ENHANCERIA

Sharing Research Infrastructures across ENHANCE

Enhanceria Toolbox for sustainable and effective sharing of research infrastructures

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// INTRODUCTION

Research infrastructure management is a cornerstone of universities' sustainability.

To strengthen the research and innovation capacities of European Universities Technology Alliance, the development of a transformative agenda has become a key focus. This agenda underscores the critical role universities play as catalysts for sustainable development.

Given their substantial startup and maintenance costs, Research Infrastructures (RIs) and major facilities are strategically important in fostering the long-term sustainability of European universities. Beyond economic returns on investment, their broader impact on science, education, and society must be a central consideration when evaluating support strategies at institutional level.

Achieving this requires cultivating a shared understanding among researchers and staff regarding the RIs potential to drive innovative and groundbreaking research. Equally important is recognizing their capacity to develop new skills among students and young researchers through hands-on use. Moreover, strengthening links with local communities and industries can lead to the development of enhanced and more effective services, further positioning universities as active contributors to sustainable development.

To reach these goals, a broad range of initiatives was implemented within the framework of ENHANCERIA activity on "Building up a community of users for strengthening Research Infrastructures":

- Workshops: to collect needs and ideas from the RIs community, map and exchange best practices in RI management, and share information on funding and mobility opportunities;
- Enhance RI Catalogue: to promote awareness and facilitate use of Alliance's facilities;
- Reconnaissance Events: a structured format for mutual exchange, facilitating networking activities and in-person visits to laboratories.

An in-depth understanding of the organizational, financial, and technological challenges associated with operating large facilities must be assumed as an action point for institutions that want to enhance the valorization and sustainability of their RIs.

This should involve the following aspects: effective RI management; promotion and valorization of RIs University landscape and creation and facilitation of a community of RI users.

In the following sections, the findings of each activity's stream have been employed to propose a set of draft recommendations and guidelines on common principles to be considered as a path to an effective and sustainable shared use of RIs.

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In this context, we recall that the *Draghi Report* states: "Most Member States cannot achieve the necessary scale to deliver world-leading research and technological infrastructures, in turn constraining R&I capacity" [...] Increased funding and stronger coordination is required to develop world-leading research and technological infrastructures, when scale is needed"[1]. The Heitor report suggests that: "*Research and Technology infrastructures should be prioritised throughout Europe to foster the European RD&I ecosystem, attract and retain researchers"*[2].

// PART I – MANAGING RESEARCH INFRASTRUCTURE

Effective management of research infrastructures is essential for maximizing their potential and ensuring long-term sustainability. This involves not only strategic planning and resource allocation but also optimizing operations and maintaining flexibility in response to emerging needs and technologies. To this aim, infrastructure management needs to consider several aspects - institutional, legal, financial and technical - and associated obstacles, to widespread and efficient use of large facilities.

1.1. IMPLEMENT INSTITUTIONAL POLICIES AND STRATEGIES FOR CUTTING-EDGE RESEARCH INFRASTRUCTURES

A key tool to achieve sustainability when sharing RIs is the development of a common view according to which RIs are effectively embedded in the University strategic dimensions.

A first step would require an a*greement on the definition of "Research Infrastructures"* and the identification of key parameters, to distinguish them from laboratories and other university facilities[3]. This would help in elaborating policies and actions tailored to the needs of the facility, according to its main characteristics: size (laboratory/medium-large facility/etc...), type (single-sited/distributed), nature (research/technology), services offered (blue sky research/testing/commercial/etc...).

[1] "The future of European competitiveness - Part A: A competitiveness strategy for Europe" - 9 September 2024 pagg. 25-29.

[2] "Align. Act, Accelerate. Research, Technology and Innovation to boost European Competitiveness" European Commission Directorate-General for Research and Innovation Directorate G — Common Policy Center Unit G2 — Common Programme Analysis and Regulatory Reform, page. 81-83

[3] Appendix 2 "Guideline tool for mapping RI ecosystem of Enhance Alliance" of Deliverable 2.5 "Report on mapping activities and main findings on RI portfolio within the Alliance" - ENHANCERIA – 31 August 2022

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Careful thought should be given to *striking a better balance between challenge-driven and curiosity-driven research*, thus considering classifying internal facilities according to their prevalent activity.
The second step would be the *acknowledgment of key facilities as advocates for access harmonization* in local, national, and European research systems. This should include the consideration of open science issues, as encouraging standardization, harmonisation, and interoperability both inside and between RIs, supporting multidisciplinary requirements and Findable, Accessible, Interoperable and Reusable (FAIR) principles. It will include also an endeavor to map the internal RIs ecosystem and connect it with EU and national existing networks of RIs, partnerships, EU, national and regional specific programs, as well as training initiatives.

Internal governance could assist RIs managers in i*dentifying tailored funding strategies*. These should consider a variety of funding sources and financial models to promote long-term support.

Finally, University central level should *advocate for EU and national assistance* to guarantee the top researchers in Europe have access to the top RIs, also providing specialist support to key facilities to attract EU and national fundings.

SHOWCASE #1: In NTNU six overarching areas of research infrastructures are defined in a newly developed **Roadmap for large infrastructures**. The six RIs align to NTNU strategic research areas: life sciences, oceans, energy, community, or specific focus areas (materials and e-infrastructures). The roadmap presents the status, challenges and trends for each of the six research infrastructures and serves as a tool to strengthen the awareness of RIs as cross-faculty assets. The governance structure of each RI reflects the cross-faculty and multidisciplinary dimensions and will play a significant role when it comes to forthcoming priorities on RI investments and projects. It has been set up to balance bottom-up processes to involve the internal RI ecosystem and research community, and top-down perspectives on strategic development and coherence to national priorities and cross-university joint initiatives.

SHOWCASE #2: In POLIMI, the **Strategic Plan 2023-2025** sets specific guidelines for research. These include enhancing the breadth and scope of research infrastructures as a strategic goal. Three major streams of action are defined. These encompass elements associated with Living labs and Joint Research Platforms, Interdisciplinary labs and related staff training, as well as new research infrastructures. Specific KPIs are set in this context.

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1.2. PROMOTE AN ORGANIZATIONAL RENEWAL

An effective *governance structure* with clearly defined roles and responsibilities associated with development of RIs, both at the central and single facility levels, is key for supporting decision-making processes and the implementation of the strategy. Key elements include *setting clear objectives for each facility*, targeted at responding to the Institutional policy on RI, whose achievement should be monitored periodically (e.g., on a yearly basis) from the central level.

The *creation of a central platform or coordinating body* such as a RIs Rector's delegate and office will help to align policies, standardize practices and increase internal knowledge on the opportunities, services, and accessibility that RIs offer. The *organization of support services should be orchestrated to foster easy communication and information processes* at all the levels involved in large facilities management: governance, central administration, departments, institutes.

Sustainable funding remains a challenge and RIs must continuously seek out diverse funding sources to support long-term goals: c*entral offices should provide support to RIs management teams to pursue innovative funding models*.

The renewal should c*onsider prioritizing regulatory compliance, IPR, and data management*, and providing adequate resources and specialized staff. This includes considering also responsibility issues in relation to RIs access.

Operatively, these objectives could ideally include the *adoption of standardized model for contracts, transparent cost structures, and digital management systems*.

All this will *unfold in upskilling RI staff* on standardized procedures to ensure efficient operations and scalability. Specific attention should be given to areas like data stewardship and user training, intellectual property rights, open licensing, GDPR, as well as EU funding, science communication, and research assessment of RIs. In case of large facilities generating huge quantity of data, researchers should receive topical disciplinary support from the data stewards in addition to general cross-disciplinary support. Granting access to e-infrastructures and research resources (including research outputs and services) could be of this support.

SHOWCASE #3: POLIMI has strongly invested in design, development, and continuous enhancement of laboratories. A notable action is offered by the initiative denoted as **Interdepartmental laboratories**. The latter encourages and financially supports development of laboratories, involving researchers from several departments and stimulating cross-disciplinary research.

SHOWCASE #4: The NTNU **Roadmap for large infrastructures** and the process leading to the roadmap has fostered a renewed way of collaboration on research infrastructure challenges

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across the university. There is a specific governance structure in place to ensure the continued involvement of the internal research community, the university administration on all levels (technicians and other administrative functions), the faculty and department leadership, and the university research committee. The governing body of each of the six research infrastructures (see showcase #1) will serve as a central platform and coordinating hub within each RI, which in the outer layer is linked to the *Rector's Strategic Committee for Research Infrastructures*.

1.3. EVALUATE THE IMPACT OF YOUR RESEARCH INFRASTRUCTURES

Impact assessment should be used to evaluate and enhance RIs performance: this would be useful both for decision-making at the university level and in building ad hoc strategies for supporting own facilities, and it would also be advantageous for the single RI to better know its strengths and weaknesses.

It *would help the strategic planning* by considering how internal resources are allocated, which results in ongoing service improvement and concentration on user and stakeholder needs, contributing to build a *customized approach rather than a one-size-fits-all methodology*.

It *would establish openness and accountability*, which lends credibility, prominence, and worth to a RI's existence. Impact assessment *would also imply involving the user community*, addressing social responsibility issues and putting quality assurance procedures into place.

Finally, gathering user needs and integrating them into RIs strategy will contribute to consider *state-of-the-art technological needs*.

SHOWCASE #5: POLIFAB (POLIMI micro- and nanotechnology facility) shows how impact assessment provides a clear added value to our facilities. The overall concept rests on a centralized shared electronic system that allows accessing external parties for both customer-supervised and unsupervised research. All projects, experiences and ideas of PoliFAB are collected in an annual report. The latter is openly shared in a public event and in the online platform. A specific section collects users' contributions. As such, it sets future directions with emphasis on multidisciplinary aspects.

// PART II – PROMOTING AND VALORIZING UNIVERSITY RESEARCH INFRASTRUCTURE LANDSCAPE

Communicating to society the advantage of any public investment is beneficial.

To increase the visibility of the existing landscape of research infrastructures in each University, *the creation of platform collecting main information* linked to each single facility is a winning factor.

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The process of creating a catalogue – both at institutional and at Alliances levels - should involve striking a balance between the following: autonomy and alignment, whose choice depends on the issue of institutional policies; functionality and resources decided trough the issue of technical solution and long-term maintenance, and data complexity and simplicity that reflects into the issue of standardization.

The *creation of a knowledge-sharing system* is another tool to allow internal scientific community and external stakeholders to exchange knowledge in a trusted setting. It also enables one to define appropriate terms for knowledge sharing.

2.1. OPEN AND SHARE RESEARCH INFRASTRUCTURES

To make RIs easily findable and more open, their categorization is one of the major challenges to face. The catalogue could be also intended as a unified system for managing research infrastructure data, aimed at facilitating the process of cross-institutional access. Such a catalogue should be dynamic, allowing for filtering, sorting, and searching; it must be updated, practical and easy to use.

To provide uniformity and coherence in the design of such platforms, EU and national policies for sharing RIs should be considered[4], paying attention to provide clear and transparent access rules, linked to the EU policy for RIs access[5] .These platforms should adhere to European connectivity and data security regulations and could be interoperable, linked to the European Open Science Cloud (EOSC), and, when applicable, adhere to the FAIR data standards. This would facilitate international collaboration as well as attract funds.

SHOWCASE #6: NTNU **Sealab** is a multifunctional facility for research, that needs access to freshwater or seawater. Under internal agreements, all research teams have access to SeaLab, as a centralized shared resource. Customers utilize SeaLab's electronic system for booking and settling services at a later level of collaboration. One of the system's most notable benefits is automatic billing, which has greatly streamlined the financial processing of services

2.2. ENSURE KNOWLEDGE VALORIZATION THROUGH RESEARCH CONDUCTED ACROSS FACILITIES

RIs should maximize their impact by prioritizing t*ransdisciplinary initiatives and strengthening relationships with external user*s, including industry and non-academic actors. This approach not only expands the user base of RIs but also fosters knowledge transfer and economic sustainability through enhanced interactions and training opportunities.

[4] "Report on Access to Research Infrastructures and Charter on Access to RIs" - European Strategy Forum for Research Infrastructure (ESFRI) - 23 January 2024

5 "European Charter for Access to Research Infrastructures" - Directorate General for Research and Innovation (European Commission) - 27 November 2024

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To do so, it could be useful to empower career development to include partnerships with non-academic entities, such as private companies and non-profits and encourage entrepreneurship through university-led start-ups and collaborations with investors, starting from the results if testing and prototyping activities carried on thanks to cutting-edge equipment.

SHOWCASE #7: **Wind Tunnel** at POLIMI maximizes its impact by focusing on partnerships with non-academic entities, such as private companies. This laboratory is involved in both research actions as well as in meaningful commercial partnerships, resulting in a large testing activity for key sector players (e.g., Bombardier, Leonardo, Vestas, Enel, Ansaldo Breda, Salini-Impregilo, ARUP, Parsons NY).

SHOWCASE #8: The **Clean Mobility and ThermoFluid Laboratory** at UPV illustrates a solid foundation for promoting collaboration between academic research and industry. The laboratory uses its research team's knowledge and ability to not only perform fundamental research but also actively participate in knowledge application initiatives that address real-world industry difficulties. This flexibility enables the team to adapt research tools and processes to changing project objectives, ensuring that industry partners receive specialized answers.

// PART III – EMPOWERING COMMUNITIES OF RESEARCH INFRASTRUCTURES

Piloting initiatives intended to pull expertise, data, and other resources belonging to large facilities is a necessary step to create a community of RIs.

Exploring training and mobility opportunities between RIs, encouraging both virtual and physical mobility for RI staff, would also enable continuous learning and professional development, fostering a culture of mutual exchange, capable of reinforcing institutional collaboration[6].

Developing a *community of users through initiatives like "Living Labs[7]"* could be an additional way to valorize RIs landscape since they support sustainability-focused and transdisciplinary research and innovation.

[6] Enhanceria "reconnaissance events format" promoted the reciprocal use of the Enhance RIs' portfolio, paving the way for piloting exchanges between RIs' research staff and facilitating synergies among research groups to create new project ideas.

[7] In recent decades, grand societal challenges and wicked problems have arisen that need new ways of collaboration and problem-solving methods. Several scholars and policy actors (e.g., European Commission, 2017; Parodi et al., 2022; Wanner et al., 2023) see Living Labs (LLs) as an opportunity to meet these challenges by facilitating collaborative innovation (Compagnucci et al., 2021; Fuglsang and

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3.1 CREATE YOUR OWN COMMUNITY THROUGH TALENT DEVELOPMENT, SKILL BUILDING, AND PEER LEARNING

Involving students and PhDs in education activities conducted in research facilities is a way to enhance their use and to value them, fostering at the same time peer learning. This could be facilitated through, for instance, the activation of internal Executive PhD programmes.

Students and Early-career researchers may receive more attention in using specific equipment: mature researchers could provide assistance and training.

Investing in *continuous training* for RI staff and users, addressing key topics, such as digitalization, Open Science, as well as technical aspects, would help in creating specialized networks around key facilities. In this way communities of trainers will be encouraged.

Structured mobility programs - such as job shadowing, exchange visits, and EU-level training initiatives - would encourage mutual learning and skill development across RIs.

SHOWCASE #9: Key aspects of POLIMI **LPM – Materials Testing Laboratory,** the large University facility for environmental and civil engineering, include the combination of the high-level equipment and the outstanding know-how ensured by unique skills of operators. LPM collaborates with several American enterprises. In parallel with industrial collaborations, LPM is equipped with a well-structured model of valorization of research activities. These are mainly carried out by PhD students, who are then required to complete a template that is evaluated by the scientific committee. Furthermore, educational activity is carried out with the support of the students for MSc their thesis and through collaboration with high schools in a context of school-work activities.

SHOWCASE #10: POLIMI **Wind Tunnel**'s attractiveness has reached an increasing number of international students who ask for a training period during their Master's degree or PhD projects. Furthermore, since 2020 the "Wind Tunnel Research Grants for POLIMI PhDs" offers PhDs the possibility to use the wind tunnel for free for their research activities.

S**HOWCASE #11:** Chalmers **Materials Analysis Laboratory (CMAL)** has a skill development program based on the use of its equipment: in addition to providing hands-on training for getting started using the different instruments, it offers courses and workshops for improving the operational and theoretical skills of the users. These courses are mainly aimed at operators who are quite new to the technique. The theory is connected to the practical aspects that an operator will encounter when running the instrument and performing analysis.

Hansen, 2022). Hence, LLs create new research infrastructures and spaces for transdisciplinary knowledge (co-)production processes.

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SHOWCASE #12: TU BERLIN **Center for Electron Microscopy (ZELMI**) offers Company internships: for interested students it provides the possibility to get an insight into our daily work as a central research support facility within the framework of the company internship of Berlin schools.

3.2 TRANSFORM YOUR FACILITY IN A REGIONAL INNOVATION HUB

A facility may be turned in a *regional innovation hub* combining outstanding research infrastructures with collaborative networks, accelerating technical developments, stimulating entrepreneurship, and connecting local industry to all over the world research projects.

Fostering strong ties with regional businesses to address local issues and provide solutions through applied research. In this way, a facility will not only enhance its research capabilities, but it will also encourage economic growth, recruit talent, and set up your region as an innovation leader.

Facilitating industry partnerships by simplifying administrative and legal processes, creating dedicated liaison offices, and involving industry representatives in RI advisory boards.

Supporting SMEs through co-financing of customized services and an EU platform to showcase RI capabilities for industrial use.

SHOWCASE #13: The **Centre for Advanced Materials and Technology** of WUT (CEZAMAT) stands as a beacon of innovation, poised to transform itself into a regional hub for cutting-edge research and development in the fields of semiconductor technology and biotech. CEZAMAT established state-of-the-art laboratories and infrastructure designed to unite the research community and foster interdisciplinary collaboration. The Centre actively seeks to broaden its impact as a regional innovation hub by enhancing partnerships with industry. A dedicated sales team focuses on engaging customers in high-potential sectors such as biotech and medicine. CEZAMAT's services are priced based on rigorous cost analysis, ensuring transparency and alignment with market expectations.

SHOWCASE #14: Initiatives such as the **Match UPV program** connect businesses and researchers, tackling innovation concerns through collaborative R&D and consulting services. The UPV Solutions web channel strengthens this collaboration by allowing businesses to request research and innovation services from UPV professors, directly addressing their technology requirements.

3.3 Consider Societal Engagement and Science Communication

Engaging with society and *fostering citizen participation* in science should be a priority also for RIs. RIs should be encouraged to *liaise with Communication Offices* at Central or Departmental level and to *take part in public events* like the European Researchers' Night.

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This would effectively *showcase the societal contributions of RIs*, enhancing their visibility and reinforcing public trust in scientific research.

SHOWCASE #15: RWTH Aachen University's **Living Labs Incubator** (LLI) is tasked with networking and supporting new and existing Living Lab initiatives at and around RWTH Aachen University. It is amongst the ten measures to achieve excellency and the University's goal to become an "integrated interdisciplinary university of science and technology", aiming to incorporate skills for transdisciplinarity. The LLI conducts research and aims at better grasping knowledge transfer between science and society, structural aspects of Living Labs and different types of LL strategies and approaches.

// FINAL MESSAGES

A set of quick tips to complement this toolkit to engage with large facilities in the day-to-day routine and in the long run:

Run your facility like a company, not a research project! Do not forget that infrastructure management is not the same as research project management.

Be aware of your goals! The key to success is to consciously balance the various forms of using your infrastructure.

Set standards! Having clear rules, standardized templates of contracts, and fixed price lists and laboratory tests is a key success factor. The implementation of the electronic management system could be extremely helpful.

Take care of internationalization! Collaborating with researchers from other countries is a chance to learn what approaches are being implemented by others, and which are the main trends in the relevant field.

Make your finances transparent! You need to know where funds are coming from and where exactly they are spent to keep them in a sustainable balance.

Encourage collaborations between all the laboratory users! It is a straightforward way to achieve synergy.

Debrief after test activities! This helps to identify strategies to set standards, valorize research and testing activity results, and manage critical situations both concerning the technical and the organizational point of view.

Promote technology foresight practices! It will allow you to provide new set-ups to upgrade the quality of the research performed, keeping an eye beyond the lab!

Talk to your users! Strong coordination with the research groups representing the typical users to adapt the services provided to the real needs is strongly advised.

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// CONCLUSIONS

Reflecting on the experience gained from the ENHANCERIA, a series of recommendations have emerged that can serve as guiding principles for the continuation of the path initiated, for establishing future collaborations and for the development of new alliances focused on Research Infrastructures (RIs).

Based on the project main findings, given the wide range of approaches taken in the management, the unique characteristics of each university and its research facilities, the specificity of the research groups, it would be difficult to provide the “right” receipt on how to share RI resources. Otherwise, this work stands as a basis for effective RIs management by summarizing key elements.

It is evident that this toolbox addresses a larger issue and could be viewed as a supplementary document, offering a complementary viewpoint to the outputs of other SwafS projects of the other European University Alliances dedicated to creating a European strategy for managing and sharing Research Infrastructures, even though it represents the approach discussed within the Enhanceria consortium.

Within the perspective of RIs management, in the next future it should be necessary to expand the analysis of existing links between ENHANCE RIs and identify areas of common interest to be able to keep working on the RI path.

To this aim, the European strategy for University and the European University Alliances initiative will have a key role to avoid dispersing the heritage set up so far by these first actions. To do so, creating clear agendas and action plans that align with the strategic goals of the ENHANCE should be the first step to be implemented by each Institution. This ought to facilitate cross-border cooperation and advance the alliance’s global reach.

This document can then be used to inspire further drafting of internal policies, contribute shaping current practices as well as future policy and operational frameworks for sustaining and enhancing RIs across Europe.

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