ministry of Health** (MoH) coordinates the National Strategy for Health 2023-2030, which has specific objectives and targets related to the promotion of R&I in health.

The **Ministry of European Investments and Projects** (MIPE) coordinates implementation of the ESIF and is also responsible for the elaboration, negotiation, approval, implementation, monitoring and control of the funds granted under the Recovery and Resilience Plan (RRP). The Partnership Agreement 2021-2027 between the EC and Romania lays down the strategy and investment priorities, including the support for the development of a competitive, innovative, and export-oriented Romanian economy.

The **Ministry of Finance** (MoF) implements Romania's Fiscal and Budgetary Strategy and oversees the state budget, including the state R&I allocations and the R&D tax incentives.

The **General Secretariat of the Government (GSG)** ensures the legal and strategic operations related to the act of government. Different departments and committees under the GSG are of particular interest for the R&I system, i.e. The Sustainable Development Department coordinates the 2030 National Sustainable Strategy, which has dedicated R&I targets; the National Cybersecurity Coordination Centre oversees the National Cybersecurity Strategy, which has a strong focus on the RDI components. The National Institute of Statistics, The National Commission for Strategy and Prognosis, The Romanian Agency for Investments and Trade also act under the GSG.

The **Regional Development Councils** consist of local government representatives and have decisional powers in relation to regional development, including regional innovation and competitiveness; they approve and supervise implementation of the Research and Innovation Strategy for Smart Specialisation (RIS3). The Councils are supported by **Regional Innovation Consortia** that serve as consultative bodies for R&I and smart specialization.

Different funding agencies support MCID and other public authorities in implementation of R&I funds: the **Executive Agency for Higher Education and R&I funding** (UEFISCDI) implements most of the programs of the National RDI Plan (PNCDI) 2022-2027 and manages different R&I registries; the **Romanian Space Agency** (ROSA) and the **Institute of Atomic Physics** (IFA) coordinate the PNCDI programs in their specific fields.

The **Regional Development Agencies** (RDAs) are the executive bodies of Regional Development Councils and oversee the implementation of RIS3 strategies and the management of Regional Operational Programs 2021-2027. MCID also has dedicated units acting as intermediate bodies for implementation of R&I-related ESIF and NRRP interventions.

The Romanian R&I system benefits from two main coordination committees. Under the NRRP Reform 2, MCID made steps forward for the creation of the **National Committee for Science, Technology and Innovation**; the Committee works under the Prime Minister and is empowered to define, monitor, and update national R&I priorities. The Committee has a decisional role in the M&E of SNCISI and in the oversight of the national R&I system; it is also expected to coordinate national, sectorial, and regional priorities on R&I along with the private sector and civil society. The M&E of Smart Specialization falls under the auspices of the Committee for Coordination of Smart Specialization (CCSI), which is part of Romania's commitment for ESIF (2021-2027) enabling condition: "Good governance of national/ regional smart specialization strategy".

Romanian R&I performers

The national registry (BrainMap) managed by UEFISCDI offers a valuable centralization of **researchers, innovators, technicians, and entrepreneurs**, with a total of 60500 accounts.

Research organizations are listed in another national registry (Organizations Registry) managed by UEFISCDI, with a total of 3692 accounts.

There are 46 **National R&D Institutes** (INCDs), most of which (43) under the coordination of the MCID; the remaining function under the coordination of the MADR, Ministry of Labor and Social Solidarity (MMSM) and GSG. Most National R&D Institutes (INCDs) are active in technical and engineering fields and their main mission is to contribute to the consolidation of scientific and technological competence in fields of national interest, established in accordance with Romania's development strategy.

The Romanian Academy has about 60 institutes and research centers covering 14 scientific, artistic, and literary domains; their focus stays—but is not limited to—fundamental research.

There are 49 research units under the coordination of **The Romanian Academy of Medical Sciences** and about 70 R&D entities being coordinated by **The Academy of Agricultural and Forestry Sciences**. To these, one should add the R&I units organized under **The Academy of Romanian Scientists** and **The Technical Sciences Academy of Romania**, as well as other R&I units organized within national (public) companies or central and local public administration.

There are 87 (public and private) **higher education institutions** (HEIs) that function under the coordination of MEDU; research, development, innovation, and technology transfer is part of the mission of (almost all) HEIs and it takes place in dedicated research institutes, labs or research centers organized at the universities level.

According to the National Institute of Statistics, the **private R&I sector** in Romania comprises 285 private R&D units (CDP101B) and about 2900 innovative enterprises (INO101B).

Romanian R&I enablers

At the time of writing, there is scarce and disparate evidence of R&I intermediaries and the services they provide. R&I intermediaries have a crucial role in connecting researchers and innovators to industry and society and in matching the offer and the demand for knowledge and technology.

UEFISCDI manages the **national registry of research infrastructure** (EERTIS) with information on 413 organization with research infrastructure.

As per February 2024, the **National Registry of Innovation and Technology Transfer Entities** (ReNITT)[46] includes 44 R&I intermediaries, namely technological transfer centers, technological information centers, technological and business incubation centers and research liaison offices. ReNITT entities are expected to support innovation and technology transfer, the valorization of R&I results, creation of new jobs and sustainable economic development; yet there is much space to improve the visibility and access to the services provided by ReNITT entities.

MCID gathers evidence on Romania's **science and technology parks** and on **Smart Specialization parks,** while the Ministry of Development, Public Works and Administration has responsibilities in relation to the activities of **industrial parks**.

Most Romanian cluster organizations are gathered into the **Clustero** association**,** which provides them a hands-on cooperation platform.

[46] For more information, see https://www.mcid.gov.ro/sistemul-de-cercetare/infrastructuri-de-cercetare/entitati-de-inovare-si-transfer-tehnologic/.

The Authority for the Digitalization of Romania keeps record of the **National Network of Digital Innovation Hubs (DIHs)**[47]**.**

Accelerate Romania[48]—a platform developed by UEFISCDI and MCID—maps Romania's **accelerators, facilitators, workspaces, start-ups** etc., while providing search options by categories or by domains.

The **Enterprise Europe Network Romania** and the eight regional **ERA (European Research Area) Talent Platforms** (funded from the NRRP) also have a prominent intermediation role.

SNCISI expresses four main strategic objectives: (i) developing the national R&I system; (ii) integrating Smart Specialization innovation ecosystems into global value chains; (iii) promoting business engagement in innovation; and (iv) enhancing internationalization and European and international collaboration. SNCISI outlines thematic priorities, focusing on Smart Specialization priorities and the Strategic Research Agenda addressing societal challenges. This effort is nationwide because each of Romania's eight development regions has adopted a RIS3, and these strategies are integrated within SNCISI.

Legal framework of Romanian R&I policies

For the current programming period, **the National Strategy for Research, Innovation and Smart Specialization 2022–2027** (SNCISI[49]) drafted by MCID defines the **Vision 2030** for the Romanian R&I system. SNCISI is driven by **four main strategic objectives**: (i) developing the national R&I system; (ii) integrating Smart Specialization innovation ecosystems into global value chains; (iii) promoting business engagement in innovation; and (iv) enhancing internationalization and European and international collaboration. SNCISI outlines **thematic priorities**, focusing on **Smart Specialization priorities** and the **Strategic Research Agenda** addressing societal challenges. This effort is nationwide because each of Romania's eight development regions has adopted a RIS3, and these strategies are integrated within SNCISI.

The **Action Plan of SNCISI 2022-2027** (Annex 3 of SNCISI) connects SNCISI's actions, expected results, responsible institutions, financing instruments and timelines by general (OG) and specific (OS) objectives. SNCISI's targets are aggregated at the level of Vision 2030, together with the premises to turn vision into reality; these refer—inter alia—to the commitment to increase public spending on R&D up to the 1% of GDP target by 2027 and to ensure the structural convergence of the national R&I system to other R&I systems in the EU. SNCISI's estimated budget is of approx. EUR 16,6 bn for the 2022-2027 period (Annex 2 of SNCISI), which covers the national R&D funds, the R&I allocations from ESIF, as well as the RDI investments and reforms planned through the NRRP. Table 20 introduces the main funding sources for SNCISI (Annex 2 of SNCISI), while shedding light on the managing authorities and the implementing bodies that make up the institutional set-up for SNCISI implementation.

Table 20 SNCISI 2022-2027 funding sources

	Managing Authority	Implementor(s) / Intermediate Body	Planned allocations (Euro)
NATIONAL R&D FUNDS			

[47] For more information, see https://www.adr.gov.ro/centrele-de-inovare-digitala-dih/.
[48] Link to website: https://accelerate.gov.ro/en.
[49] GD 933/2022 Government Decision for the approval of the National Strategy for Research, Innovation and Smart Specialization 2022-2027.

APPENDIX 4

PNCDI IV		MCID	MCID 's implementation units	12,000 million
		UEFISCDI		
		Institute of Atomic Physics		
		Romanian Space Agency		
R&D Programs of the Romanian Academy		Romanian Academy	Romanian Academy	400 million
R&D Programs of the Academy of Romanian Scientists		Academy of Romanian Scientists	Academy of Romanian Scientists	12 million
Budgetary lines for R&D in universities		MEDU	MEDU & UEFISCDI	120 million
R&D Plans of other ministries		MADR	MADR & Academy of Agricultural and Forestry Sciences	
	MH		MH & Academy of Medical Sciences	
	Other ministries with sectoral R&D Plans			
EUROPEAN STRUCTURAL AND INVESTMENT FUNDS				
Smart Growth, Digitalization and Financial Instruments Program (POCIDIF)		MIPE	MCID—Intermediate Body for POCIDIF, Priority 1 (RDI), Priority 2 (RDI in the ICT sector)	1,000 million
Health Program			MCID—Intermediate Body for PS, Priority 5 (Medical Research)	386 million
Education and Employment Program			MEDU—Intermediate Body for PEO, Priority 7 (Education and Training)	40 million
Just Transition Program			RDAs in selected regions, Priority 1-6 (Entrepreneurship support)	200 million
Regional OPs		RDAs	RDAs—Priority 1 (Competitive regions through innovation, digitalization, and dynamic enterprises)	2,200 million
NATIONAL RECOVERY AND RESILIENCE PLAN (NRRP)				
Component 9: Support for the private sector and RDI		MIPE	MCID—PSF unit and RRP Direction	259 million
TOTAL				16,617 million

Source: World Bank compilation, based on Annex 2 of SNCISI.

Appendix 5. How could RO-RIO contribute to recommendations of the PSF report

RO-RIO's key objectives and primary functions proposed in this report are based on the recommendations of the PSF Report:

- The PSF report highlights four key objectives of RO-RIO:

"Recommendation 3.2: Establish an R&I Observatory, to **map Romania's best R&I strengths in the international context [*Objective 1*]** and **study national developments in the light of EU and international trends [*Objective 2*]**. **Reinforce the use of such evidence [*Objective 3*]** to serve the needs of the MCID in terms of policy implementation (including for an **internationalisation strategy [*Objective 4*]** – see Recommendation 9.1)." (European Commission, 2022a, p.27)

- The PSF report emphasize ***three primary functions*** of RO-RIO, aligned with primary functions identified in our international case studies of RIOs:

"A Romanian R&I Observatory could **collect statistical data from international databases [*Function 1: centralization of data and information*]**, **analyse them in the Romanian context, and map Romania's position [*Function 2: research and analysis*]**. **The information should be shared [*Function 3: dissemination*]** with policy makers and the public." (European Commission, 2022a, p.59)

- RO-RIO's **mission statement** proposed in this report directly **serves these objectives** and emphasizes RO-RIO's core functions:

"Provide a rigorous evidence-base and promote its use in policy decision-making in R&I by:
(i) centralizing [*Objectives 1 & 2*];
(ii) analyzing [*Objectives 1 & 2*];
(iii) disseminating statistical data from national and international databases and information on R&I and productivity, and [*Objective 3*];
(iv) building capacities of R&I and productivity stakeholders [*Objective 3*].
RO-RIO will identify Romania's areas of excellence in R&I that can guide investments in R&I and Romania's internationalization strategy [*Objective 4*]."

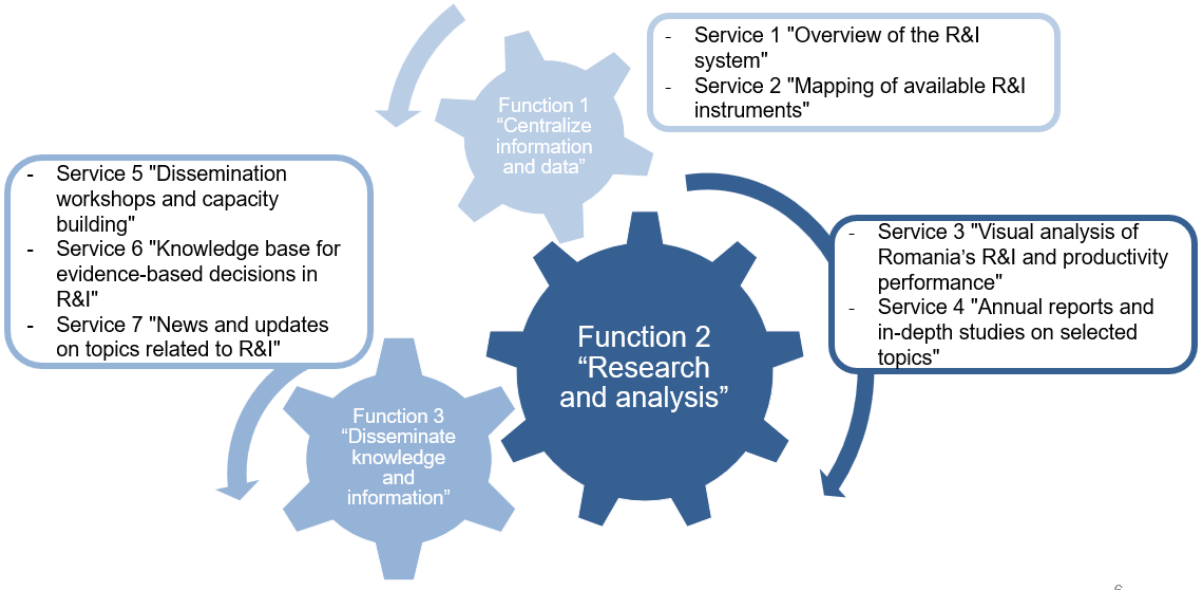
Through its capacity-building role, RO-RIO also contributes to **Recommendation 3.3** on strengthening institutional capacities in ministries and agencies[50]. The evidence produced by the observatory also supports MCID efforts in implementing **Recommendation 3.1** on the implementation of a monitoring system for the whole Romanian R&I system[51].

- RO-RIO's seven core services proposed in this report would together perform these primary functions (see Figure 29). The services under "research and analysis" are particularly important in meeting RO-RIO's objectives. This function aims to identify strengths and weaknesses in Romanian R&I through the **analysis of four main dimensions of R&I involving the comparison of Romania's situation with that of other countries**: (i) resource analysis for R&I, covering expenditure, personnel, and research infrastructure (R&I levers), (ii) analysis of enabling factors of R&I (R&I

[50] "Strengthen institutional capacities, by investing more resources for capacity development and ensuring good performance-related working conditions, including effective delegation of authority and up-to-date digitalisation." (European Commission, 2022a, p.59).
[51] "Design and implement the envisaged all-encompassing monitoring system for R&I, based on the interoperability of national and Cohesion Funds systems." (European Commission, 2022a, p.59).

structural conditions), (iii) analysis of R&I performance (R&I performance, *including the internationalization of R&I*), and (iv) understanding the role of R&I investments in the economy and society (R&I outcomes, *including Smart Specialization outcomes*).

Figure 29 RO-RIO's core services



Source: World Bank.

- By conducting these analyses on the basis of **international comparison** and by examining Romania's performance on the **internationalization of R&I**, RO-RIO will address PSF's recommendation to produce "Policy intelligence (to be integrated into the proposed RIO and M&E system proposed in Chapter 3) should be used to acquire a better understanding of the areas of excellence, drawing lessons from successful and unsuccessful attempts to internationalise and from impact of funding schemes." (European Commission, 2022a, p.128).

- RO-RIO could **support the Entrepreneurial Discovery Process** (European Commission. Joint Research Centre., 2021) backing the Smart Specialization strategies with evidence on evolution of Romania's Smart Specialization domains and mapping of knowledge-based competitive advantages or presence in global value chains. RO-RIO could also investigate more closely the complementarities between national and regional Smart Specialization and inform efforts to align Smart Specialization objectives and policy instruments. RO-RIO could map indicators of competitiveness and exports from an international comparative perspective by Smart Specialization domains. In addition, it could take a step forward and carry out an analysis of participation in global value chains. Finally, analyses of knowledge flows and of their effects could inform the international component of Smart Specialization strategies and could facilitate interregional and transnational cooperation in Smart Specialization domains. In this sense, RO-RIO would contribute to PSF's recommendation on the role of the observatory in Smart Specialization: "The identification of technological trends and foresight activities are already part of UEFISCDI's activities and have been used during consultations for SNCISI and S3 preparation. These should be reinforced to serve the ongoing needs of the MCID in terms of policy implementation, and also to further refine and update S3 priority domains where Romania's R&I system can excel." (European Commission, 2022a, p.59).

- RO-RIO's proposed services will also support the implementation of other PSF recommendations:
    - **Recommendation 1.3** on the establishment of a public debate about 'science for society'[52]: through its SERVICE 1 "Overview of the R&I system", RO-RIO could share information on research organizations, contributing to showcase the benefits of their activities.[53] Through its dissemination function, RO-RIO contributes to the promotion of science, technology and innovation towards the general public.[54]
    - **Recommendation 6.1** on the simplification of evaluation and alignment of career advancement to EU practice[55]: through its SERVICE 3 "Visual analysis of Romanian R&I and productivity performance", RO-RIO will have a role in the **monitoring of research careers** and of their alignment with the provisions of the European Charter of Researchers.
    - **Recommendation 7.1** on a coherent research infrastructure strategy aligned with priorities and promoting cooperation[56]: through its SERVICE 4 "Annual reports and in-depth studies on selected topics", RO-RIO will have a role in **mapping the performance of Romania's major/ flagship research infrastructure** and in analyzing Romania's participation in European Strategy Forum on Research Infrastructures (ESFRI)/European Research Infrastructure Consortium (ERIC) consortia and in major international infrastructure programs. In the future, RO-RIO could also develop customized tools for the M&E of research infrastructure, as part of its SERVICE 6 "Knowledge base for evidence-based decisions in R&I".
    - **Recommendation 8.3** on the effectiveness of intermediary institutions[57]: through its SERVICE 1 "Overview of the R&I system", RO-RIO will collect and share information on the **activities of R&I intermediaries and the services they provide**.

- To enable a gradual implementation of RO-RIO, the report highlights a sub-set of priority services considering both technical requirements and services most valuable to **policy makers and the public, two key target groups** emphasized by the PSF report (European Commission, 2022a, p.59).

[52] "Establish a public debate about the implementation of the new strategy and the vision of 'science for society', in all major cities and with the involvement of national, regional and social media. Establish a sounding board representing the voice of stakeholders (from the quadruple helix, not only from the public research system) to support the relevance of the R&I activities." (European Commission, 2022a, p.26).
[53] As indicated in the PSF report, "The different roles and missions of the various publicly-funded Public Research Organisations (PROs)/Higher Education Institutions (HEIs)/Romanian Academy Institutes (RAIs) could be explained and illustrated." (European Commission, 2022a, p.68).
[54] As emphasized by the PSF report, " Promotion of science, technology and innovation towards the general public could be improved. It is important to improve the image of the research within the society in general and to promote the importance of R&I for Romania's development, general economy and people." (European Commission, 2022a, p.67).
[55] "Under Reform 3 in the NRRP, simplify the evaluation of human resources in the research system and align conditions for career advancement to those implemented in other EU countries. Individual career plans should be agreed with institutions, and researchers should be held accountable against their own development plans." (European Commission, 2022a, p.28).
[56] "Establish a coherent research infrastructure strategy with good articulation, institutional structure and human resource capacity, on the basis of the needs of all user groups. The strategy should align with the process of consolidation of the Romanian public research landscape by promoting clustering and cooperation of various research organisations on major research infrastructures, in priority areas." (European Commission, 2022a, p.29).
[57] "Make intermediary institutions more effective and provide them with basic and project funding, and provide ongoing support to innovative clusters which demonstrate viability and impact." (European Commission, 2022a, p.29).

Appendix 6. Overview of RO-RIO's thematic analyses

An analysis of resources for R&I: the R&I levers

R&I expenditure

Rationale

An in-depth analysis of public and private investment in R&I will inform the development of better targeted fiscal and financial incentives for R&I. Romania has the lowest R&D intensity (i.e., gross domestic expenditure on R&D (GERD) per GDP) in the EU but has an ambitious 1% GDP investment target for R&D expenditure in the public sector and 1% GDP target for R&D expenditure in the private sector by 2027. This could be primarily done by increasing and diversifying the R&I investments from national funds, creating stronger synergies between national and European funds for R&I, ensuring better application of R&D tax incentives and creating favorable conditions for private investments.

SNCISI advocates for structural convergence with the EU on R&D expenditure and for increases in innovation expenditure, which need to be closely monitored. When compared to other EU countries, Romania displays a different pattern of R&D expenditure by sectors, with much lower shares of R&D expenditure in the Higher Education Sector and much lower expenditure on experimental development. In this vein, SNCISI aims is to double the share of R&D expenditure on experimental research (which is now at about half of the EU average) and doubling of the share of public R&D expenditure in the higher education sector (one third of the EU average). Moreover, with its much higher focus on the private sector and public-private collaboration, SNCISI also expects substantial increases in innovation expenditure. Reaching all these objectives needs a continuous benchmark of R&D and innovation expenditure patterns against peers and the EU average.

Resources

A combination of national (the PNIM) and international (Eurostat, OECD, UNESCO) data sources can be used to inform on public and private investments in R&I. Data on public direct investments in R&I (national and European funds) will be available from the PNIM and will allow multiple comparisons between programs and instruments. For international comparisons, the Eurostat, OECD, and UNESCO databases on science and technology provide detailed statistics on GERD by source of funds and government budget allocations for R&D (GBARD) at the national and regional levels. At the same time, the **EC's Cohesion Open Data Platform**[58] could be instrumental for comparing R&I-related ESIF allocations and achievements by funds, by themes and by specific objectives. The **EC's Recovery and Resilience Scoreboard**[59] also facilitates comparisons on investments and common

indicators, including thematic analyses (European Commision, 2022). Study of direct investments in R&I should be complemented by in-depth comparative analyses of R&D tax

[58] Link to website: https://cohesiondata.ec.europa.eu/
[59] Link to website: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/index.html?lang=en

incentives, based on the **OECD's R&D Tax Incentives database**[60]. This allows cross-countries comparisons of generosity of R&D tax instruments (i.e., allowances, exemptions, deduction, or credit), as well as country specific analyses. Not last, for data on venture capital (VC) investments, Eurostat and the European Innovation Scoreboard (EIS) rely on data from **Invest Europe**[61], the world largest association of private capital providers; RO-RIO could also look at data for Romania from Invest Europe, as well as from other VC databases such as PitchBook[62].

The Community Innovation Survey (CIS) is the reference survey on firm innovation, and it is carried out every two years in all EU countries, based on a harmonized methodology. Innovation expenditure capture R&D and non-R&D expenditure, including spending on engineering and design, marketing and brand equity, IP-related activities, employee training activities, software development, investments in equipment and machinery. INS releases a comprehensive report for Romania on Innovation in business enterprises,[63] which includes a chapter on international comparisons. For further insights, RO-RIO could build on the Eurostat and OECD databases of business innovation statistics and indicators and look for disaggregation of expenditure on innovation activities by, for instance, area of expenditure, economic activity, size class.

Value added of RO-RIO

An analysis of R&I funding and support could scrutinize data on GERD by source of funds, as well as data on GBARD. GBARD has two components: direct funding for R&D through instruments such as grants, institutional funding, procurement programs, loans and credits and indirect support through the tax system. VC expenditure should also be considered in the analysis of R&I funding and support (i.e., in Global Innovation Index (GII), EIS), to capture investments in early-stage and risky innovations.

An analysis of R&D and non-R&D expenditure at various disaggregation levels will inform decisions on better targeted policy interventions. R&D expenditure statistics (i.e., Eurostat, OECD) allow multiple disaggregation options to measure performance of R&D. Of particular interest for SNCISI goals is the in-depth analysis of R&D expenditure by sectors of performance (government, higher education, business enterprise, private non-profit) and by type of R&D activity (basic research, applied research, experimental development). Moreover, an in-depth analysis could go further and explore data on R&D expenditure by type of expenditure, fields of R&D, types of institutions or socio-economic objectives, which are useful in understanding sectoral R&D patterns. Statistics on business expenditure on R&D (BERD) and on non-R&D innovation expenditure allow even more detailed comparisons by economic activities (International Standard Industrial Classification (ISIC)/ Nomenclature of Economic Activities (NACE) classification), by industry orientation, by size class, or by concentration of personnel. Such data captures the formal creation of new knowledge within firms. Through the lens of international comparisons, these insights will show trends in firms' innovation expenditure, but also the underexploited opportunities and potential investment needs.

[60] OLink to website: http://oe.cd/rdtax
[61] Link to website: https://www.investeurope.eu/about-us/
[62] Link to website: https://pitchbook.com/about
[63] For more information, see https://insse.ro/cms/ro/content/inovarea-%C3%AEn-%C3%AEntreprinderile-din-mediul-de-afaceri-0

R&I personnel

Rationale

Romania must develop more attractive conditions for R&I careers and keep the evolution of R&I personnel under systematic observation. The country faced a significant decrease in the number of researchers in the past decades and the pool human resources for R&I was highly affected by brain-drain (World Bank, 2023b). SNCISI pleads for a significant increase in the number of Ph.D. graduates and in the share of researchers in total employment. To this end, a continuous review of size and demographic characteristics of human resources for R&I activities is needed.

Resources

The PNIM plans to collect data on researchers supported through projects and to link to BrainMap, the community of researchers and innovators in Romania. From an international perspective, UNESCO, Eurostat, and OECD provide detailed statistics on R&D personnel and Human Resources in Science and Technology. RO-RIO could also link to the (upcoming) EC's Research & Innovation Careers Observatory[64], which is meant to monitor jobs, working conditions, mobility, and research career paths in the EU.

Value added of RO-RIO

Periodical analyses of stocks and flows of Ph.D. students and researchers by sectors or performance, educational attainment, age class, domains, among others, would be very informative for understanding the supply and demand of human resources for R&I. RO-RIO has also the responsibility of monitoring the application of national and European provisions regarding to the recruitment, placement and promotion of RDI personnel.

Research infrastructure

Rationale

Keeping an eye on investments, access, use and sustainability of research infrastructures is equally important to monitor the capacities of the R&I system. Together with human resources, research infrastructures are critical for science, economy, and the society, as they enable high-quality research and breakthrough discoveries. Research infrastructure includes major equipment and sets of instruments, collections, archives, computing systems etc. and provides resources and services for the research communities. In the past years, Romania invested massively in creating new research infrastructure, upgrading labs, or procuring state-of-art equipment. Now Romania hosts world-class research infrastructure, such as Extreme Light Infrastructure-Nuclear Physics (ELI-NP)[65] and Danubius, as well as of infrastructure of European importance (European Strategy Forum on Research Infrastructures, European Strategy Forum on Research Infrastructures, ESFRI[66]/ European Research Infrastructure Consortium, ERIC[67]) or of national relevance. Yet, monitoring the operation and use of these infrastructures is still underdeveloped.

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[64] For more information, see https://european-research-area.ec.europa.eu/policy-agenda-2022-2024/deepening-truly-functioning-internal-market-knowledge? and https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3807.
[65] Link to website: https://www.eli-np.ro/.
[66] Link to website: https://www.esfri.eu/.
[67] Link to website: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures/eric_en

Resources

The PNIM foresees the collection of data on value of equipment and investments in research infrastructure by linking to EERTIS, the Romanian Registry of Research and Technology Infrastructures.

Value added of RO-RIO

RO-RIO could make incremental progress by producing maps of major research infrastructure and by collecting evidence on Romania's participation and performance in ESFRI/ERIC infrastructure. Over time, RO-RIO could draw lessons from the ESFRI Monitoring System (now in testing phase)[68] or the (upcoming) ERIC Observatory[69] and develop more customized tools for the M&E of research infrastructure.

An analysis of enabling factors of R&I: R&I structural conditions

Rationale

Innovation performance is strongly influenced by structural conditions and contextual factors. Differences in economic structure (i.e., sectoral composition of the economy) or in the macro-economic conditions determine the demand for innovation and explain differences in innovation performance. For example, compared to other EU countries, Romania still has a much higher share of employment in agriculture in the overall economy, at the expense of the service sector, which is more knowledge intensive. Such structural differences and contextual factors should be carefully considered in international comparative analyses, to better understand the drivers and barriers to innovation performance.

Resources

Different economic outlooks and forecasts for Romania are already available. INS and The National Commission for Strategy and Prognosis release summaries and forecasts for Romania's main macroeconomic indicators. The World Bank's "Systemic country diagnosis" (IFC, 2023) provides a detailed analysis of country's progress towards high-level outcomes. The "Economic outlook note for Romania" (OECD, 2023) and the "Economic survey of Romania" (OECD, 2024) provide detailed analyses of key economic developments and challenges. In the context of the European Semester, the EC produces comprehensive annual country reports for Romania that analyze the economic and social developments in the light of EU shared goals and commitments[70] and the EIS[71].

Value added of RO-RIO

The R&I ecosystem in Romania would benefit from a brief economic outlook prepared by RO-RIO, to provide solid contextual background to R&I performance analysis. The economic outlook could include—but not be limited to—key macroeconomic indicators such as GDP,

[68] Link to website: https://mos.esfri.eu/mos/auth/login/simple. For more information, see https://www.esfri.eu/monitoring-system-mos.
[69] For more information, see https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures/eric/eric-landscape_en.
[70] Link to website: https://commission.europa.eu/business-economy-euro/economic-and-fiscal-policy-coordination/european-semester/european-semester-your-country/romania/european-semester-documents-romania_en.
[71] Link to website: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en.

GDP/capita, investments, employment, and gross value added per economic sectors, inflation, labor costs, growth forecasts. Structural differences (e.g., share of employment and value added by sector, share of SMEs in total enterprises) could be analyzed. RO-RIO's economic outlook should consider data at the most granular level available and should comment on implications for innovation systems. To be of most relevance, the economic outlook should be updated regularly, from annually to bi-annually.

An analysis of R&I performance

Publications and intellectual property rights

Rationale

RO-RIO could inform national efforts in promoting the creation and quality of scientific publications and in increasing the stock and the value of intellectual assets (patents, designs, and trademarks). According to the European Innovation Scoreboard 2023, Romania has relative strengths and strong increases in what concerns the most cited publications, but this is not the case for intellectual assets, in particular for patent applications. SNCISI has very ambitious targets in this respect: by 2027, it is expected that the number of triadic patent applications will increase by 50% (as compared to 2021) and that the share of top 10% and top 1% most cited publications will increase exponentially. Such targets need to be closely monitored and benchmarked against both aspirational (e.g., Germany or France) and regional peers (e.g., Poland or Bulgaria) and best international practices.

Resources

The PNIM plans to collect detailed data on publications from projects, including open access publications and on intellectual assets in the form of European Patent Office (EPO)[72] and Patent Cooperation Treaty (PCT)[73] patent applications, trademarks, and industrial designs. Other international data sources on publications such as Web of Science[74] and Scopus[75], on data from the World Intellectual Property Organization[76], the European Union Intellectual Property Office (EUIPO)[77] or on IP statistics produced by Eurostat[78] and OECD[79] could also be mobilized.

Value added of RO-RIO

RO-RIO could complement the efforts of the PNIM by adding an international comparison component, relying on metrics from international data sources. In the longer term, RO-RIO can even take a step forward and produce regular Research and Technology Specialization Indices (i.e., based on scientific publications, patents), to identify Romania's distinctive characteristics and strengths in science and technology.

[72] Link to website: https://www.epo.org/en.
[73] Link to website: https://www.wipo.int/patentscope/en/data/.
[74] Link to website: https://www.webofscience.com/wos/.
[75] Link to website: https://www.scopus.com/.
[76] Link to website: https://www3.wipo.int/ipstats/key-search/indicator.
[77] Link to website: https://www.euipo.europa.eu/en/manage-ip/searches.
[78] Link to website: https://ec.europa.eu/eurostat/web/science-technology-innovation/database.
[79] Link to website: https://www.oecd.org/sti/intellectual-property-statistics-and-analysis.htm.

Internationalization

Rationale

Participation in joint R&I international programs offers many advantages and opportunities, i.e., it enables access to unique research infrastructures, new funding sources, large networks, frontier knowledge and advanced technologies. For firms, it also opens the possibility to boost expansion into new markets. For the 2021–2027 programming period, Romania has the ambition to increase participation in Horizon Europe to double the funding amounts attracted by the previous program, Horizon 2020. Apart from Horizon Europe, SNCISI supports participation in many other EU programs with a R&I component (e.g., Digital Europe, European Defense Fund, EU4Health, Interregional Innovation Instrument), in internationally coordinated programs, as well as in different bilateral and multilateral projects. A better understanding of the patterns and evolution of Romania's participation in international programs could support these efforts.

Resources

The PNIM is already connected to e-CORDA and will monitor the participation of Romanian R&I actors in Horizon Europe; data on participation in different other European and international programs (e.g., Eureka, bilateral/ interregional research projects) will be also available at the program levels. For international comparisons, Eurostat data allows rigorous investigation of GBARD allocations for participation in bilateral, multilateral, and transnationally coordinated R&D programs. The EC Horizon Dashboard[80] offers public access (and data export functions) to detailed statistics of country and region-specific performance in Horizon Europe and its predecessors. This source gives ample evidence of funding received, top beneficiaries, collaboration with other countries, project results (scientific publications, IPRs) among other information. Data on participation in other R&I programs funded at the EU level are also available in dedicated platforms.

Value added of RO-RIO

International data sources, especially those overseen by the EC, could be regularly examined by RO-RIO to assess Romania's ongoing participation in international R&I programs. These sources could be mobilized to map international R&I programs in which Romania takes part and produce periodic reports on participation and performance of Romanian R&I actors.

Leading research organizations

Rationale

The culture of recognition and appreciation for Romania's top R&I organizations should be strengthened. Monitoring the presence of the Romanian R&I organizations in Top Scimago 500 or in the Academic Ranking of World Universities (ARWU) is already included in the list of SNCISI indicators. Additional sources on international rankings could be mobilized to provide a more nuanced picture of the performance of Romanian research organizations.

Resources

In addition to ARWU and Scimago to be mobilized by the PNIM, RO-RIO complements these sources with rankings calculated in the context of Horizon Europe based on participation rates

[80] Link to website: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard

or funding received (e.g., top organizations, top collaborations). The EU Industrial R&D Investment Scoreboard[81] ranks world's top 2500 companies and top 1000 EU-based companies with the highest R&D investment.

Value added of RO-RIO

RO-RIO could enlarge the list of global and European rankings to be reviewed, taking advantage of the sources described above. Mapping the country's overall position in international R&I-related rankings and scoreboards, such as the GII, the European Innovation Scoreboard and the RIS, should also be taken into consideration. Mapping Romania 's position in such rankings would allow a better understanding of the innovation performance, in addition to the evidence on research performance collected by the PNIM.

Knowledge transfer and innovation in firms

Rationale

Romania's business innovation performance, as measured with the CIS, is critically low, disconnected from EU trends and susceptible to potential measurement biases. With the changes introduced by the CIS revision, it is expected that innovation statistics will be better integrated into the context of European Business Statistics; this will increase harmonization and will allow cross-validations, which should be fully considered. Meanwhile, there is a growing interest in the development of knowledge transfer metrics and European-wide set of harmonized indicators (Joint Research Centre (European Commission) et al., 2020).

Resources

In what concerns the monitoring of Romania's business innovation performance, the PNIM plans to collect project level data on product and business process innovation, sales of innovative products, licensing revenues, spin-offs, tech transfer and incubation results. RO-RIO could add international comparisons based on the CIS, complemented by data on Business Statistics. Of particular interest are the statistics on high-growth enterprises (HGEs), including gazelles, disaggregated by economic activity and by region. There are several platforms (e.g., EU-Startups[82], Accelerate Romania[83]) or commercial data providers on start-ups (e.g., Crunchbase[84], Dealroom[85]), whose databases and reports could be scrutinized by RO-RIO with a view to identify Romania's unicorns, gazelles, and tech startups. The recently created Observatory on Patents and Technology[86] by EPO maps critical technology developments. To capture the depth and breadth of R&I linkages, in addition to CIS indicators, RO-RIO should rely on analysis of R&D funding flows and interaction, with a particular emphasis on public R&D financed by business enterprises.

Value added of RO-RIO

RO-RIO would rise Romania's R&I profile by showing up its unicorns, technology startups and business champions. RO-RIO could link the Deep Tech Finder of the Observatory on Patents and Technology to identify dynamic tech companies with patent applications at the EPO. Moreover, through RO-RIO, Romania could also join and support the flagships actions

[81] Link to website: https://iri.jrc.ec.europa.eu/scoreboard/2023-eu-industrial-rd-investment-scoreboard
[82] Link to website: https://www.eu-startups.com/directory/wpbdp_category/romanian-startups/
[83] Link to website: https://accelerate.gov.ro/en
[84] Link to website: https://about.crunchbase.com/about-us/.
[85] Link to website: https://dealroom.co/about.
[86] Link to website: https://www.epo.org/en/about-us/observatory-patents-and-technology.

of interest of the New European Innovation Agenda[87], such it is the case of the Innovation Talent Platform[88] or the Virtual European Innovation Space, to be created soon. Based on international best practices, Romania could improve the oversight of knowledge transfer performance in the Romanian R&I system.

Understanding the role of R&I investments in the economy and society: R&I outcomes

R&I related productivity outcomes

Rationale

Investment in R&D and innovation is a key driver of productivity. Increasing firm-level productivity is largely acknowledged as one of the most important goals to be achieved through RDI investments (European Commission, 2022b). Hence, both academics and practitioners are increasingly using (longitudinal) data on RDI investments to provide predictive and causal interpretation of productivity gains. In this respect, the OECD/Eurostat's OSLO Manual (OECD and Eurostat, 2018) links to the CDM Model (named after the initials of its authors: Crépon, Duguet, and Mairesse), which is the workhorse model used to explain productivity by innovation output. At the aggregate level, productivity is typically measured by labor productivity and/or total factor productivity (TFP), which is a proxy for technological progress and is computed through an accounting exercise. For example, the GII (World Intellectual Property Organization, 2023) uses Labor productivity growth (%) as a predictor for Knowledge Impact.

Resources

The PNIM will collect project level data on firm-level innovation for firms having benefited from public funds. In addition to this source, INS owns microdata on firms, balance sheet data is available at MoF and other firm-level data is owned by the National Trade Register Office. Eurostat and OECD (Compendium of Productivity Indicators) (OECD, 2024) also provides indicators on productivity.

Value added of RO-RIO

RO-RIO could take a step forward in observing the relationship between innovation and productivity both at firm-level and at the aggregate level. RO-RIO could seek to link firm-level data from the PNIM or from INS to data from MoF and the National Trade Register Office. A firm-level analysis of productivity growth in Romania, as the one carried out by the World Bank in 2019 (Iootty et al., 2019), could be reproduced by RO-RIO to analyze the role of innovation in convergence to the productivity frontier. At the aggregate level, RO-RIO could track progress in labor productivity and TFP by sectors and by Smart Specialization domains based on existing statistical indicators from international data sources: for example, Eurostat's Productivity Indicators include breakdowns by industry, region, and asset, while the OECD's Compendium of Productivity Indicators (OECD, 2024) provides insights on productivity developments based on experimental estimates.

[87] For more information, see https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en.
[88] For more information, see https://euraxess.ec.europa.eu/euraxess/innovation-talent-platform.

Evolution of smart specialization domains

Rationale

There is room for more in-depth analyses of Smart Specialization outcomes and for strengthening synergies between national and regional Smart Specialization. SNCISI has ambitious targets for Smart Specialisation Strategy (S3): by 2027, it is expected that the growth rates in employment, value added and exports in selected S3 domains will be twice as high as the national averages for those domains. Such a target is well aligned with the rationale of Smart Specialization, but it needs complex computations, as most Smart Specialization priorities are defined at the cross-section of different sectors, technologies, and knowledge domains.

Resources

RO-RIO could embark on the challenge of tracking Romanian performance in Smart Specialization domains and link to best European practices in this area. For example, the recently launched S3 Community of Practice Observatory[89] has developed a methodology for the categorization of S3 priorities across different taxonomies (NACE Sections and divisions, NABS codes, Industrial Ecosystems). Such a methodology could be used to analyze evolution and performance of smart specialization ecosystems in terms of growth rates in employment, value added and exports. Moreover, by definition, Smart Specialization links to competitive advantages and to ambitions to climb up value chains. To this end, SNCISI already considers indicators that measure export performance and employment in high and medium-high technology sectors and in knowledge-intensive services. The updated Oslo Manual (OECD and Eurostat, 2018) provides guidance on capturing knowledge flows with the rest of the world and relevant statistics and indicators have been recently developed to capture these effects (i.e., Trade in Value-added and Employment in global value chains (GVCs) databases by OECD).

Value added of RO-RIO

RO-RIO could support the Entrepreneurial Discovery Process (European Commission. Joint Research Centre., 2021) backing the S3 strategies with evidence on evolution of Romania's S3 domains and mapping of knowledge-based competitive advantages or presence in global value chains. RO-RIO could also investigate more closely the complementarities between national and regional Smart Specialization and inform efforts to align S3 objectives and policy instruments. RO-RIO could map indicators of competitiveness and exports from an international comparative perspective. In addition, it could take a step forward and carry out an analysis of participation in global value chains. Analyses of knowledge flows and of their effects could inform the international component of S3 strategies and could facilitate interregional and transnational cooperation in S3 domains.

R&I related societal outcomes

Rationale

The Strategic Research Agendas defined in SNCISI link to the SDGs and to societal outcomes; yet no specific KPIs are defined to track progress towards the sustainability transitions. With directionality (i.e., directing money to clearly identified thematic priorities) staying at the center of modern innovation policy, there is a growing body of work focused on producing targeted

[89] Link to website: https://ec.europa.eu/regional_policy/assets/s3-observatory/index_en.html.

R&I evidence. For example, the European Innovation Scoreboard has recently added a new dimension, namely environmental sustainability, to measure R&I effects. This new dimension captures efforts to increase resource productivity, reduce pollution or foster development of environmental-related technologies. There is also scope for aligning the goals of SNCISI with the R&I objectives of sectoral strategies such as strategies for energy, climate change, environment, agriculture, and health, and with Romania's 2030 Agenda for Sustainable Development.

Resources

RO-RIO could take on board the mission to track Romania's progress in meeting the R&I-related sustainability targets. For example, RO-RIO could provide evidence on environment-related R&D budgets, could track evolution of green patents and the development of environmental-related technologies or join efforts to build specific R&I indicators for national SDGs. It is worth mentioning here that the national SDGs agenda has R&I targets for several development goals (SDG2, SDG4, SDG8, SDG9, SDG15) (National Institute of Statistics, 2023).

Value added of RO-RIO

RO-RIO should bring together all R&I-related targets and indicators from the sectoral strategies (e.g., the National Integrated Plan in the field of Energy and Climate Change 2021-2030, the National Strategic Plan 2023-2027 for Agriculture and Rural Development, the National Strategy for Health 2023-2030, the National Strategy for Circular Economy). RO-RIO could facilitate the harmonization of indicators, build consensus on common indicators, and provide strategic intelligence advice for developing mission-oriented R&I policies.

Appendix 7. User manual for setting up indicator dashboards

This appendix serves as a user manual for setting up indicator dashboards and is targeted towards the RIO staff. This manual explains what a dashboard is, presents the main principles and elements of dashboards, summarizes available software to produce dashboards, and provides guidance and examples on visualization options.

What is an indicator dashboard?

An indicator dashboard is a tool for visually displaying information on a variety of indicators in one place. An indicator dashboard aims to communicate diverse yet interconnected information in a format that is easily comprehensible. It can be used to enhance informed decision-making by presenting complex data in more easily comprehensible formats. For this, dashboards use various elements of visualization, such as tables, charts, and different font and size of text to highlight key numbers, shapes and design illustrating the context or topic being represented. The type of visualization may also be tailored to pre-defined type of users, to ease access to and use of information. An indicator dashboard should allow for aggregating and disaggregating the data on different variables (for example, at different policy levels, by program, by Smart Specialization domain and Strategic Research Agenda, or by type of policy instrument).

Principles/elements of a dashboard

Clarity:

- The dashboard should be easy to understand at a glance: Information provided should be easy to understand when just quickly looking at it (i.e., within 5 seconds)
- Use clear and concise language, avoid clutter, and prioritize important information.
- The content should fit fully on one screen without the need for scrolling
- Use icons only if familiar to the target audience
- Use degrees of change or put single value numbers into context
- Limit the numbers before and after the decimal point where not relevant, e.g., 65 million Euro instead of 65.000.000,00 Euro.
- Avoid detailed tables
- Graphs need to be large enough to be readable
- Graphs need to contain a legend and axis labels and should not be overloaded with value labels
- The scale of the axes should be consistent with other information provided on this matter visible in the same dashboard view
- The scale should not distort the results
- Avoid using circular shapes as they are more difficult to interpret for the human brain
- Do not use different type of graphs just to have variety

Relevance:

- Include only the most relevant data and KPIs that align with the objectives and goals of the dashboard's audience.
- Avoid unnecessary distractions.
- Consider how exceptions or actions required based on the data displayed can be highlighted visually.
-

Consistency:

- Maintain consistency in design, layout, and terminology across different parts of the dashboard to facilitate easy navigation and comprehension.
- Colors concerning the same categories (e.g., men versus women) need to be consistent across graphs.

Visual hierarchy:

- More aggregate information should be provided first and be followed by more detail in the direction that the audience is used to read
- Use visual cues such as color, size, and position to highlight important information and guide the user's attention through the dashboard.
- Consider whether different colors have meanings associated to the information displayed or can be used for signaling

Interactivity:

- Incorporate interactive elements such as filters, drill-down capabilities, and tooltips to allow users to explore the data in more depth and customize their viewing experience.

Accessibility:

- Consider load time of dashboards
- Ensure that the dashboard is accessible to all users, including those with disabilities.
- Use appropriate contrast ratios, text sizes, and alternative text for images.
- Colors should be distinguishable for colorblind people

Context:

- Provide context for the data by including relevant annotations, trends, benchmarks, and comparisons to help users interpret the information correctly.
- The information on the dashboard should tell a story—related information should be provided close to each other.
- Each indicator could be accompanied by a small description of the indicator facilitating the understanding for the user.

User-centered design:

- Design the dashboard with the end-user in mind, considering their needs, preferences, and level of expertise.
- Conduct user testing and gather feedback to refine the design and functionality.

Mobile responsiveness:

- Ensure that the dashboard is responsive and optimized for viewing on various devices, including smartphones and tablets, to accommodate users who may access it on the go.

Transparency:

- Each indicator is accompanied by detailed guidance on how it is measured.
- Information provided should contain the information source if the dashboard presents information originating from various sources.
- Information provided should contain a date when it was last updated.
- The dashboard should provide the option to download the data used in the dashboard.

Software

Various software exists to set up dashboards. Existing software differs in their costs, functionalities, user-friendliness, and interoperability with other software. Table 21 gives an overview of software used by other observatories and organizations for their indicator dashboard.

Table 21 Overview of software used by RIOs and related institutions for their indicator dashboard

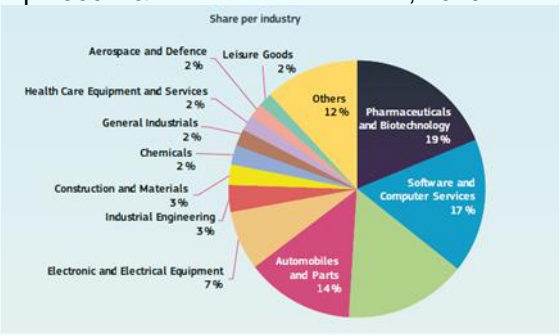
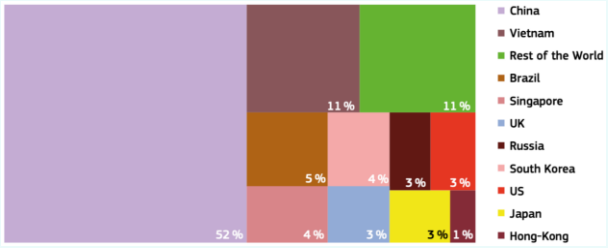
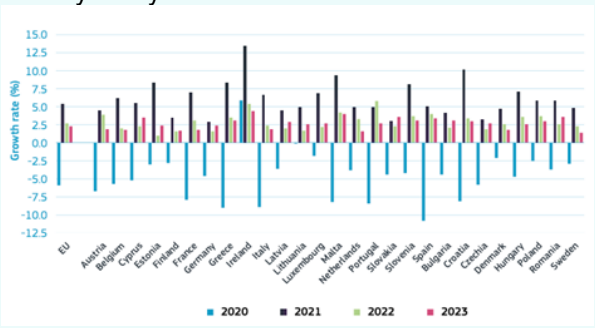
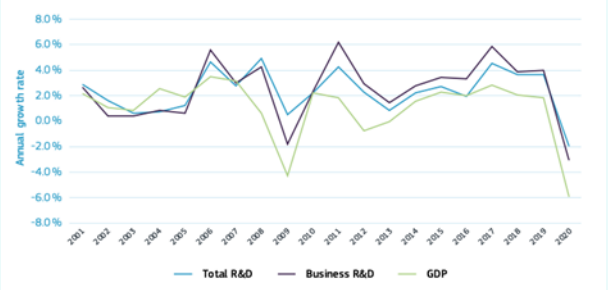
Dashboard Software	Advantages	Disadvantages	Example
Tableau	- User-friendly interface - Robust visualization options - Great for large datasets	- Costly for full functionality	- Chile - Navarra
Power BI	- Integration with Microsoft ecosystem - Good for data modeling and analysis - Scalability	- Limited visualization customization - Performance issues with large datasets	- Colombia - Finland - Portugal
Qlik	- Associative data model for complex analysis - Comprehensive data integration options - Strong visualization capabilities	- Higher pricing for enterprise editions - Resource-intensive for larger datasets	- Horizon Europe Dashboard
Superset	- Open-source and free - Scalable architecture - Integration with various data sources	- Limited support compared to commercial options	- Panama
Grafana	- Open source - Extensive visualization options	- Resource intensive - Complexity for advanced configurations	- Romania

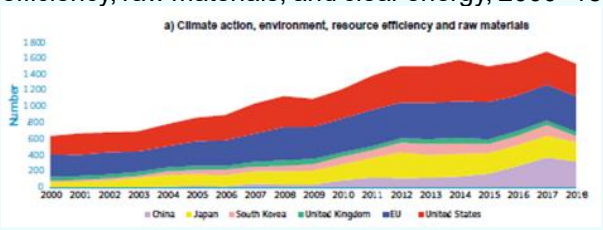
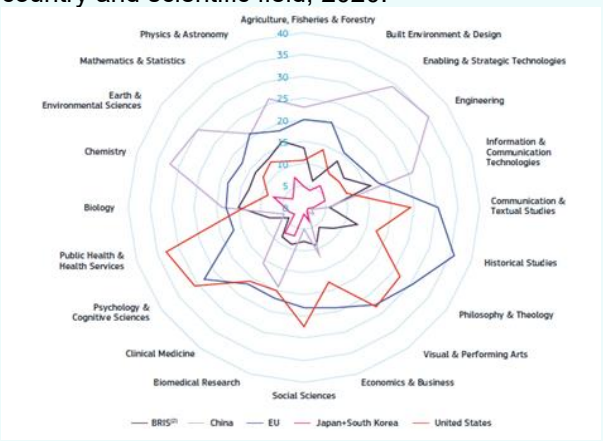
Source: World Bank.

Type of visualization

Charts in dashboards are essential visual tools that translate raw data into intuitive formats, enabling users of all expertise levels to access and interpret complex information effectively. Charts are a fundamental component of dashboards, serving as visual representations of data that enhance accessibility and comprehension for users across various levels of expertise. By translating raw data into intuitive visual formats, charts facilitate the democratization of data access, enabling individuals to engage with and interpret complex information effectively. Various types of charts with different characteristics and purposes are available to be used in dashboards. Table 22 summarizes some of them.

Table 22 Examples of visualization

Type of charts	Description	Example
Pie chart	A pie chart is a circular graphic representation of data in which each segment corresponds to a proportion of the whole, effective for depicting the composition of indicators.	R&D private investments by industry in the EU for the top EU R&D investing companies amongst the top 2500 R&D investors worldwide, 2020.  Source: (European Commission, 2022b)
Tree map	A tree map is a data visualization technique that represents hierarchical data using nested rectangles, with each rectangle's size proportional to a specific attribute such as value or frequency, commonly used to display the hierarchical structure of data and visualize the relative contributions of different categories within a dataset.	Share of EU imports value for identified dependent product (critical materials) by country of origin.  Source: (European Commission, 2022b)
Bar chart	A bar chart is a graphical representation of data that uses rectangular bars to represent the quantities or values of different categories, with the length or height of each bar proportional to the value it represents, commonly used to compare data across categories or over time.	Economic forecast (GDP growth, volume) by country and year.  Source: (European Commission, 2022b)
Line chart	A line chart is a graphical representation of data that uses a series of data points connected by straight lines to show the trends or changes in values over time or across different categories, commonly used to visualize continuous data and identify patterns or trends.	Annual growth rate of EU GDP, Total R&D expenditure, and business R&D expenditure (in constant prices), 2001–20.  Source: (European Commission, 2022b)

Stacked area chart	A stacked area chart is a type of data visualization that represents multiple data series stacked on top of each other. Each data series is typically represented by a colored area, and the areas are stacked in such a way that the cumulative total forms the entire area of the plot. A stacked area plot can illustrate the evolution of an indicator over time, emphasizing relative differences between groups. This graph is recommended when different groups follow a similar trend over time but exhibit sufficiently different performance levels.	Evolution of number of patent applications filed under PCT in climate action, environment, resource efficiency, raw materials, and clear energy, 2000–18.  Source: (European Commission, 2022b)
Spider graphs	Spider graphs (or radar charts) are graphical representations of multivariate data in a two-dimensional plane. They consist of a series of radiating lines, or "spokes," extending from a central point, with each line representing a different variable or category. Spider graphs are valuable for illustrating differences in domain specialization or relative performance in complementary areas. By presenting values for different geographic areas, this graph allows for international comparisons.	World shares (%) of scientific publications per country and scientific field, 2020.  Source: (European Commission, 2022b)
Scatterplot	A scatterplot is a graphical representation of data that uses a collection of points to display the values of two variables, with one variable plotted on the x-axis and the other variable plotted on the y-axis, commonly used to visualize the relationship between two quantitative variables and identify patterns or correlations between them. Highlighting distinct clusters with different colors can emphasize the relative performance of more similar groups.	Labor productivity 2018 and compound annual growth 2010–18 by regional development, to study relationship between productivity levels and productivity growth  Source: (European Commission, 2022b)

Source: World Bank, taking examples from (European Commission, 2022b).

Summary tables with a traffic light system and icons provide succinct information on diverse indicators, complementing other visualizations. Summary tables featuring a traffic light system and icons (see Figure 30) offer concise information on a variety of indicators. This visualization complements rather than substitute other forms of illustration but should be used

judiciously, as its strength lies in providing a wealth of information at once, which can potentially overwhelm and lead to the oversight of important patterns and trends.

Figure 30 Example of a summary table featuring a traffic light system

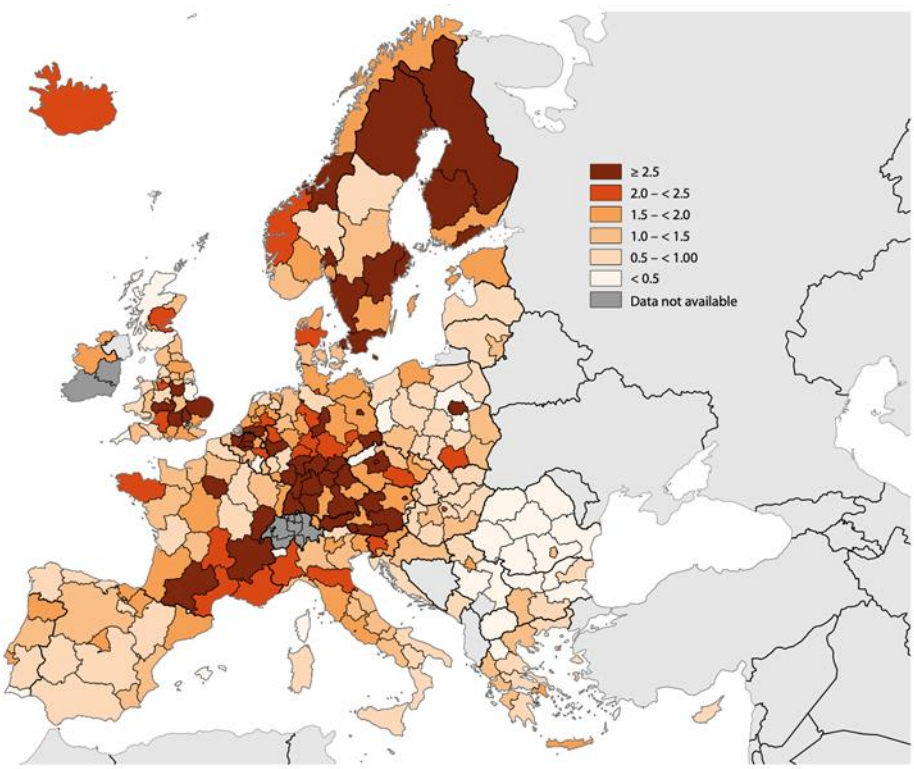
	Indicators	Last available year	EU	Trend	United States	Trend	China	Trend	Japan	Trend	South Korea	Trend
General Indicators	GDP per capita, PPP (constant 2017 international $)	2020[1)]	41504	↗	60236	↗	16411	⇗	41380	↗	42251	⇗
	Share of population aged 65+ (%)	2020	20.6	⇗	16.6	⇗	12.0	⇗	28.4	⇗	15.8	⇗
	Gini coefficient of equivalised disposable income	2019[2)]	0.31	→	0.39	→	0.51	n/a	0.33	n/a	0.35	↘
	CO_2 emissions (metric tons per capita)	2018	6.4	↘	15.2	↘	7.4	↗	8.7	→	12.2	↗
R&D Investment	R&D investment as % of GDP	2019	2.20	↗	3.07	↗	2.23	⇗	3.24	→	4.64	⇗
	Business spending on R&D as % GDP	2019	1.46	↗	2.27	⇗	1.71	⇗	2.57	↗	3.73	⇗
	Public spending on R&D as % of GDP	2019	0.73	→	0.66	↘	0.53	↗	0.63	↘	0.85	↗
Human Resources	Researchers employed per million population	2019	4157	⇗	4414	↗	1340	⇗	5360	↗	7913	⇗
	Population aged 25-34 with tertiary education (%)	2019[3)]	40.5	⇗	50.4	↗	14.0	⇗	61.5	↗	69.8	↗
Scientific Performance	Scientific publications (world share %)	2020	19.6	↘	15.6	⇘	22.4	⇗	3.3	⇘	2.4	→
	Scientific excellence (% of publications within 10% most cited)[*)]	2018	9.9	→	13.3	↘	11.1	⇗	5.8	↘	7.8	→
	International scientific co-publications /million population	2020	783	⇗	759	⇗	126	⇗	335	⇗	549	⇗
	Share of public-private co-publications (%)	2020	9.1	↗	8.4	↘	7.7	⇗	10.7	→	7.9	↘
Innovation Performance	PCT patent applications (world share %)	2018	19.4	⇘	22.0	⇘	20.9	⇗	18.3	→	6.5	↗
	PCT patent applications /million population	2018	106.4	↗	165.1	⇗	36.7	⇗	353.9	⇗	308.7	⇗
	European Innovation Scoreboard (index)	2021[4)]	113	↗	120	⇗	84	⇗	114	⇗	136	⇗
	Number of unicorns	Jul 2021	60	n/a	392	n/a	157	n/a	6	n/a	11	n/a
	Number of companies in Top 100 of the R&D Industrial Scoreboard	2020	26	n/a	35	n/a	10	n/a	15	n/a	4	n/a
Export Capacity	Share of High-Tech and Medium High-Tech Exports (%)	2021[4)]	57.1	↗	53.7	↗	58.1	↗	73.6	→	72.3	↗
	Share of Knowledge-Intensive Services Exports (%)	2021[4)]	67.3	↗	70.8	→	65.9	→	69.3	↘	58.6	→
ICT Sector	Scientific publications (world share %)	2020	17.8	⇘	10.3	⇘	25.9	⇘	2.7	⇘	2.3	↘
	Scientific excellence (% of publications within 10% most cited)[*)]	2018	9.7	↘	12.1	⇘	11.6	⇗	4.9	⇗	8.1	↘
	PCT patent applications /million population	2017	17.9	↗	51.1	⇗	17.4	⇗	80.0	→	101.4	⇗
	PCT patent applications (world share %)	2017	11.0	⇘	22.9	⇘	33.2	⇗	14.0	⇘	7.2	↘
	Business R&D intensity in ICT sector (%)	2019[5)]	5.6	→	10.1	→	6.0	⇗	7.6	↘	21.4	⇗
Climate & Environment Sector	Scientific publications (world share %)	2020	19.8	⇘	10.7	⇘	25.1	⇗	1.8	⇘	2.1	↗
	Scientific excellence (% of publications within 10% most cited)[*)]	2018	13.5	→	15.2	⇘	15.7	⇗	7.8	↘	11.0	↘
	PCT patent applications /million population	2018	0.98	→	1.22	→	0.24	⇗	1.91	⇗	2.77	⇗
	PCT patent applications (world share %)	2018	22.5	⇘	20.5	⇘	16.9	⇗	12.4	↘	7.3	↗
Health Sector	Scientific publications (world share %)	2020	21.0	↘	20.8	⇘	16.6	⇗	3.9	⇘	2.5	↗
	Scientific excellence (% of publications within 10% most cited)[*)]	2018	9.9	↗	13.6	↘	10.8	⇗	5.9	→	8.0	↗
	PCT patent applications /million population	2018	4.7	⇗	13.1	⇗	0.9	⇗	15.0	⇗	13.8	⇗
	PCT patent applications (world share %)	2018	17.4	⇘	35.4	⇘	10.3	⇗	15.7	⇗	5.9	⇗

→	Annual growth between -0.5% and 0.5% (inclusive)
↗ or ↘	Annual growth between 0.5% and 2% or between -0.5% and -2% (inclusive)
⇗ or ⇘	Annual growth above 2% or below -2%

Source: European Commission, 2022b.

Geospatial maps are a critical visual component commonly integrated into dashboards, offering a powerful means of illustrating the spatial relationships inherent in data. By overlaying data onto maps (Figure 31), users can quickly discern spatial patterns, identify hotspots or areas of interest, and gain insights into regional variations or disparities. Interactive features such as zooming, and filtering empower users to explore data dynamically, uncovering spatial correlations and trends that may not be apparent through traditional tabular or chart-based representations alone.

Figure 31 Example of geospatial maps: R&D intensity (Gross R&D investment as % of GDP), 2019 or latest year available



Source: (European Commission, 2022b).

Appendix 8. Case studies of Research and Innovation Observatories and Research Information Systems

Chile: Observatory of the National System of Science, Technology, Knowledge and Innovation (Observa)

Mission

According to Observa's website, the observatory "seeks to collect, standardize, analyze and disseminate in a safe, responsible, fluid and friendly manner all the information that concerns the National System of Science, Technology, Knowledge and Innovation, to support public policy decision-making based on evidence and to inform citizens and relevant actors of the System."

Origins

Observa was designed in 2020 and implemented in 2021 to support the Ministry of Science, Technology and Innovation in its role of analyzing and disseminating data on Science, Technology and Innovation (STI).

The design of Observa was first informed by an initial survey organized in 2020 to better identify the needs of the national system. The survey involved 11 interviews with 35 respondents, including public sector representatives, research groups, consultancy firms, academicians, members of the civil society and gender specialists and international organizations.

Services

The observatory involves data from eight national entities and displays information on 112 indicators, a mapping of 86 instruments and of 47,602 projects, and has conducted 11 webinars to date. The services included in Observa are highlighted in Table 23. Statistics and indicators are the most used products of the observatory.

Table 23 Services provided by Observa

	Services	Included in Observa:
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	■
	Overview of actors of the R&I system	■
	Mapping of available RDI instruments	

	Open data repository, including:	
	Download option of indicators displayed on the website	
	Micro-data from projects monitoring	
	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	
	M&E reports	
	Other publications related to R&I	
	Scientific publications involving a local researcher	
Research and analysis	**Visual analysis of the performance of R&I public funds**	
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	
	International perspective	
	Visual analysis of gender in science	
	Primary data collection	
	Annual reports and in-depth studies on selected topics	
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	
	News and updates on R&I system	
	Feedback form	

Source: World Bank, based on Observa's website and the interview with representatives of Observa

Operational aspects

Governance

The observatory is managed by a ministerial unit of the Ministry of Science, Technology and Innovation. The observatory was designed two years after the establishment of the Ministry, which involved the consolidation of various agencies from different ministries. The creation of one ministry department to oversee the observatory aligned with the broader ministry objective of consolidating information and services in a unified location. This institutional arrangement affords them convenient access to resources and budget flexibility, maintaining a distinct space with its own regulations. This format was chosen for its ease of implementation in the short term and minimized associated risks. However, it bears limitations, including the potential vulnerability to budget reductions from the observatory and a possible short-term perspective.

Staff

The observatory is run by a team of four individuals with diverse expertise in economics, sociology, journalism, visualization, and IT. This core team is primarily responsible for managing the observatory's online platform. Additionally, other members of the Ministry contribute to the efforts by producing statistics on STI. To enhance the IT structure of the observatory, an external IT firm has been engaged. This external firm collaborates with the Ministry's internal IT team to provide support for the platform. While IT profiles were particularly important at the start of the observatory, now the most important profile is that of data analyst.

Funding

In its design phase, the observatory received external funding from the Inter-American Development Bank, which was used for the initial needs assessment. The remaining budget for the observatory is provided by the Ministry and is subject to annual updates.

Networking strategy

The Ministry actively involves target users through various dissemination events, specifically reaching out to users and journalists. They invite them to test the Observa platform, encouraging their contribution to outreach efforts. This effort has resulted in gathering approximately 2,000 email addresses for the observatory's newsletter and 68,000 impressions. However, a notable challenge for Observa lies in expanding its outreach beyond the capital city.

Future developments

The Ministry is currently working on the standardization of sub-national data to disseminate indicators at the sub-national level. In addition to this initiative, the Ministry aims to enhance the search functionality on the observatory's website and introduce a greater automation of its processes. As part of other planned developments, there is an intention to conduct an evaluation of Observa, seeking user feedback through a survey to better understand users' perceptions and further improve the platform.

Challenges

Two main challenges were mentioned during the interview. The first main challenge consisted of reaching agreement between all entities providing data to the observatory. The second main challenge related to the technical aspects of the observatory's website, from the conception of the initial IT infrastructure of Observa's platform to the continuous improvement of its processes.

Success factors

The two main success factors of Observa were the relevance of its services, as it addressed a real need for centralized STI data, and the political support received by this initiative. The observatory stands as a noteworthy product for the ministry, enhancing its reputation. Additional success factors encompass effective visualization, contributing to user engagement, and the establishment of a user community that plays an important role in sustaining and promoting the platform.

Colombia: Colombian Observatory of Science and Technology (OCyT)

Mission

According to OCyT's website, the observatory "strengthen the social capital of Scientific and Technological Research and Development of the country, through the production of information and indicators; contribute to the quantitative and qualitative knowledge of the National Science and Technology System through its weighted representation; and support strategic planning and decision-making processes through a comprehensive interpretation of the dynamics of Science and Technology in the country and its positioning at a regional and global level".

Origins

The observatory was established in 1999 with the initial goal of creating indicators mandated for reporting to international institutions. The need for these indicators arose at a time when there was no existing capacity to fulfill this requirement. Therefore, the idea emerged to create an institution in collaboration with universities and other entities. Although the original focus was on the production of indicators, the observatory evolved and generated a mixed sustainability plan, which includes 30% funding for the production of R&I indicators and 70% self-financing through consulting activities.

Services

OCyT covers a wide range of services, as shown in Table 24. Its main product is the yearly publication of a book of indicators.

Table 24 Services provided by OCyT

	Services	Included in OCyT: ■
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	■
	Overview of actors of the R&I system	■
	Mapping of available RDI instruments	
	Open data repository, including:	
	Download option of indicators displayed on the website	■
	Micro-data from projects monitoring	
	Micro-data from R&I related surveys	■
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	■
	M&E reports	
	Other publications related to R&I	
	Scientific publications involving a local researcher	■
Research and analysis	**Visual analysis of the performance of R&I public funds**	
	Visual analysis of R&I performance, including:	

	National or regional R&I indicators	
	International perspective	
	Visual analysis of gender in science	
	Primary data collection	
	Annual reports and in-depth studies on selected topics	
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	
	News and updates on R&I system	
	Feedback form	

Source: World Bank, based on OCyT's website and the interview with representatives of OCyT.

Operational aspects

Governance

The observatory operates as a private non-profit organization. Its inception took place at a time when there was no dedicated ministry for science and technology. It was initiated by a collaborative effort involving various public institutions from different ministries, territorial levels of governance, and a group of universities. Presently, the Ministry of Science and Technology leads the board of directors, although the observatory maintains full autonomy in its actions. This independence is considered a strength, enabling the observatory to objectively evaluate the performance of universities and research outputs.

Staff

The staff size of the observatory is contingent on the workload but with a technical core team of six individuals, in addition to four administrative staff members. The core team is composed of scientists with expertise in statistical analysis, in bibliometrics, in innovations, and management.

Funding

OCyT was originally financed by the government, but over time, the share of these resources has diminished and currently constitutes around 30% of the total budget. Most of the budget is sourced from project-based contracts with public institutions, both within Colombia and internationally.

Future developments

A part of OCyT's current developments, the observatory is actively engaged in the creation of new indicators, including indicators related to Open Science and gender.

Challenges

OCyT faces challenges in accessing data produced by ministries and the National Statistical Office and in producing regional and local indicators.

Success factors

The observatory has demonstrated over time its technical capabilities and capacities.

Estonia: Estonian Research Information System (ETIS)

Mission

According to the Estonian Research Council, governmental agency of the Ministry of Education and Research, ETIS "concentrates information on research- and development institutions, researchers, research projects and various research results. The Estonian Research Information System is also an information channel for submitting and processing grant applications and for submitting and confirming project reports.".

Origins

ETIS originated from a commission by the Ministry of Education and Research and research funders with the aim of obtaining a comprehensive overview of research funding in Estonia. The initiative also sought to contribute to the digitalization of grant applications and evaluations. In 2001, ETIS started as a small-scale research information system (ERIS), bringing together data from funding bodies and providing a platform for researchers to upload their CVs on ERIS' website. Subsequently, efforts were directed towards the digitalization of grant applications using online forms. Eventually, the Ministry aspired to create a unified national research information system, countering the trend of individual universities developing their own systems to enhance centralization and harmonization of information. The new system was launched in 2006.

Services

ETIS gathers meta-data on a variety of information related to research: researchers, R&D institutions, projects financed by public funds, publications, supervisions, industrial property, collections, scientific equipment, research infrastructure, and products and services brought to the market. ETIS' data comes mainly from researchers themselves, while project data is extracted from applications and reporting directly done on ETIS' platform. Additional information can be added directly by research institutions, such as contracts with Horizon Europe or collaborations with private companies. ETIS is linked with other national systems, allowing to extract information from these other sources (e.g., information on university degrees). ETIS also feeds information into a separate platform, ADAPTER, aimed to foster public-private linkage by supporting private companies in finding relevant research partners. ETIS services go beyond that of a traditional research information system by incorporating visualization of national R&I indicators in comparison with international levels. Table 25 illustrates the services covered by ETIS that can be compared with services identified for RIOs.

Table 25 Services provided by ETIS

	Services	Included in ETIS: ■
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	
	Overview of actors of the R&I system	■
	Mapping of available RDI instruments	■
	Open data repository, including:	
	Download option of indicators displayed on the website	■
	Micro-data from projects monitoring	■
	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	
	M&E reports	■
	Other publications related to R&I	■
	Scientific publications involving a local researcher	■
Research and analysis	**Visual analysis of the performance of R&I public funds**	■
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	■
	International perspective	■
	Visual analysis of gender in science	■
	Primary data collection	■
	Annual reports and in-depth studies on selected topics	
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	■
	Methodology for indicators construction	■
	News and updates on R&I system	■
	Feedback form	■

Source: World Bank, based on ETIS's website and the interview with representatives of ETIS.

Operational aspects

Governance

ETIS is owned by the Ministry of Education and Research and managed by the Estonian Research Agency. The governance model's advantage lies in its backing by the ministry and adherence to legal documents, ensuring a solid foundation for effective oversight and decision-making. The governance of ETIS involves a Steering Committee, led by the ministry and including representatives from major universities. Currently undergoing a relaunch, the committee plans to expand its composition to include an IT research representative and a member from other ministries for broader perspectives. This committee convenes annually to assess needs, vote on priorities, and define the development plan for the upcoming year.

Staff

Within the Estonian Research Council, a team of three are dedicated to ETIS, including managing its help desk, the review of information from smaller institutions and researchers

abroad, and daily communication with an external software company to relay needs and address metadata gaps. The ETIS staff collaborates with a software company employing 2.5 programmers dedicated to the system's new developments. This collaboration, facilitated through tenders by the ministry, has endured for over a decade.

The team boasts a diverse background, featuring a psychologist adept in database work, a theoretical physicist responsible for data queries and dynamic application routes, and an historian primarily engaged with the software company, focusing on needs description and data analysis, particularly in data visualization.

Funding

Most of ETIS' budget comes from the Ministry of Education and research. This budget is complemented with European Structural Funds, dedicated to the development of specific modules of ETIS' platform.

Future developments

Future developments in ETIS are driven by user requests, primarily from funding bodies but extending beyond them. Ongoing projects include incorporating details about research infrastructure and enhancing features for browsing ethical committee applications. Looking ahead, one of ETIS's objectives is to integrate information from other ministries, such as the Ministry of Culture, which also contribute funds to research initiatives.

Challenges

The first challenge encountered by ETIS involved overcoming initial resistance from universities to share their data. To address this, ETIS developed an encryption system and enabled users to determine which data becomes public. Despite this solution, ongoing discussions and negotiations with other line ministries remain a persistent challenge.

The second challenge emerged during the creation of a new website version in 2016 aimed at enhancing online tool speed and efficiency. However, numerous bugs prolonged the process, lasting almost three years before achieving a smoothly functioning system.

Success factors

ETIS has achieved success through a combination of strategic factors. Firstly, its design aligns with real workflows, ensuring practicality and relevance in its applications. Secondly, it significantly reduces the reporting burden for research institutions and researchers, streamlining processes related to grant applications and evaluations of research institutions. The legal mandate compelling universities to contribute to ETIS serves as a foundational element, securing their participation and commitment. Additionally, ETIS's commitment to public transparency, allowing citizens access to project data, meets the growing demand for openness and clarity in funding decisions. The initiative also capitalized on the right timing, taking advantage of Estonia's digital readiness. Lastly, the well-developed classification schemes for publications within ETIS contribute to efficient organization and retrieval of information, enhancing the system's overall effectiveness.

Finland: Finnish Research Information Hub (Research.fi)

Mission

According to Research.fi's website, Research.fi "collects and shares information on research conducted in Finland. The service improves the location of information and experts on research and increases the visibility and societal impact of Finnish research.".

Origins

The key insight behind Research.fi was the need to have the same metadata available in a multitude of unconnected systems within researcher's workflow, i.e. to enable interoperability. High quality metadata on scientific publications was already collected for the generation of various indicators tied to universities' funding. The development of the Finnish Research Information Hub started in 2017, and Research.fi serving as its public face, was officially launched in 2020, Previously, this research metadata had been collected since 2011 but lacked of a unified system. Additionally, a small independent service was launched to collect funding call information in 2013. In 2015, the Finnish ORCID consortium was set up to aid researchers keeping ORCID-ID voluntarily. The National Research Information Hub built on these initial initiatives in addition to long-time and comprehensive co-operation between higher education institutions, funders, the government and its operating institution.

Services

Research.fi serves as a central hub for metadata on various aspects of scientific endeavors in Finland. This includes information on researchers, research publications, projects funded by both public and private sources, research infrastructure, and research organizations. The service goes beyond by providing details on funding calls and open access to research data, based on researchers' own initiative. Moreover, Research.fi offers information and interactive visualizations on the monitoring of Open Science and research in Finland, along with the performance of science and research. This window into Finnish research adds on the key contribution of the research information hub, that is to enable information flows on research activities. Table 26 highlights the services provided by Research.fi, allowing for a comparison with the services identified for RIOs.

Table 26 Services provided by Research.fi

	Services	Included in Research.fi: ■
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	■
	Overview of actors of the R&I system	■
	Mapping of available RDI instruments	
	Open data repository, including:	■
	Download option of indicators displayed on the website	■
	Micro-data from projects monitoring	

	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	
	M&E reports	
	Other publications related to R&I	
	Scientific publications involving a local researcher	
Research and analysis	**Visual analysis of the performance of R&I public funds**	
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	
	International perspective	
	Visual analysis of gender in science	
	Primary data collection	
	Annual reports and in-depth studies on selected topics	
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	
	News and updates on R&I system	
	Feedback form	

Source: World Bank, based on Research.fi's website and the interview with representatives of Research.fi.

Operational aspects

Governance

Research.fi was commissioned by the Ministry of Education and Culture and is operated by CSC – IT Center for Science, a state- and university-owned Science Information Technology Center. The governance of the Research Information Hub is overseen by a steering group, comprising representatives from higher education institutions, research institutes, other research organizations, and research funders.

The parliament of Finland passed an Act of the Research Information Hub in the beginning of 2021. The act simplified the field defining the content, purposes and utilization of metadata as well as addressing the GDPR issues of personal data included in the metadata.

Staff

The Research.fi team consists of a person under the ministry overseeing the project, a steering group with approximately 5 meetings annually to discuss vision and development direction, and 10-15 individuals from CSC, including 3 coordinators. These coordinators not only manage coordination with a large variety of stakeholders of the Research Information Hub – with a Steering committee including representatives from 37 universities and universities of applied sciences, 12 research institutes, all public funders and private foundations and a few research actors not included in these groups, but also play a role in defining new functions within the portal.

The staff at CSC comprises individuals with master's and doctoral degrees, including 2-3 developers and an architect of the data infrastructure. Additional IT staff are hired from partner companies to address areas outside their expertise. The team boasts diverse backgrounds,

ranging from physics to humanities and arts, with a common thread of experience in metadata collection, research metadata, university settings or science communication.

Funding

Research.fi is funded by the Ministry of Education and Culture through an annual contract with CSC. In addition to this budget, European funds are secured for specific services provided by the platform.

Future developments

Research.fi's upcoming development plan includes the better integration of metadata on research infrastructure, including defining what data should be collected and reported on. Additionally, there are plans to enhance researchers' profiles to better showcase their interests and expertise. Both services aim to assist private companies in identifying relevant expertise and services within the research domain. Another planned development is to have a two-way API allowing research actors to directly input information into the hub.

Challenges

An initial challenge for Research.fi was aligning data from diverse data warehouses. A valuable lesson learned from this experience is the importance of prioritizing systems interoperability and early efforts to connect the research information system internationally. Another ongoing challenge involves maintaining effective coordination with all stakeholders participating in this initiative.

Success factors

The success of this initiative was facilitated by having all key success factors already established. Another crucial success factor was fostering sufficient cooperation and dialogue with all relevant interest groups from the outset, leading to consensus on the goals of the Research Information Hub. Additionally, the Hub's key objective and clear added value to the ecosystem is to enable researchers and research organizations to input information once, which can then be reused multiple times for tasks such as applying for funds, reporting on research results, or evaluations, significantly reducing researchers' reporting burden. This objective is met through an API allowing research actors to directly get research metadata into their own systems.

France: Science and Technology Observatory (OST)

Mission

OST is a department of Hcéres, the High Council for Evaluation of Research and Higher Education, a publicly funded independent agency. According to Hcéres' website, OST "produce scientometric indicators and analyzes of R&I systems in order to contribute to: the knowledge of R&I activities in France and around the world; the evaluation of research and transfer activities; the evaluation of R&I policies.".

Origins

The observatory, established in 1995, initially operated as a publicly funded independent entity with a primary focus on monitoring the performance of universities and research organizations. Its core mission involved developing tailored and reliable indicators based on scientific publications, making significant contributions to the field of bibliometrics. In 2015, it has been integrated into Hcéres. While maintaining its historical mission, the observatory expanded its role to contribute to the evaluation processes of research and higher education in France.

Services

Being a department of Hcéres, OST does not have a separate website. OST's primary products include the annual production of indicators for the Ministry of Higher Education and Research and for about 120 higher education institutions. OST's in-depth studies are conducted as a contribution to Hcéres evaluation processes (universities, research organizations). OST also produces thematic studies on the international position of France or on methodological issues. Any organization, from publicly funded to the private sector, can benefit from OST expertise in the form of tailored studies. OST's reports and thematic studies are published either on Hcéres' website or in scientometric journals.

Operational aspects

Governance

Since 2015, OST has functioned as a department within Hcéres. This integration was prompted by statutory motives and opportunity. It also proved beneficial in leveraging the expertise of OST staff to serve Hcéres' mission effectively. The activities of OST are overseen by a scientific observatory board comprising 12 members, including experts in the field (academicians) and users of the indicators (universities and research organizations). Due to the limited number of experts in scientometrics, the board includes a notable proportion of international members. The board advises on both technical and strategic matters.

Staff

The OST team consists of 16 members and four scientific advisors. Leveraging long-term experience, the team is highly skilled and brings a wealth of expertise to its work. Approximately half of the staff holds a Ph.D. degree, and while their backgrounds are diverse, a majority have expertise in economics, particularly in the realms of science and innovation, and possess extensive experience in handling data. The team's core competencies include bibliometrics, computer science and programming skills, statistics, and analytical capabilities.

Funding

As a department within Hcéres, OST's budget is part of Hcéres' budget. A portion of OST activities relies on external contracting with public institutions, the policy sector or research organizations, including funding agencies.

Challenges

A significant challenge currently faced by OST is the transition from relying on commercial data sources of scientific publications to embracing open data sources. The team works both on the French archive HAL and on OpenAlex. In April 2024, OST hosted an international seminar on the broadening of data sources for bibliometrics; the synthesis is on the website: https://www.hceres.fr/en/publications/broadening-data-sources-bibliometric-analyses-recent-results-and-further-developments .

Success factors

The primary success factor for the observatory lies in the expertise it has cultivated over time, establishing itself as a leading authority in the field of scientometrics. As a result, OST produces studies for various actors of the French national research and innovation system.

Panama: Science, Technology and Innovation Observatory of Panama (OPCyT)

Mission

Established in 2023 and officially launched in May 2024, the observatory's role is to collect and maintain information on the national science and technology system.

Origins

The National Secretariat of Science, Technology, and Innovation (SENACYT) has been responsible for collecting and producing indicators on R&I for nearly two decades. Recognizing the need to enhance their capabilities, SENACYT decided to move to a second level where they could integrate and complement this information with other services to better support the innovation system. Identifying a lack of a platform and a comprehensive offer for both internal use (within the innovation system) and external use (e.g., for international allies), SENACYT initiated a prioritization workshop. This workshop involved stakeholders from the system to understand the most relevant topics, missing information that the observatory could provide, regional priorities within Panama, and national or international subjects deemed important for the observatory to analyze.

Services

OPCyT is in its early stages of development. The initial services provided by OPCyT are detailed in Table 27. An interesting initiative involves the training of human capital in the regions on data collection and analysis. This training initiative aims to build local capacity and enhance the effective utilization of the observatory's resources and information.

Table 27 Services provided by OPCyT

	Services	Included in OPCyT: ■
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	
	Overview of actors of the R&I system	
	Mapping of available RDI instruments	
	Open data repository, including:	
	Download option of indicators displayed on the website	■
	Micro-data from projects monitoring	
	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	■
	M&E reports	
	Other publications related to R&I	■
	Scientific publications involving a local researcher	
Research and analysis	**Visual analysis of the performance of R&I public funds**	
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	■
	International perspective	
	Visual analysis of gender in science	■
	Primary data collection	■
	Annual reports and in-depth studies on selected topics	■
Informing and dissemination	**Dissemination workshops and capacity building**	■
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	
	News and updates on R&I system	■
	Feedback form	■

Source: World Bank, based on the observatory's website and the interview with representatives of OPCyT.

Operational aspects

Governance

Given the incipient nature of the innovation system in Panama, SENACYT recognized the need for the observatory to be institutionally hosted within SENACYT initially. The goal is for the observatory to grow, mature, and eventually become an autonomous entity within the Panamanian government. Operating within SENACYT's structure provides the observatory with relevance and recognition from stakeholders and companies. Additionally, the observatory can leverage SENACYT's 15-20 years of experience in data collection and the support received from international entities and experts. While plans include making it an independent structure, specific details regarding this transition are yet to be defined.

Staff

Currently, one full-time employee from SENACYT is dedicated to the observatory, supervised by a more senior expert. SENACYT encounters the challenge of incorporating new human resources and strengthening personnel in highly specialized areas required for the expanded scope of work of the observatory.

Funding

Initially, securing resources from the Ministry of Economy and Finance posed challenges, but SENACYT successfully obtained the necessary funding, marking a significant achievement. With an initial budget covering one and a half years, they strategically invested in technologies for data management.

Future developments

The implementation of the observatory is planned in three distinct phases with specific objectives and time limits:

i. Institutional Framework: This phase involves the definition of agreements and strategies to establish the foundation of the observatory.

ii. Required Structure: In this stage, nodes will be formed with entities possessing statistics, alliances will be established, and there will be a focus on strengthening personnel to build the necessary structure for the observatory.

iii. Monitoring and Follow-Up: Once the observatory is operational, this phase entails continuous assessment to identify areas that need correction and improvement, ensuring its ongoing effectiveness.

Challenges

SENACYT faces challenges in the collection of relevant data, historically experiencing low response rates to outsourced R&I surveys. To address this, they internalized data collection, leveraging SENACYT's higher level of trust among survey respondents. However, a persisting challenge lies in collecting data from other entities. Despite collaboration agreements in place, the process has been slow to set up, and operational challenges remain in obtaining data in a timely manner from these entities.

Success factors

A key success factor for the observatory is the collaboration between SENACYT and the National Institute of Statistics and Census of Panama. This collaboration involves support from both entities in the collection of innovation statistics. The National Institute of Statistics and Census assists the observatory in validating survey instruments and revising manuals. Importantly, they also play a role in certifying and validating the Science and Technology

indicators collected for the observatory, enhancing the overall credibility and accuracy of the data.

Portugal: Directorate-General for Education and Science Statistics (DGEEC)

Mission

According to the Directorate General for Education and Science Statistics' (DGEEC) website, DGEEC has the mission "of ensuring the production and statistical analysis of education and science, technically supporting the formulation of policies and strategic and operational planning, observing and globally evaluating the results obtained by the systems educational and scientific and technological, in conjunction with other services in the government areas of science, technology, higher education and education."

Origins

Since 1995, Portugal has had several science and technology observatories, which were eventually integrated into DGEEC. DGEEC, a delegated entity of the National Statistical Office, has the mandate to collect and produce official statistics on education (all levels of education, including higher education) and science. The first observatory (Observatory of Science and Technology) in Portugal was initiated by the Ministry of Science and Technology in 1995 to reform and structurally change statistical production on R&I. Another observatory (Observatory of Science and Higher Education) extending its focus on higher education was created in 2003, at the time of the integration of higher education into the Ministry. Its role was taken other by the DGEEC at its creation in 2012, following change in central administration. In 2011, an observatory on science, technology, and qualifications was established to advise the yet-to-be created DGEEC, to monitor its statistics production and study the national scientific capacity. This observatory, functioning until 2017, facilitated collaboration between DGEEC and the scientific community, broadening coverage, cross-referencing data, and exploring expectations beyond official statistics.

Services

DGEEC's primary function is to collect, monitor, process, produce and disseminate statistics on science and education. The services available on DGEEC's website are summarized in Table 28.

Table 28 Services provided by DGEEC

	Services	Included in DGEEC: ■
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	
	Overview of actors of the R&I system	
	Mapping of available RDI instruments	
	Open data repository, including:	

	Download option of indicators displayed on the website	
	Micro-data from projects monitoring	
	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	
	M&E reports	
	Other publications related to R&I	
	Scientific publications involving a local researcher	
Research and analysis	**Visual analysis of the performance of R&I public funds**	
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	
	International perspective	
	Visual analysis of gender in science	
	Primary data collection	
	Annual reports and in-depth studies on selected topics	
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	
	News and updates on R&I system	
	Feedback form	

Source: World Bank, based on DGEEC's website and the interview with representatives of DGEEC.

Operational aspects

Governance

The observatory of science, technology, and qualifications (2011-2017) was a collaborative effort with the Foundation of Science and Technology. It was supported by a scientific council comprising internationally renowned experts in the observatory's focus areas.

The DGEEC operates as a delegated entity of the National Statistical Office, overseeing responsibilities related to education and science statistics in Portugal.

Staff

DGEEC benefitted from a substantial history of enhancing R&I statistics in Portugal. Since the inception of the first observatory in 1995, there were concerns about the formation of human resources dedicated to this work. To address this, various forums were established for debates and discussions with similar entities in other countries engaged in statistical production in this field. Meetings and visits to different R&D units were organized to observe organizational structures and R&D practices. Presently, DGEEC has a workforce of nearly 70 individuals dedicated to their mission.

Funding

The primary funding source for DGEEC is the government budget, supplemented by funds from the EC (through projects).

Challenges

Acquiring relevant knowledge and sufficient skills has been a key challenge, successfully overcome, for the Portuguese observatories.

Success factors

One of the success factors for DGEEC is its openness to the scientific community, sharing data and results not only within the ministry but also with researchers, students, and technicians. This transparency is crucial to showcase the diverse purposes and applications of the statistics they produce or collect daily. DGEEC has established protocols to share anonymized data with researchers and Ph.D. students in a safe center environment, enhancing collaborative efforts.

Another success factor stems from DGEEC's active participation in multiple international working groups, including those within OECD, Eurostat, and the EC. This engagement allows DGEEC to share lessons learned, discuss challenges, and stay informed about international best practices in the realm of education and science statistics.

Spain: Innovation Observatory of Navarra (Mira la I - Begira)

Mission

According to the observatory's website, its mission consists in "continuously analyzing the reality of R+D+i in Navarra, monitoring the execution of the Science, Technology and Innovation Plan 2021-2025 as well as measuring the impact of the public policies defined by Navarra's Regional Law on Science and Technology".

Origins

The idea for a regional observatory in Navarra, Spain, originated from the 2018 Law of STI. This law emphasized the importance of annual reports with STI statistics to assess and improve the region's performance in science and technology. In 2022, the regional government implemented the observatory, a website providing insights into their STI efforts. It goes beyond reporting by allowing everyone in the regional STI community to observe government actions, track progress, and showcase their initiatives, both within Navarra and beyond.

Services

The services included in the observatory are highlighted in Table 29. The primary products utilized from the observatory are the indicators and dedicated portals. The observatory's website presents data on 30 indicators grouped into six pillars through a user-friendly dashboard. The observatory caters to different user groups (companies, citizens, public administration, Navarra RDI system agents) with specific entry points. This allows users to easily find services, whether internal or external to the observatory, that are most relevant to them.

Table 29 Services provided by the Innovation Observatory of Navarra

	Services	Included in Mirala I – Begira:
Centralizing	**Overview of the R&I system, including:**	
	Overview of the governance structure of the R&I system	
	Overview of actors of the R&I system	■
	Mapping of available RDI instruments	■
	Open data repository, including:	
	Download option of indicators displayed on the website	■
	Micro-data from projects monitoring	
	Micro-data from R&I related surveys	
	eLibrary of reports and publications in R&I, including:	
	Key legal documentation on R&I policies	■
	M&E reports	■
	Other publications related to R&I	■
	Scientific publications involving a local researcher	
Research and analysis	**Visual analysis of the performance of R&I public funds**	■
	Visual analysis of R&I performance, including:	
	National or regional R&I indicators	■
	International perspective	■
	Visual analysis of gender in science	■
	Primary data collection	
	Annual reports and in-depth studies on selected topics	■
Informing and dissemination	**Dissemination workshops and capacity building**	
	Knowledge base for evidence-based decisions in R&I, including:	
	Methodology for data collection	
	Methodology for indicators construction	■
	News and updates on R&I system	■
	Feedback form	■

Source: World Bank, based on Innovation Observatory of Navarra's website and the interview with representatives of the Innovation Observatory of Navarra.

A key focus of the observatory is addressing gender disparities, with active collaboration with the coordination body of the RDI ecosystem (ADItech) to integrate a gender perspective into research projects. The observatory also serves as a centralized hub for information on policies, tools, calls, activities, and training related to innovation in Navarra.

Operational aspects

Governance

The observatory operates within the government of Navarra and is overseen by its technical group. This group comprises representatives from key institutional entities within the regional R&I ecosystem. These include the regional statistical office (Navarra Institute of Statistics), the Smart Specialization for Sustainability (S4) Strategic Projects Service, a regional observatory of social reality, the RDI funding agency (SODENA), and the coordinator of the RDI ecosystem (ADItech).

Staff

The observatory's coordination is led by a designated individual within the Navarra government, supported by a team of 12 technical group members, supplemented with external staff as required. The team comprises three essential profiles: data analysts and sociologists for information translation, and IT professionals.

Funding

The entire budget for the observatory comes from the government of Navarra.

Future developments

Future developments for the observatory include efforts to develop tools better suited to the needs of private companies. Additionally, there are plans to introduce new indicators, encompassing areas such as public investment, ecosystem evolution, science and citizenship, and the automation of grant evaluations. The expansion of comparability beyond Europe represents another future objective of the observatory, alongside increased efforts in disseminating their work.

Challenges

A key challenge of the observatory lies in establishing a clear connection between policies and resources and their ultimate impacts. Another challenge involves fostering a cultural shift towards greater use of data in decision-making processes.

Success factors

One crucial success factor, as highlighted in the interview, is the participative approach of the observatory. Involving representatives from key R&I stakeholders in the technical group ensures guidance based on their needs and diverse perspectives, providing a comprehensive view of R&I. Despite taking three months to establish initial agreements and clarify expectations, the resulting product proved valuable for all, emphasizing the stakeholders' recognition of the observatory's value, which was crucial for their engagement.

The second important success factor consists of the observatory's normative support. The legal framework mandates key institutional actors to contribute to the observatory's efforts. This combination of normative support and committed collaboration were essential to the observatory's effectiveness.

Appendix 9. Recruiting profile for RO-RIO staff

Disclaimer

The following draft terms of reference are to serve as a guideline to MCID in the recruiting process for RO-RIO's staff members, and it is advised that they are reviewed internally with MCID's Human Resources Services to guarantee that it is in line with current recruiting mandates.

Draft Terms of Reference

Position title: **Manager**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I), by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting the Manager for the Research and Innovation Observatory. This role is central in guiding, managing, and executing projects, ensuring the quality and relevance of services and products, and fostering a culture of rigorous analysis and critical thinking within the team. The ideal candidate will bring clear leadership and managerial skills, an innovative mindset, a tech-driven approach on research and a proven track record of communication with policy makers and academia or private sector actors.

The Manager will have the following responsibilities:

- Lead the observatory team in performing its functions of centralizing, analyzing, and disseminating information on R&I and productivity.
- Report to the observatory's steering committee in terms of the strategic direction, management, and results of the observatory.
- Oversee the execution of the observatory's projects, development of services and product delivery.
- Allocate resources effectively, including staff, budget, and assets, to support the observatory's objectives and optimize efficiency.
- Act as the head of communication of the observatory, leading its engagement with senior parties in the Romanian Government and in European Union institutions, universities, research institutes, regional development agencies, private sector associations, citizens, and media

APPENDIX 9

Selection Criteria
The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Education
Required education:

- Bachelor's degree in sciences, social sciences, economics, statistics, or engineering.

Desirable:

- Master's or Ph.D. in management, economics, statistics, engineering, sciences, social sciences, and related fields.

Competences and skills

- 8 years of leadership roles in technology, product development or consultancy.
- Experience in agile management or similar methods.
- Exposure to data science or quantitative analytics.
- Proven ability to communicate effectively with stakeholders and media.

Conditions
Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

APPENDIX 9

Draft Terms of Reference

Position title: **Research and Analysis Leader**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting a Research and Analysis Leader for the Research and Innovation Observatory. This position will report directly to the Manager of the observatory and will oversee the work of two staff positions. The ideal candidate will bring clear project management skills, a deep understanding of research methods, and a tech-driven approach for product or service development.

The Research and Analysis Leader will have the following responsibilities:

- Lead the analyzing function of the observatory, providing support to the research and data analytics team, and shaping the development of services, website features and knowledge products.
- Oversee the planning, execution, and completion of the observatory's projects and development of services, ensuring adherence to timelines, budgets, and quality standards.
- Foster a culture of excellence in research and analysis, promoting rigorous methodologies and data integrity.
- Develop partnerships and collaborations with external stakeholders, including researchers in academia, government bodies, and international organizations.

Selection Criteria

The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Education

Required education:

- Ph.D. in economics, statistics, engineering, sciences or related fields

Competences and skills

- Proficiency in data science or quantitative analytics.
- Formal training in econometrics or statistical modelling.
- Basic proficiency in programming languages (for example, R or Python) and query languages (such as SQL).

Conditions

APPENDIX 9

Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

APPENDIX 9

Draft Terms of Reference

Position title: **Science and Communications and Outreach Specialist**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting a Science, Communications and Outreach Specialist for the Research and Innovation Observatory. This position will report directly to the Manager of the observatory and will be key in enhancing the visibility and engagement of the observatory with diverse audiences, including policymakers, researchers, media, and citizens. The ideal candidate will bring strategic communications skills, social media management experience, outreach management abilities, and a clear understanding of scientific and innovation terms and language to help amplify the observatory's analysis and services to a greater audience.

The Science, Communications and Outreach Specialist will have the following responsibilities:

- Develop and implement comprehensive communication strategies to promote the mission and initiatives of the observatory.
- Identify target audiences in the Romanian Government, European institutions, academia, regional agencies, private sector associations, and citizens, to tailor messaging and communication channels and effectively engage them.
- Manage the observatory's digital presence, including collaboration in the production of website content, blog posts, and social media channels.
- Oversee the production of printed and digital publications, including the observatory's annual report, in-depth reports, policy briefs, newsletters, and promotional materials.
- Plan, organize, and promote events, workshops, and digital meetings according to the observatory's objectives and workplan.
- Monitor media coverage and news regarding actors in the R&I system, to inform communication strategies and feed the observatory's newsfeed.

Selection Criteria

The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Competences and skills

Required:

- Proven track record of communication and networking roles.

- Exposure to topics related to science, technology, and innovation (R&D, technology, innovation, entrepreneurship, etc.)
- Ability to communicate effectively with stakeholders and media.

Desirable:

- Proficiency in social media management tools, including user feedback methods.

Conditions

Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

APPENDIX 9

Draft Terms of Reference

Position title: **Data Manager**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background
The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility
As part of the process to build the observatory's structure and team, MCID is recruiting a Data Manager for the Research and Innovation Observatory. This position will report directly to the Manager of the observatory and will oversee the work of one additional staff position. The ideal candidate will be able to effectively oversee the collection, storage, quality assurance and integrity of the data centralized by the observatory.

The Data Manager will have the following responsibilities:
- Develop and implement data management policies, procedures, and standards to ensure an optimal handling of data throughout its lifecycle.
- Design and maintain databases, data repositories, and metadata catalogs to facilitate data retrieval, and interoperability.
- Implement quality control measures to monitor and assess the accuracy, completeness, and consistency of data.
- Provide technical expertise and support to the observatory staff in accessing and querying data using appropriate tools and software.
- Collaborate with data providers in the Romanian Government and external partners to address data quality issues and improve data collection processes.

Selection Criteria
The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Competences and skills
Required:
- Proficiency in API design principles and data exchange formats.
- Experience in Python or Java.
- Experience in data modeling, indexing, and optimization techniques.

Conditions
Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

Draft Terms of Reference

Position title: **Researcher**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting a Researcher for the Research and Innovation Observatory. This position will report to the Research and Analysis Leader, and its role is central in advancing knowledge about the performance of the Romanian R&I system, conducting research, and contributing to the observatory's function of analysis and dissemination. The ideal candidate will bring a deep understanding of research methods and strong communication skills to produce the publications and products of the observatory.

The Researcher will have the following responsibilities:

- Collaborate in the design of the observatory's features, including website interfaces, dashboards, and database user interaction features.
- Collaborate with the observatory staff to understand questions, hypotheses, and research requirements, translating them into analytical tasks.
- Plan and execute research projects in alignment with the observatory's quality standards.
- Analyze data using appropriate statistical and analytical techniques.
- Prepare research drafts, inputs for the annual report and in-depth publications, and presentations on the analysis of the observatory.

Selection Criteria

The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Education

Required education:

- Bachelor's degree in economics, social sciences, statistics, or engineering.

Desirable:

- Master's in economics, statistics, engineering, sciences, social sciences, and related fields.

Competences and skills

- Proficiency in quantitative analytics.
- Formal training in econometrics or statistical modelling.
- Basic proficiency in programming languages (for example, R or Python).

Conditions

Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

Draft Terms of Reference

Position title: **Data Scientist**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting a Data Scientist for the Research and Innovation Observatory. This position will report to the Research and Analysis Leader, and its role is central in leveraging data analytics techniques to extract insights and to design and deploy the observatory's services. The ideal candidate will bring an innovation mindset, deep understanding of data science analysis and computational methods (including machine learning and other AI techniques), and management of large and complex datasets.

The Data Scientist will have the following responsibilities:

- Collaborate in the design of the observatory's features, including website interfaces, dashboards, and database user interaction features.
- Collaborate with the observatory staff to understand questions, hypotheses, and data requirements, translating them into actionable data science tasks.
- Explore and visualize data using descriptive and exploratory analysis techniques.
- Apply computational methods, including machine learning algorithms and AI techniques, to optimize data collection processes, extract insights from data, and help automate the observatory's services and reports.

Selection Criteria

The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Education

Required education:

- Bachelor's degree in economics, sciences, statistics, or engineering.

Desirable:

- Master's in economics, statistics, engineering, sciences, and related fields.

Competences and skills

- Proficiency in data science methods, including formal training in data analysis or management tools (such as data scraping or machine learning)
- Proficiency in programming languages (for example, R or Python) and query languages (such as SQL)

Conditions

Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

Draft Terms of Reference

Position title: **IT Professional**
Unit: **Research and Innovation Observatory**
Location: **Bucharest, Romania**
Type of appointment: **[TBD] Fixed / Permanent**
Estimated starting date: **[TBD]**
Closing call date: **[TBD]**
Language: **Romanian** (oral and written required) and **English** (oral and written required)

Background

The Ministry of Research, Innovation and Digitalization (MCID) has established a Romanian Research and Innovation Observatory. The observatory's mission is to provide rigorous evidence and promote its use in policy decision-making in the fields of research & innovation (R&I) and productivity areas, by centralizing, analyzing, and disseminating statistical data from national and international databases. By performing these functions, the observatory provides stakeholders in Romania with better access to relevant data and specialized knowledge on R&I and productivity trends, actors, funding, and performance.

Roles and Responsibility

As part of the process to build the observatory's structure and team, MCID is recruiting an IT Professional for the Research and Innovation Observatory. This position will report to the Data Manager, and its role is central in managing, maintaining, and optimizing the IT infrastructure and systems necessary for the observatory's website and operations. The ideal candidate will bring proficiency in front-end programming languages, deep knowledge of visualization tools and website management, technical support skills, and ability to optimize IT resources.

The IT Professional will have the following responsibilities:

- Plan and execute the development and deployment of features in the observatory's website and data architecture, including data visualization and interaction features.
- Manage and maintain the observatory's IT infrastructure, including servers, networks, storage systems, and computing resources.
- Provide technical support and assistance to the observatory's staff, and administer and configure operating systems, databases, and software applications used within the observatory.
- Collaborate with vendors and service providers to procure IT hardware, software, and services as needed.

Selection Criteria

The selected candidate should meet the following required criteria, while desirable elements would strengthen its eligibility:

Competences and skills

Required:

- Proficiency in front-end programming languages (such as HTML, CSS, or JavaScript).
- Experience in server-side administration tools.
- Knowledge of log analysis and error tracking.
- Knowledge of website maintenance routines and performance optimization.
- Knowledge of data visualization libraries and frameworks (such as Tableau, or PowerBi).

Conditions

Contract terms and conditions, including salary, benefits, and renewal provisions, will be specified in accordance with the MCID's policies and procedures.

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