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for Collaboration
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**Deliverable Report:
D3.1 Strategy to exploit the innovation potential of RIs**

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Terminology

“Big Science” – Big Science is a common term used to describe legal entities which build and manage large-scale international research infrastructures where the scope and cost of the investment exceeds the capability of just one country. In this case, several countries (member states) join forces to finance the infrastructure. These types of infrastructure are usually found in the ESFRI Physical Sciences & Engineering domain and consist of particle accelerators and telescopes. Examples of some Big Science organisations are CERN, ESO, ESRF, and ITER.

BSBF – Big Science Business Forum is a business-oriented congress which congregates the main European Big Science Research Infrastructures focused on technology with the aim to be the key meeting point between these Research Infrastructures and industry. The first edition was held in 2018 in Copenhagen. The second edition will take place in October 2022 in Granada.

ENVRiplus – a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects and networks together with technical specialist partners to create a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe.

ESFRI RESEARCH DOMAIN – The European Strategy Forum of Research Infrastructures (ESFRI) has identified six main thematic domains of research (ESFRI Strategy Report and Roadmap 2018; pg. 38): Energy (ENE), Environment (ENV), Health & Food (H&F), Physical Sciences & Engineering (PSE), Social & Cultural Innovation (SCI), and – since 2017 – Data, Computing and Digital Research Infrastructures (DIGIT).

ILO – INDUSTRY LIAISON OFFICER is an individual officially appointed by the Member States and Associated Countries to stimulate the collaboration amongst the national industry and the international RIs, providing advice on business opportunities, R&D collaborations, calls for tenders, and industrial services.

ICO – INDUSTRY CONTACT OFFICER is employed by a research infrastructure and is in charge of developing business relations with all potential industrial suppliers of innovative components or services, as well as encouraging the economical use of their facility by private players.

PERIIA – The Pan-European Research Infrastructure ILO Association (PERIIA) network launched in 2019 as a grassroots movement offering a communication and discussion platform for ILOs. The aim of the network is to pave the way and prepare for the establishment of PERIIA as a legal entity in the form of a European association.

RI – RESEARCH INFRASTRUCTURES are facilities that provide resources and services for research communities to conduct research and foster innovation. Research infrastructures can be used beyond research, e.g. for education or public services. Research infrastructures include the following: major scientific equipment or sets of instruments, collections, archives, or scientific data, computing systems and communication networks, and any other research and innovation infrastructure of a unique nature which is open to external users.

List of Abbreviations

BSBF	Big Science Business Forum
CDTI	Centre for the Development of Industrial Technology
DTI	Danish Technological Institute
EC	European Commission
EATRIS	European Infrastructure for Translational Medicine
EIROFORUM	The European Intergovernmental Research Organisation Forum
EMSO	European Multidisciplinary Seafloor and water column Observatory
ENRIITC	European Network of Research Infrastructure and Industry for Collaboration
EOSC	European Open Science Cloud
EOSC DIH	European Open Science Cloud Digital Innovation Hub
ESRF	European Synchrotron Radiation Facility
ESFRI	The European Strategy Forum on Research Infrastructures
ERA	European Research Area
ESS	European Spallation Source ERIC
FG	Focus Group
PERIIA	Pan-European Research Infrastructure ILOs Association
RI	Research Infrastructure

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Executive Summary

The ENRIITC project aims to build a permanent pan-European network of Industrial Liaison and Contact Officers (ILOs and ICOs) and enable industry to become a full partner of research infrastructures (RIs) whether it is as a user, a supplier, or a co-creator. In other words, through its activities by supporting ILOs and ICOs, ENRIITC is helping to support the establishment of strategic, cross-border partnerships between industry and RIs.

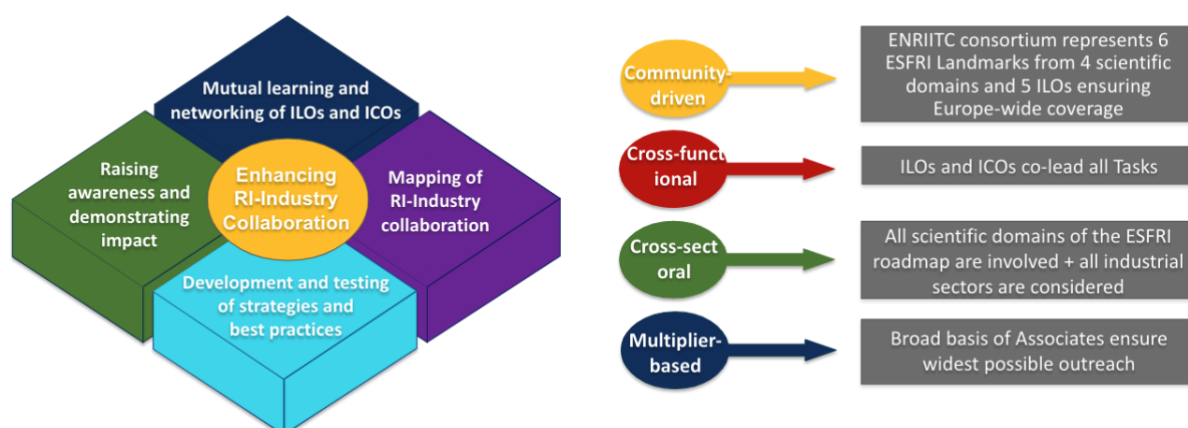


Figure 1: Primary objectives in ENRIITC

This report puts forward strategic recommendations for improved interactions between RIs and companies on the topic of innovation based on the key findings from the ENRIITC survey, reported as D2.1 ("Report on the mapping of industry as a supplier and user"), and selected input from other studies. The work proposes an overall strategy to improve the engagement between European RIs and industry and forms the backbone for the ENRIITC WP3 deliverables composed of:

- D3.2 ("Strategy for innovation and industry-RI cooperation") that proposes specific strategic actions for each RI,
- D3.3 ("Strategy for training of ILOs/ICOs and outreach towards industry") that details the roles of ICO and ILO and recommends training activities to improve industry outreach, and
- D3.4 ("Practical step-by-step guide for ILOs/ICOs to organise brokerage events") which is a detailed description for organising industry events.

Much previous work has been done to determine how to increase the interaction between RIs and industry. Most notably, the development of the ESFRI reports on RI long-term sustainability in three volumes addressed both the research rationale and the innovation aspects.

The ENRIITC survey presented in D2.1 constitutes the most comprehensive input of impressions and ideas from the communities working with RIs and industry: ILOs and ICOs or similar RI-staff working with industrial procurement, industry users or innovation. The survey covers both the operation of RIs and the roles of ICO and ILO. Furthermore, the ILO/ICO communities were engaged in several different fora created by ENRIITC:

- The ENRIITC networking event, 16-17 October 2020 where topical break-out sessions were held
- #ENRIITCyourCoffee sessions used for short discussions on narrow topics

- The ENRIITC Focus Groups which allowed more in-depth discussions with groups of relevant stakeholders

There was great interest from the ICOs and ILOs who took part in the discussions in the Focus Groups. As was also expressed at the meetings, this can only be translated as an urgent need for support and sparring in the role of ILO and ICO. A combined strategy for the RI area in Europe must include measures to address this need from the stakeholders.

As a starting point for discussing strategic actions, the “Research Infrastructures Innovation-Preparedness Roadmap” introduced in the ENVRiplus project was used. This tool was developed for RIs to help improve the RI internal structure to make the vision presented in the ESFRI report a reality (see Appendix 1). Secondly, it should encourage RIs to better communicate and “package” success stories of existing ties with industry to clearly demonstrate the significant economic benefits stemming from public investments in the RIs.

In particular, the roadmap suggests a set of basic measures and actions RIs can adopt and undertake to organise and position themselves more effectively in identifying and dialoguing with prospective private sector partners.

From the ESFRI reports, a fundamental barrier that penetrates several of the other barriers relates to the lack of understanding, or a common language, between RIs and companies. To solve this, RIs and industry need to engage far beyond the conventional exchange of research for funding, for example, by participating in joint Horizon Europe funding programmes.

Another aspect that must be included is the open innovation concept which is an important idea for making knowledge available across the European institutions. Much knowledge is assembled at the individual RIs, and free circulation of researchers and knowledge would lead to better cross-border cooperation, building of critical mass and continent-wide competition.

In order to create an efficient knowledge base that will support industrial innovation and Open Innovation models between RIs, we propose a new strategy to exploit the innovation potential of RIs employing a new “Research Infrastructures Innovation Preparedness Roadmap” consisting of five main initiatives.

The model proposed is tailored for ESFRI RIs. Indeed, ESFRI works with a mandate from the EU Council to support a coherent and strategy-led approach to policymaking on RIs in Europe, and in addition we needed to leverage the ESFRI clusters to make the most out of what is already existing and diminish the time to operation.

The roadmap is composed of five main actions that are listed below and which are particularly targeted to help nurture emerging RIs wishing to better engage with industry via a core support environment:

1. Establish a pan-European ICO and ILO network.
The core activity of the hub is to provide advice and support to all manner of RIs in their engagement with industry, drawing upon existing experience and good practice and building its body of knowledge as the hub matures.
2. Adopt a set of core competencies for ICOs and ILOs.
The role of ILO and ICO is defined including duties and competencies. It is recommended that each RI appoints an ICO.

3. Each RI should review and implement specific key actions.
As detailed in ENRIITC D3.2 “Strategy for innovation and industry-RI cooperation”, 17 key areas with recommended actions are defined to help an RI improve the collaboration with industry and establish a common baseline for RIs for developing systematic innovation-partnering industry-liaison programs.
4. Building strategic alliance relationships.
Establishing partnerships at European level to ensure that the RI operational model and interactions modes with industry is understood and recognised so that RIs can seek more easily individual collaboration partners.
5. Develop a European RI Innovation Strategy.
Formulation of a European RI Innovation Strategy to describe the ambitions for a better integration between RIs and industry. The strategy will enable RIs to be the core engine of the innovation supply-chain facilitating the constituency of spin-offs, start-ups and partnerships with private entities in close cooperation with universities.

1. Introduction

This report puts forward strategic recommendations for improved interactions between RIs and companies on the topic of innovation based on the key findings from the ENRIITC survey, reported as D2.1 (“Report on the mapping of industry as a supplier and user”), and selected input from other studies. The work proposes an overall strategy to improve the engagement between European RIs and industry and forms the backbone for the ENRIITC WP3 deliverables composed of:

- D3.2 (“Strategy for innovation and industry-RI cooperation”) that proposes specific strategic actions for each RI,
- D3.3 (“Strategy for training of ILOs/ICOs and outreach towards industry”) that details the roles of ICO and ILO and recommends training activities to improve industry outreach, and
- D3.4 (“Practical step-by-step guide for ILOs/ICOs to organise brokerage events”) which is a detailed description for organising industry events.

Thus, some of the topics introduced in D3.1 will be further elaborated in the other deliverables.

European RIs are an essential pillar of the European Research Area ecosystem that strive for scientific excellence, provide transnational services, support education and skill development and are key for delivering scientific breakthroughs and fostering innovation.

In addition, the European RIs are helping Europe to give a strong and quick response to the greatest challenges we are facing such as fighting cancer, adapting to climate change, protecting our oceans, living in greener cities and ensuring soil health and food security.

It goes without saying that the scenario we see nowadays, looking at the status of play in the relationships of RIs with industry, is quite poor and there are several challenges we have to tackle in order to revamp the actual practices and remove the bottlenecks in processes of RI innovation exploitation.

To identify the main challenges, we can use the Marine sector as a case study, taking advantage of the work performed during the H2020 Columbus¹ project in the document “Use and sharing of marine observations and data by industry”:

The Columbus project built upon the experiences done in the framework of the Europe Marine Observation and Data Network (EMODnet) finding that the current scenario is not effective to actively engage industry, either as users or providers of data.

The list of main challenges is the following:

1. Marine data and information sharing initiatives are not visible to industry.
2. The “Public data is for public users” perception.
3. Marine data managers and private sector users speak different languages.
4. Availability doesn’t imply usability.
5. Industry may be less likely to make long term decisions based on short term initiatives.
6. Industry represents a diversity of actors with a diversity of needs.
7. Europe’s marine data and information sharing landscape is too complex.
8. Industry are largely willing to share data but there are barriers.

¹ <http://www.columbusproject.eu/>

Several of the items in the text box are easily generalised to common challenges for the RIs.

To effectively support meeting these challenges, RIs need to be constantly aligned with the choices of the European Commission (EC) in designing and setting up the ERA funding frameworks.

RIs constitute a powerful resource for industry, and it is vital to develop and exploit the potential of European RIs as knowledge and innovation hubs integrated into local communities, forming the basis of European competitiveness with regional impact and global outreach². The ENRIITC survey performed in the Summer of 2020 was conducted among key stakeholders from the RI ecosystem:

- 1) ICOs and RI-staff responsible for industry interactions concerning industrial users, suppliers and partners, and
- 2) ILOs from RI-member countries working closely with the RIs concerning supplier industry.

The analysis was submitted as D2.1 and includes a set of conclusions that will serve as a starting point for developing strategic recommendations.

As a general comment, it should be noted that the definition of “ILO” is chosen to align with the definition from the H2020 topic INFRAINNOV-02-2019, where it designates persons working for a particular country that is a member of an RI and who has the role of promoting the national supplier companies to the RI. The “ICO” definition describes a person employed by an RI working with industry interactions. Thus, this includes the “ILOs” working for an RI to promote industry interactions, and to avoid confusion, the term ILO will only be used to describe the former (i.e., national ILOs working with suppliers).

2. Methodology

Much previous work has been done to determine how to increase the interaction between RIs and industry. Most notably, the development of the ESFRI reports on RI long-term sustainability in three volumes addressed both the research rationale and the innovation aspects. Some presentations from ESFRI representatives provided further details on particular aspects.

The ENRIITC survey constitutes the most comprehensive input of impressions and ideas from the communities working with RIs and industry: ILOs and ICOs or similar RI-staff working with industrial procurement, industry users or innovation. The survey covers both the operation of RIs and on the roles of ICO and ILO.

The communities were also engaged in the different fora created by ENRIITC:

- The ENRIITC networking event, 16-17 October 2020, where topical break-out sessions were held
- #ENRIITCyourCoffee sessions used for short discussions on narrow topics
- The ENRIITC Focus Groups which allowed more in-depth discussions with groups of relevant stakeholders:
 - FG#1: How can ILOs and ICOs interact, learn from each other and collaborate?
 - FG#2: RIs in the innovation landscape/ecosystem
 - FG#3: Outreach strategies for RIs

² From ESFRI White Paper 2020, “Making Science Happen”

- FG#4: Industry access/usage of RIs and the ICO role
- FG#5: Industry suppliers to RIs and the role as ILO
- FG#6: Innovation Advisory Board

3. Analysis of current situation for RI-industry engagement

3.1 ENRIITC survey results

The ENRIITC survey generated a lot of relevant input both on the operations of RIs and on the roles of ICOs and ILOs. The following six points are emphasised from the conclusions of D2.1:

1. RIs collaborate with companies of all sizes, from SMEs to large enterprises and in many technical fields, in particular for:
 - a. Companies using the RIs: Biotechnology, Healthcare Industries, Energy, Chemical, Medical Devices, ICT/Data, Aeronautics, and Automotive and for
 - b. Companies supplying to RIs: Electrical & Electronic Engineering, Mechanical Engineering, Energy, ICT/Data, Space, Construction, Aeronautics, Pressure Equipment and Gas Appliances.
2. ILOs form a homogeneous group that are well connected to national facilities. They mainly work with one RI and their job performance has a narrow focus on achieving a strong geo-return. A majority of the ILOs point to an added potential for innovation by engaging in tech-transfer together with the RIs and companies.
3. The services offered by RIs appear to be well matched to those requested by companies and include:
 - a. access to facilities, instruments, and testing,
 - b. testing and quality/standards compliance validation,
 - c. access to data,
 - d. modelling, and
 - e. specialised training.
4. A majority of the RIs have a strategy for working with industry, but they do not monitor the interactions, e.g., by tracking the income from industry.
5. Nearly half (47%) of the surveyed RIs employ dedicated ICOs or equivalent staff in charge of engagement with industry (29% employ full-time staff, 18% part-time). This relatively low percentage is an important challenge, although RIs lacking a central ICO may work through equivalent positions located in the decentralised structures. The significance of the ICO is documented by the RIs with an ICO being significantly more likely to:
 - a. maintain an online catalogue of RI services and technologies targeting industry,
 - b. have brochures or other information material targeting industry,
 - c. have a “corporate” presentation targeting industry,
 - d. publish user cases,
 - e. maintain a calendar of events for industry, and
 - f. organise/participate in brokerage events.
6. Regarding partnerships and alliances, it is noted that only half of the RIs cooperate with technology clusters, science parks and innovation hubs, pan-EU innovation promotion organisations, and local or regional business clusters. RIs with an ICO employed are much more likely to interact with these other stakeholders.

Interestingly, regarding point 3 on the correlation between RI service offers and industry needs, the results of the survey appear to be in contrast with the conclusion from ESFRI (e.g. presented by Octavi Quintana, Principal Adviser, DG RTD, EC during his keynote at the II RICH Symposium in Lisbon in 2017) which pointed to a significant gap in this area. It would be expected that the RIs have improved their service offer to match industry needs over the last 4 years, but we must also keep in mind that the ENRIITC survey only asked the ICOs how the situation was perceived, not industry, and the question did not ask about future service growth opportunities in terms of the service match.

Several of these findings indicate that the role of an ICO is central for the level of interaction between the RI and companies. The presence of an ICO is also important for an improved interaction with the innovation ecosystem surrounding the RI, which is lacking. In this respect, we think it would be useful to develop at a European level an ICO network similar to the one already existing for ILOs (PERIIA³). Taking inspiration from PERIIA, the pan-European ICO network could have the following objectives:

- Be a key intermediary between the European RIs and Industry in supporting the “upstream” and “downstream” business models.
- Create an ICO community for the exchange of best practices and lesson learned.
- Enhance the cohesion and functioning of Industrial Contact Offices at RI level.
- Act as a consultative reference body for other European/International stakeholders.
- Encouraging the economical use of the RIs facilities by private players.

The ICO network will be part of the Initiative 1 of the Roadmap explained in Chapter 4.

Clearly, there is a need for further clarification and strengthening of the ICO and ILO roles.

In addition, half (53%) of the surveyed RIs, have a centralised procurement office, and of these, 59% involve up to five FTEs (full time equivalents),. More than half (57%) of the RIs employ a central hub/headquarters communications officer with commercial promotion experience and skills.

Finally, from D2.1 emerges that there is already a fertile soil on which start building a much solid innovation cycle, but it is quite evident that the effort at the moment lacks a common structure and language which could produce dysfunctionalities on the long run.

3.2 Input from stakeholders and Focus Groups

Some of the challenges that arose from the ENRIITC survey either as conclusions, ambiguities and comments were tested qualitatively in discussions during the Focus Group meetings and the #ENRIITCyourCoffee sessions.

The Focus Groups were defined around six themes that were chosen based on the interest from the stakeholders and the alignment with topics to be used as input to Deliverables 3.1-3.4.

The main findings from the Focus Groups were recorded in the summaries published on the ENRIITC homepage and in D3.2 (“Strategy for innovation and industry-RI cooperation”) and D3.3 (“Strategy for training of ILOs/ICOs and outreach towards industry”). Much of the input remains anecdotal and has served to inspire new thoughts and discussions helping draft the recommendations in this report (and D3.2-D3.3).

³ <https://www.periia.eu/>

The following points should, however, be highlighted:

1. There was great interest from the ICOs and ILOs who took part in the discussions in the Focus Groups. As was also expressed at the meetings, this can only be translated as an urgent need for support and sparring in the role of ILO and ICO. A combined strategy for the RI area in Europe must include measures to address this need from the stakeholders.
2. The interactions between the RI and the surrounding innovation ecosystem works well in an ad-hoc manner on specific problems of industrial interest, but only in a few places is this actually established as long term relationships. Exceptions include the way distributed RIs interact with the universities acting as nodes to the RI and in the science parks that have been established in the vicinity of (normally, single-sited) RIs (this is also a topic in D3.2 “Strategy for innovation and industry-RI cooperation”).
3. Both ILOs and ICOs expressed a need for guidance on how to host industry events, especially during the COVID-19 outbreak, (this is the topic for D3.4 “Practical step-by-step guide for ILOs/ICOs to organise brokerage events”) and how to train and prepare for the role of both ILO and ICO (this is the topic for D3.3 “Strategy for training of ILOs/ICOs and outreach towards industry”).

3.3 The RI Innovation-Preparedness Roadmap from ENVRIplus

The “RIs Innovation-Preparedness Roadmap” was introduced in the ENVRIplus project as a tool for RIs to help better structure RIs internally to make the vision presented in the ESFRI report a reality. Secondly, it should encourage RIs to better communicate and “package” success stories of existing ties with industry to clearly demonstrate the significant economic benefits stemming from public investments in the RIs.

In particular, the roadmap suggests a set of basic measures and actions RIs can adopt and undertake to organise and position themselves more effectively in identifying and dialoguing with prospective private sector partners.

Going deeper, the Roadmap has two overarching objectives:

1. to develop a common methodology and set of action items to help the RIs “walk the talk” vis-à-vis strengthening innovation-partnering with industry, and
2. to work towards being able to offer ESFRI a regular source of RI innovation success stories to complement those on RI scientific achievements, and thus help better showcase the ROI of the large public investments in the 50+ RIs on the ESFRI Roadmap each costing an average of €1.5 billion to construct and between €2 and €120 million annually to operate (source ESFRI).

In the next chapter, we will present a further development of the ENVRI-plus Roadmap composed of five main initiatives, including the suggestions for effective ICO recruitment, and a list of 17 key areas.

But focusing a little more on what the interactions between RIs and other societal partners can be, it is useful to cite the work done within the ENVRI-plus project and, in particular, in D1.1 (“Emerging technologies, emerging markets: fostering the innovation potential of Research Infrastructures”). The final results presented in the report are referred to RIs in the environment ESFRI cluster and some conclusions are inserted in the box below:

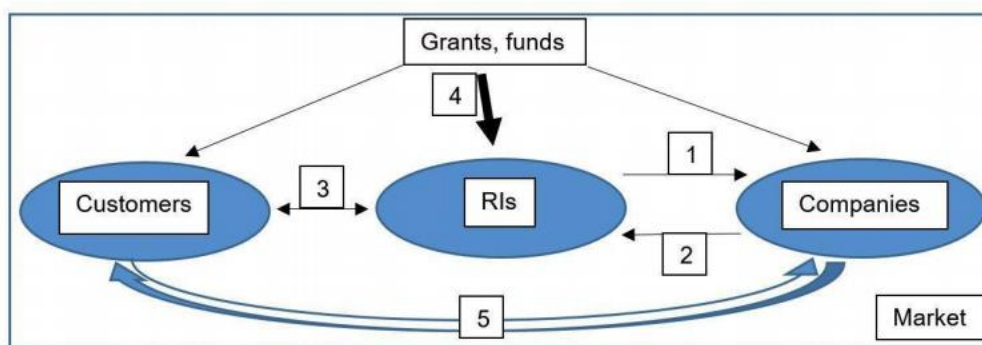


Figure 2 - Interactions of RIs with other participants in the market.

The arrows between the RI body and the companies in Fig. 2 represent:

1. Services that can be provided by RIs to companies:
 - Representing large groups of end-users, RIs are capable of purchasing products of high cost, which can be shared among the multiple end-users.
 - As large entities, connecting numerous research institutes and governmental structures, RIs can collect the demands for the standardisation and metrology and pass them to the companies for future implementation.
 - RIs can predict natural disasters affecting business and human well-being. This is a valuable capability for business management and crisis prevention.
 - Co-designing innovation. RIs can promote the development of new products and services as well as to adapt them to the market needs and rules.
 - RIs can provide the facilities, necessary for testing of new technologies.
 - RIs can perform data collection and management, to support companies and generate income.
2. Services that companies can provide to RIs:
 - Companies can sell their innovative devices to RIs. In case the devices are of high cost, RIs will be able to purchase them in contrast to the single users/scientists.
 - Companies can provide new services to the RI, in larger extent than to the single users.
 - Data collection and transmission. While using the facilities of RIs, companies can collect data at low cost. This data can be shared with the members of RIs to make their work more efficient.
3. Services that RIs can provide to customers (end-users):
 - RIs can assure that all the customers (end users) have equal possibilities to access the facilities for the environmental measurements and climate change investigations, as well as to the data provided by each and every RI.
 - RIs provide transferable and reusable data and knowledge.
4. RIs become an attractive receiver of grants and funding:
 - Given the same amount of financial support, RIs can provide the access to the research facilities to larger number of scientists or other interested communities.
5. Direct interactions between the end users and producing companies:

- Direct interactions are possible, but are never as beneficial as interactions through the RIs due to the reasons mentioned in points 1-4.

ENVRI-plus, D1.1 “Emerging technologies, emerging markets: fostering the innovation potential of Research Infrastructures”.

This is a first set of indications of what the interaction between RIs and industry could consist of, as based on a specific study using a specific RI group (environmental research cluster). But to get ready to respond to those demands, RIs should reorganise to be more proactive and process oriented. That is the objective of the next chapter.

3.4 Observations and recommendations from ESFRI

In December 2015, the EC launched an online consultation targeting RI stakeholders with the aim of collecting their views on the interrelated pre-conditions that could ensure the long-term sustainability of RIs and the potential action to tackle the challenges posed by their implementation. The main barriers preventing effective cooperation between RIs and industry, as identified during that consultation, have been reported in the ESFRI “Report on the Consultation on Long Term Sustainability of Research Infrastructures”⁴ and presented in Fig. 3:

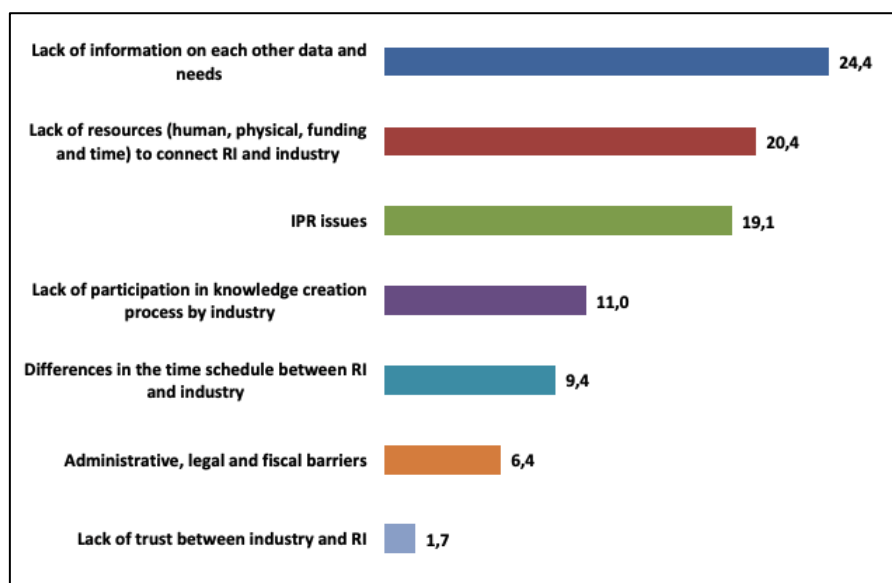


Figure 3: Barriers preventing effective cooperation between RI and industry (%)

Respondents were asked to indicate the three main barriers that in their view prevented effective cooperation between RIs and industry. The main barrier identified (24.4%) was the disconnection between research and market needs.

As the second barrier in terms of importance 20.4% of respondents mention the lack of resources (human, financial, and time) to successfully work in building fruitful relationships with industry. The lack of dedicated or clear access rules has been identified as a potential obstacle to cooperation.

⁴ Also presented by Mr. Octavi Quintana, Principal Adviser, DG RTD, European Commission during his keynote at the II RICH Symposium in Lisbon in 2017.

Further interesting points coming from the presentation of made by Octavi Quintana, Principal Adviser, DG RTD, EC, during his keynote at the II RICH Symposium in Lisbon in 2017, where barriers were highlighted on access rules (selection criteria, limits on industrial use, IPR), lack of communication and coordination between RIs and industry, risk avoidance for industry/SMEs and lack of resources.

A fundamental barrier that penetrates several of the other barriers relates to the lack of understanding, or a common language, between RIs and companies. To solve this, RIs and industry need to engage far beyond the conventional exchange of research for funding, for example, by participating in joint Horizon Europe funding programmes. These mechanisms may pave the way for developing strategic partnerships merging the discovery-driven culture of academia with the innovation-driven environment of industry, using the RIs as a bridge and a translator able to introduce a common language to make the collaboration a success. The common language is simply about having a foundation on which to build a complex environment for collaboration where the two sides are able to understand each other and exchange data and service.

The point is: what can exactly be the role of RIs in this process? What are the characteristics of this third language and what is the virtuous cycle of which the RIs could be the main gear?

To these questions, the ESFRI report on “Innovation-oriented cooperation of Research Infrastructures” vol. 3, gives some precious answers:

RIs are playing a dual role: as innovation providers on the one hand and technology purchasers on the other hand. The innovation process is strongly pushed by the leverage effect of public procurement. Such a context creates a shared driving force that stimulates the exchange of technologies and competencies and boosts common motivation and efforts. Once tested and used for the project, these newly produced devices will be subsequently integrated into products or processes to be sold to academic and private laboratories. At the same time, the results published in highly ranked scientific journals will increase the scientific outreach of the facility and potentially allow getting more resources for ensuring the development of new outstanding instruments. Similar conditions exist in the upgrade stages and in general when new instrumentation has to be developed; in some cases, also in the decommissioning phase.

ESFRI “Innovation-oriented cooperation of Research Infrastructures” vol. 3⁵

Statements from ESFRI underlines the importance of RIs in the development of ERA and in aligning National research policies and programmes:

RIs in Europe will serve as high-performance platforms for cooperation among universities, enterprises and research institutes.

The resulting innovation ecosystem will spur new ideas, solutions and innovations of benefit to the European economy and society, as well as science. Special attention should be paid to nurturing the SMEs that supply them, collaborate with them, or spinoff from them.”

European Infrastructures and the Europe 2020 Strategy “Inspiring Excellence”, Carlo Rizzuto, ESFRI Chair 2008-2010

⁵ <https://www.esfri.eu/esfri-scripta-series>

Other relevant recommendations to overcome the actual barriers in the relationship between RIs and Industry coming from the ESFRI Working Group on Innovation, as stated in the 2016 Report⁶, are as following:

- Support the ILOs [editor's note: in ENRIITC terminology, this is equivalent to Industry Contact Officers]
- Promote the creation of Industry Advisory Boards
- Raise awareness on RIs access and services for industry
- Develop a transparent data management policy
- Anticipate the foresight of purchase of large equipment in European RIs
- Support the pre-development of highly innovative components
- Define Roadmaps and strategic agendas
- Develop new collaborative frameworks for co-innovation between RIs and industrial companies
- Promote the development of local or regional ecosystems integrating RIs, T-infrastructures, Technology and service providers, industrial users

Another useful source of recommendations, even if more general, is the “Report on the Consultation on Long Term Sustainability of Research Infrastructures”⁷ published by the EC in May 2016. The document is based on a survey which aimed to collect the view of the stakeholders on the interrelated pre-conditions that could ensure the long-term sustainability of RI and the potential actions/measures to tackle the challenges posed by their implementation.

The communities targeted by the consultation were European Research Area (ERA) stakeholders, European Strategy Forum for Research Infrastructures (ESFRI) projects, European Research Infrastructure Consortia (ERIC), ESFRI delegations, members of the Programme Committee for the RIs part of Horizon 2020, e-Infrastructure Reflection Group (e-IRG) delegations, EIROforum, International Organisations, RI associations, National Contact Points (NCP), and science attachés from strategic third country partners.

3.5 RIs and Open Innovation concepts

Open innovation is an important concept for making knowledge available across the European institutions:

“Open innovation is about involving far more actors in the innovation process, from researchers to entrepreneurs, to users, to governments and civil society. We need open innovation to capitalise on the results of European research and innovation. This means creating the right ecosystems, increasing investment, and bringing more companies and regions into the knowledge economy.”

Carlos Moedas, Commissioner for Research, Science and Innovation

The words of Carlos Moedas pinpoint the main idea, “creating the right ecosystems” to overcome the barriers and generate a virtuous circle to capitalise all the investments in curiosity-driven research to

⁶ https://www.esfri.eu/sites/default/files/wginno_final_report_032016.pdf

⁷ https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/lts_report_062016_final.pdf

open new market thanks to breakthrough discoveries possibly. The contribution of European RIs to Open Innovation is enormous, but is too often underestimated.

Much knowledge is assembled at the individual RIs, and free circulation of researchers and knowledge would lead to better cross-border cooperation, building of critical mass and continent-wide competition. “Open Innovation”⁸ models that have produced phenomena like Hackathons as a means of generating new ideas may also be employed, which the following statement from the ESFRI Scripta publications testify:

The open innovation model does include Research Infrastructures at the supply side of new knowledge and also as effective testbeds of innovative devices that can be benchmarked against mature technologies in performing research. Detectors of particles, X-rays, neutrons, and their associated ultrafast, low noise electronics are developed first and qualified later by their adoption by RI for advanced research, yielding very direct innovation in all field of applications in medical, environmental, information, production monitoring. Reference signal sources, from light emission devices to precision clocks, are again developed and qualified by adoption at RIs. In the bio-medical sector RIs make available samples, images, protocols that continuously enrich the knowledge basis for open innovation to flourish. In the broad-band communication of data and high power / high throughput computing, as well as in environmental observation and modelling, or in societal studies, the RIs provide again the most advanced testbeds for innovation.

Giorgio Rossi, ESFRI “Innovation-oriented cooperation of Research Infrastructures” vol. 3

4. Strategic recommendations

While the impact of RIs is evident from the previous chapter, access to a combined knowledge of strategies that RIs may adopt to unlock the innovation potential is currently missing. A collaborative approach to innovation that implies a distributed, participatory and more open way of thinking will advance the agenda for innovation facilitated by RIs.

As underlined by Octavi Quintana, Principal Adviser, DG RTD, EC during his keynote at the II RICH Symposium in Lisbon in 2017, only a minimal part of the innovation conducted in the RIs is currently linked to the direct involvement of industry whose participation as partners in the use of RIs is typically at a maximum of 10-15% of the available access. Quintana continued by saying that many distributed RIs provide a large amount of data that are largely used by policymakers, scientists and other stakeholders to develop new strategies for the growth of a sustainable economy and society, but a quite small amount is used by industry as a user.

However, in order to pave the way for a virtuous innovation cycle, it is fundamental to keep in mind that due to the missions of RIs, they are unable to develop a business plan oriented to the market and it is much more difficult for them to design innovation plans to meet industry halfway.

The differences in the innovation processes between RIs and industry and the gap between the business management of a curiosity-driven research framework and a market-driven innovation

⁸ <https://doi.org/10.1016/j.respol.2010.01.013>

framework make a strong point on how much RIs and industry could be integrated into a coherent and efficient innovation chain

In order to create an efficient knowledge base that will support industrial innovation and Open Innovation models between RIs, we propose a new strategy to exploit the innovation potential of RIs employing a new “Research Infrastructures Innovation Preparedness Roadmap” consisting of five main initiatives.

The Roadmap proposal presented in this document is a further development from the model published by EMSO as deliverable 18.5⁹ in the ENVRI-plus project (see Section 1.3. It consists of five key actions designed to help structure and organise the way RIs engage with industry.

The model proposed is tailored for ESFRI RIs. Indeed, ESFRI works with a mandate from the EU Council to support a coherent and strategy-led approach to policymaking on RIs in Europe, and in addition we needed to leverage the ESFRI clusters to make the most out of what is already existing and diminish the time to operation. However, while the ESFRI infrastructures represent the core component of any cluster, other relevant world-class RIs with a European dimension could also be involved in a cluster, as stated in the text of the topic INFRAEOSC-04-2018¹⁰.

The Roadmap is composed of five main actions, which are listed below, that are particularly targeted to help nurture emerging RIs wishing to better engage with industry via a core support environment:

1. Establish a pan-European ICO/ILO network
2. Adopt a set of core competencies for ICOs and ILOs.
3. Each RI should review and implement specific key actions
4. Building strategic alliance relationships
5. Develop a European Research and Knowledge Exchange Strategy tailored for RIs

The following sections provides further details for each of the five proposed actions.

Initiative 1: Establish a pan-European ICO and ILO network

The network should contain the following components:

- An “Innovation and Industry Services Central Support Hub” joined by ILOs from all countries and ICOs from all interested RIs.
- A sub-organisation at the ESFRI domain cluster level composed of Industry Contact and Innovation specialists working in close collaboration with the central hub.
- Two steering boards taking decisions on the hub priorities and representing the ILO-side (e.g. PERIIA board) and the ICO-side (the ICO network mentioned above).

The core activity of the hub is to provide advice and support to all manner of RIs in their engagement with industry, drawing upon existing experience and good practice and building its body of knowledge as the hub matures. The hub will get a head start by building on the ENRIITC actions and network. This pan-European “Innovation and Industry Services Central Support Hub” will have the missions to:

- define and update the training path and opportunities for ICOs and ILOs,
- offer an exchange platform for collaboration between ILOs/ILOs on innovation,

⁹ http://www.envriplus.eu/wp-content/uploads/2019/07/D18.5-RI-Innovation-Roadmap_V2.pdf

¹⁰ https://cordis.europa.eu/programme/id/H2020_INFRAEOSC-04-2018

- coordinate the support offer provided to ICOs and ILOs,
- coordinate a network level approach with other pan-European entities, for example:
 - EIT, for building new partnerships with industry and aligning the policy with the needs of industry,
 - PERIIA, to maintain the link with ILOs and to develop a common language and to adapt the actions to the changes ongoing in industry in terms of procurement and innovation,
 - EIROFORUM, for coordinating industry aspects of Big Science facilities,
 - BSBF International Organising Committee, for collaboration and communication about the BSBF events,
 - EOSC DIH, for being aligned with the actions taken to facilitate industry in finding useful services at EOSC level.
- offering a regular source of RI innovation success stories to complement those on RI scientific achievements, and
- operate an identity for ILOs and ICOs towards other European entities.

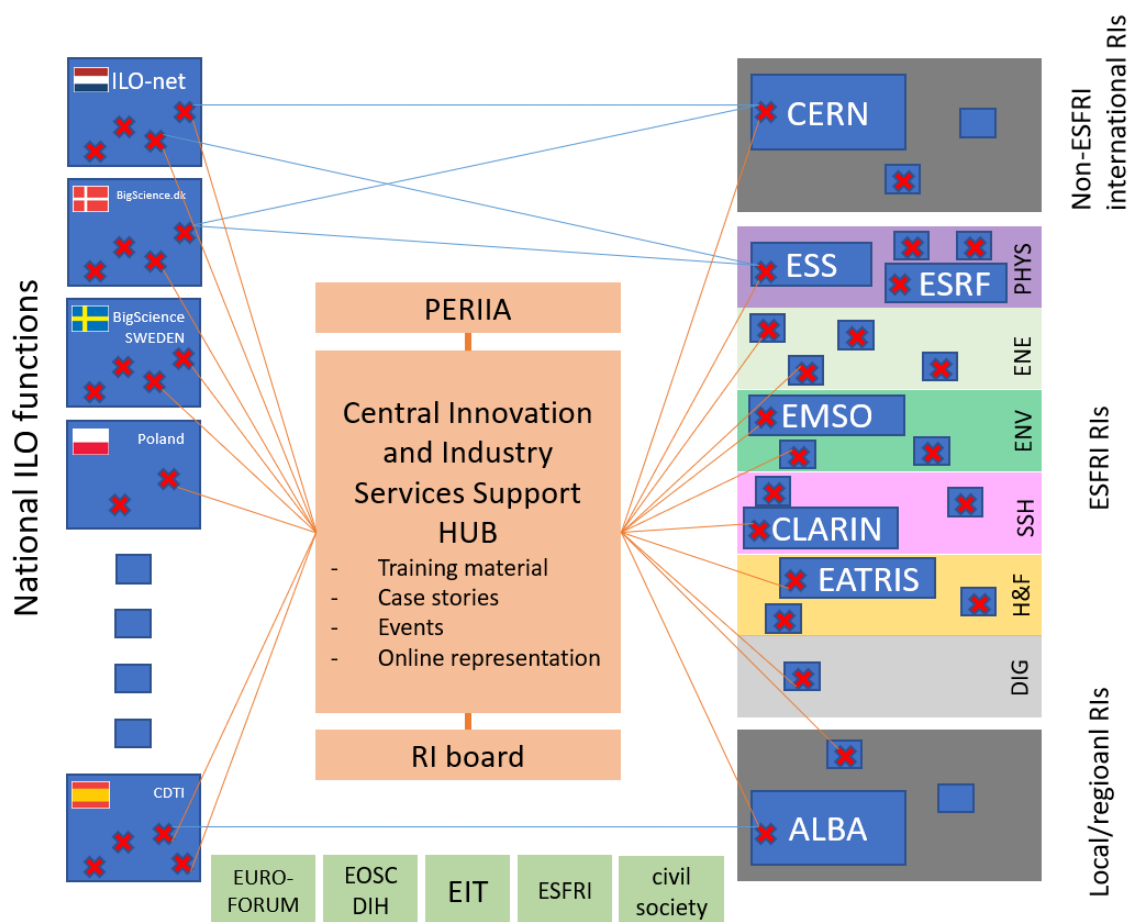


Figure 4 - Hub and spoke pan-European network for supporting RIs in building fruitful relationships with industry. Each red cross marks a person who can seek knowledge from the hub or the peers. It includes national ILOs and ICOs and procurement persons employed by RIs. Green boxes indicate identified pan-European collaborators (see Initiative 4). Here, "civil society" includes, e.g., non-academic, public sector entities with a potential interest in using the knowledge and tools generated at RIs.

In addition, the hub should support and complement RI innovation staff, focusing also on adding value in situations involving:

- multidisciplinary aspects,
- industry-academia research collaboration across a range of parties,
- cross-RI interactions in multiple domains, with and without industry partners,
- dynamic forum for requesting contacts and matchmaking, and
- connections to international partners.

Services provided by the central support hub and the ESFRI cluster hubs may also include:

- real time advice for RIs,
- document support, such as providing template documents for frequently occurring technology transfer situations (MTA, CDA, etc.),
- yearly joint industry/RI workshops on innovation, knowledge sharing, etc.,
- guidelines and assistance with cross-infrastructure, industry/academia collaboration and knowledge sharing,
- access to specialist knowledge concerning business development and legal, regulatory or ethical aspects, and
- on a case-by-case basis, hands on involvement by hub staff with real collaboration and negotiation cases.

The hub may be complemented by sub-hubs at the ESFRI cluster level that will support the RIs in:

- facilitating the developing and maintaining of relationship with cluster specific industrial stakeholder,
- promoting opportunities and services offered by the cluster RIs, and
- advising on specific cases when issues come up in the process of collaborating with industry.

Potentially, the hub could also host an online identity towards companies, although this needs to be carefully considered in correlation with existing portals and offerings from individual RIs such as ESRF¹¹ and CERN Knowledge Transfer¹² (see also ENRIITC D2.2 “Report on Information Portals and Opportunities with RIs”).

As an example, we highlight the attempt to collect offerings of many RIs in the CatRIs portal¹³ and the showcasing ability of the University of Edinburgh with Edinburgh Innovations¹⁴ and its portal to help commercial organisations to build innovative ideas using the right technologies, expertise and facilities at the university.

This could also be done in collaboration with partners such as EOSC DIH, EIT and PERIIA.

Initiative 2: Adopt a set of core competencies for ILOs and ICOs

¹¹ <https://www.esrf.fr/Industry/our-services>

¹² <https://kt.cern/>

¹³ <https://project.catris.eu/>

¹⁴ <https://edinburgh-innovations.ed.ac.uk/>

Regarding the ILOs/ICOs outlook, attitude, duties and competencies, the first point is to find a common agreement on the definitions of both job roles. The definitions put forward by the EC in the text of the call, and from which ENRIITC started, are the following:

Industry Contact Officers (ICO) are research infrastructure staff in charge of developing business relations with all potential industrial suppliers of innovative components or services as well as encouraging the economical use of their facility by private players.

Industry Liaison Officers (ILO) are generally officially appointed by the Member States and Associated Countries to stimulate the collaboration among the national industry and the international research infrastructures, providing advice on business opportunities, R&D collaborations, calls for tenders and industrial services.

The first point that emerged from the responses to the survey sent out as part of the Task 3.2 is that there is confusion on the terminology and the job title “Industry Contact Officer” is not yet perceived by RIs personnel as it is defined by the EC yet. Instead, the ICO is deeply rooted as ILO.

This misunderstanding is due to the fact that in a lot of research institutions the ILO is usually what we call an ICO. There are other examples at the European level as the ENVRI-Plus deliverable 18.5 “RI innovation and industry liaison preparedness roadmap”¹⁵ in which the ILO assumes the role of what we call here an ICO. A similar terminology was adopted by the ESFRI Working Group On innovation in the Report 2016¹⁶. Therefore, a clear communication campaign is needed to introduce and consolidate the terminology adopted by the EC and ENRIITC.

Considering ILOs, it must be emphasised that not all ILOs are officially appointed by the Member States and Associated Countries. For instance, in The Netherlands, ILOs are employed in scientific research institutes and also engage in the science at the RIs. This means that they are focused on low TRL technology developments in the domain of industry as a supplier. The low TRL technologies is an added barrier for companies on the Big Science market. The collaboration between ICOs and ILOs should be much more focused on addressing this part of the innovation chain (pathway) to overcome the barriers above mentioned.

ILOs need to entertain both soft skills (e.g. communication, management, networking) and hard skills on business knowledge, EU-funding schemes, event organisation, collaboration models (e.g. technology transfer), negotiations and IPR.

A clear recommendation for each RI is to appoint an ICO at RI level, whose staff needs to be highly competent, made of experienced individuals with specific knowledge of technology transfer and commercialisation strategies, including patenting processes, along with excellent market insight, extensive professional networks and a clear view and understanding of key science themes and drivers.

¹⁵ http://www.envriplus.eu/wp-content/uploads/2019/07/D18.5-RI-Innovation-Roadmap_V2.pdf

¹⁶ https://www.esfri.eu/sites/default/files/wginno_final_report_032016.pdf

It is also desirable that the ICOs have adequate legal and economic competence to make an initial assessment whether an invention or process is patentable or not, and with sufficient marketing and business skills in order to identify commercial partners.

Regarding more specifically the skills and competencies that ICOs should have to cover the role properly, we have identified the following lists of skills. A first list identifies the soft skills and a second one the hard skills. However, it is quite clear that in particular for the hard ones, it is not possible to define a list one-fits-all, that is because the countless differences between the hundreds of RIs, also if we limit our target to the ESFRI RIs.

A proposal for the list of the soft skills developed has been developed within Task 3.2 “Development of strategy for the training of ILOs/ICOs” and included in D3.3 “Strategy for training of ILOs/ICOs and outreach towards industry”. In summary, what emerged from the survey carried out in the Task 3.2 and during the meetings of the Focus Groups is that the ICO should be able to communicate and negotiate efficiently, and have skills in conflict management, decision making, facilitation, and supervising.

The skillset and desirable experience of ICOs is wide and diverse. As such, the training path provided by the proposed hubs should include courses to update the ICOs expertise to deal with the ever-evolving scenario of industry engagement in the context of complex societal challenges in Europe,

Overall, it is relevant to underline the importance of the introduction of managerial courses to develop skills in project management, data management, business management and general management, as remarked by the outcomes of the EC consultation¹⁷ that brought to the “Report on the Consultation on Long Term Sustainability of Research Infrastructures”.

Initiative 3: Each RI should review and implement specific key actions

The ENRIITC D3.2 “Strategy for innovation and industry-RI cooperation” list 17 key areas with recommended actions to help the RI improving their collaboration with industry AND to establish a common baseline for RIs for developing systematic innovation-partnering industry-liaison programs.

The recommendations are categorised into four groups as shown in the figure below:

¹⁷https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/lts_report_062016_final.pdf

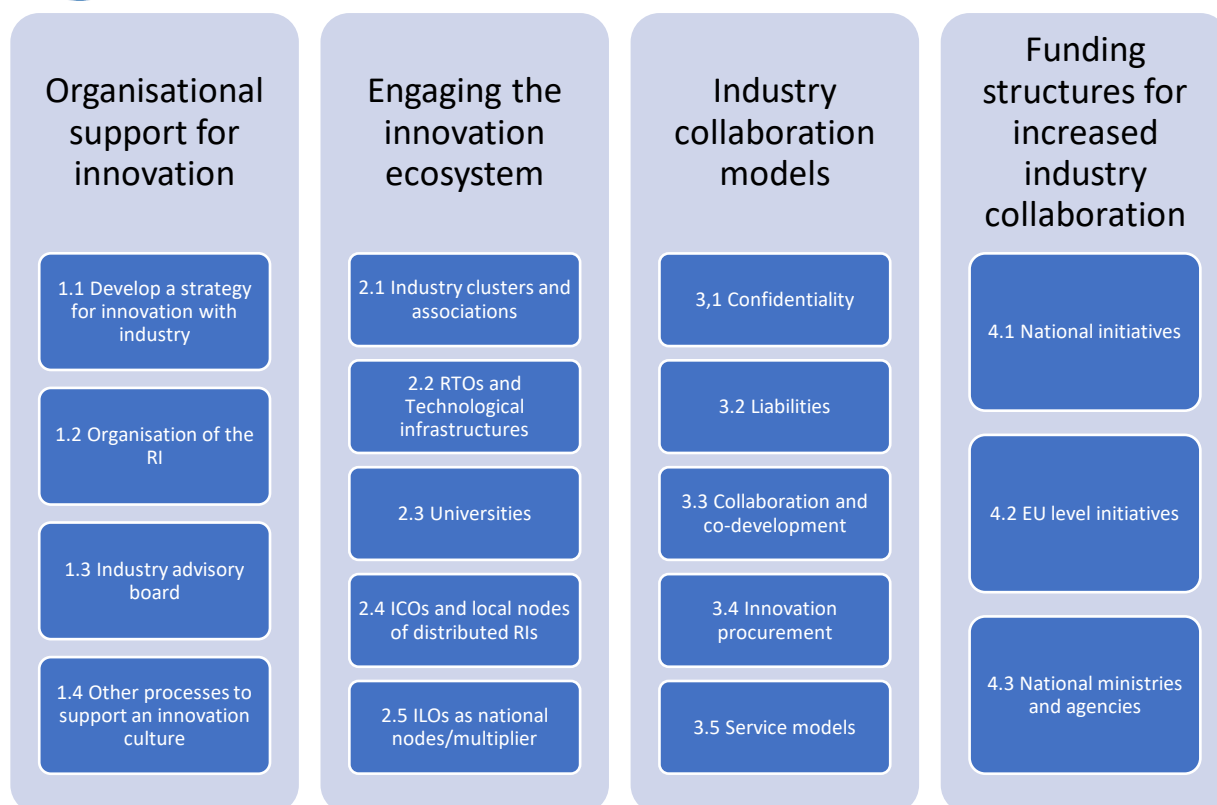


Figure 4: The 17 key areas with recommendations for RIs to improve their engagement with industry (from D3.2).

The actions in the list are described in detail in D3.2 (“Strategy for innovation and industry-RI cooperation”), but it is worth highlighting the role of the hub in this context as a platform for knowledge exchange and interaction between ICOs and ILOs for discussing how to implement the items. The hub should host events focussing on individual points and present examples and best practices for the community. Also, an open debate forum about the activities will lift the quality of industry engagement in the RI community and ensure on-going dynamic adjustments of the strategies in the ever-evolving societal and political environment.

Initiative 4: Building strategic alliance relationships

As outlines in key area 2 “Engaging the innovation ecosystem”, each individual RI should pursue collaboration with relevant local/national/European stakeholders. In parallel, we recommend that the RI community of ILOs and ICOs as a whole should build European level alliances via the hub proposed in Initiative 1.

The purpose is to ensure that the RI operational model and interactions modes with industry is understood and recognised at a European level, so that innovation policies and strategies recognise the role of RIs and lowers the barriers for both EU organisations and the potential individual collaboration partners (see key area 2) to engage in collaborations with RIs.

We consider the following European central structures to be of big importance:

- The European Institute of Innovation and Technologies¹⁸ (EIT) Knowledge & Innovation Communities (KICS) for cooperation on joint Entrepreneurship Training programmes and Industry-partnering event organisation.

¹⁸ <https://eit.europa.eu>

- The PERIIA Network¹⁹, which has the aim of paving the way and preparing for the initiation of the Pan-European RI ILO Association as a formal European association. In fact, the hub should try to integrate activities with PERIIA.
- EIROFORUM²⁰, which is the forum for policy coordinating and lobbying between 8 Big Science organisations.
- The EOSC Digital Innovation Hub²¹ (DIH), an international and multi-partner cooperation that supports companies in easily accessing the digital technologies and services offered by EOSC.

As an example of the possible collaborations with EIT KICS, an example of what the ESFRI clusters could do in this direction is the meeting that took place on March 5, 2018, where ENVRI-plus representatives and European Institute of Innovation and Technology (EIT) management met at EIT headquarters in Budapest to explore opportunities for structured collaboration between ENVRI RIs and EIT Knowledge & Innovation Communities (KICS) such as define a plan for a long-lasting collaboration, RI industry liaison activity, partnering events and related training. Participants identified numerous collaboration themes which have formed the basis for follow-up and formal MoU accord between EIT and the Board of European Environmental Research Infrastructures (BEERI). Of these, Entrepreneurship Training of RI personnel and joint recruitment at focused RI-industry partnering events were areas participants agreed to offer the greatest opportunity and scope for cooperation.

Moving to the collaboration with EOSC DIH, what is clear at the moment is that ESFRI Clusters Marketplaces²² developed within EOSC Portal are not devoted to showcasing services for industry. Likely that will be done within the project “EOSC Future” but actually EOSC DIH fills this gap, trying to help industry to find the opportunities and services offered by the RIs whether it be data related or about other services.

Supplementary to these high-level interactions, the hub should ensure strong links with industry via the four different categories listed below. Representatives from these group may be linked directly to the hub or via single RIs, RI-clusters, ILOs or ICOs:

1. Industry Association and Interest Group Aggregators: Pan-EU and national industry federations and associations, as well as industry lobby and interest groups that actively follow and advise on socio-economic issues and technology developments on behalf of private sector members and stakeholders. Such organisations usually have strong sectoral focus and expertise and can be valuable partners in helping pre-qualify and recruit RI company interlocutors and focused brokerage events participant. Appendix 3 contains a list of the most relevant aggregator organisations with a short profile and coordinates.
2. Industrial suppliers: Most often, these are found in networks or clusters operated by national ILOs that includes companies operating as providers of both off-the-shelf components and state-of-the-art technologies. Of particular interest for innovation purposes are start-ups and companies engaged in collaborative development programmes which may also be found in the next group.
3. Industrial collaborators: Potential RI industry partners who are engaged in technologies of interest for RIs, for example superconductivity, cryogenics, big data processes and AI,. These

¹⁹ <https://periiia.squarespace.com/>

²⁰ <https://www.eiroforum.org/>

²¹ <https://eosc-dih.eu/>

²² <https://marketplace.eosc-portal.eu/services>

companies are natural allies of RIs in building, e.g., technical competence centers, data management/open data access as well as the semantic technologies to exploit and enrich research data.

4. Industrial users: Industry in this group mainly acts as user of the RI facilities, services and data, for early-stage applied industrial research and for testing innovative developments and products. Additionally, industry uses RIs for training within the framework of exchange programmes. In this respect, the access to RIs by industry is regulated by the “European Charter for Access to Research Infrastructures - Principles and Guidelines for Access and Related Services”²³.

Initiative 5: Develop a European RI Innovation Strategy

The work in ENRIITC can be considered the initiation of the formulation of a European RI Innovation Strategy to describe the ambitions for a better integration between RIs and industry. It has become clear during the operation of ENRIITC that such an initiative would help the RI community (including ICOs and ILOs) to understand their role and how to train to increase the efficiency of their activities.

This practice is quite common in the UK at research organisation and University level ^{24 25 26} and has been found as key to run profitably research organisation to enhance dialogue and interchange between researchers and wider society.

In our case, the strategy should be developed to increase the exchange of knowledge between RIs and Industry and consequently also between ICOs and ILOs. Also, regular consultation with industry are necessary to ensure up-to-date available material. It is indeed paramount that ICOs and ILOs reassess periodically how the procedure and techniques defined are aligned with the market, research and innovation practices and with the societal challenge Europe will be facing.

The strategy could be inspired by the ones developed by University of Salford²⁷, Manchester, or University of Oxford that are very well written and an efficient example of such a strategy.

The key objectives of a European RI Innovation Strategy could be:

- Enable RIs to be the core engine of the innovation supply-chain facilitating the constituency of spin-offs, start-ups and partnerships with private entities in close cooperation with the universities.
- Have systematic knowledge exchanges with industry all over Europe to activate a virtuoso cycle to add value to the research outcomes creating new markets.
- To produce internationally excellent research with industry to foster European excellence in science and innovation companies.
- To exploit the potential of RIs as excellent workplaces for researcher training and career development for functioning as high quality pipeline of future research and industry leaders starting from graduates and postgraduates, or industry employees to become conversant with the latest scientific discoveries, technologies and scientific methodologies.

²³ https://ec.europa.eu/info/sites/default/files/research_and_innovation/2016_charterforaccessto-ris.pdf

²⁴ <https://www.lancaster.ac.uk/health-and-medicine/work-with-us/knowledge-exchange-strategy/>

²⁵ <https://researchsupport.admin.ox.ac.uk/files/knowledgeexchangestrategy.pdf>

²⁶ <https://sphr.nihr.ac.uk/wp-content/uploads/2018/12/NIHR-SPHR-Knowledge-Exchange-Strategy-2018-2022.pdf>

²⁷ <https://www.salford.ac.uk/sites/default/files/2020-06/Research-and-Knowledge-Exchange-Strategy-Web.pdf>

Conclusions

The starting point for our conclusions is that the first point to be considered regarding European RIs is that the landscape of European RIs is quite fragmented. There are distributed RIs and single-sited RIs, as well as many different disciplines, domains and levels of maturity.

However, after the many consultations within the ENRIITC community, a clear need for a centralised platform for exchange of knowledge, best practices and training material emerged. This platform may be able to take on the role of empowering the voices RIs in the coming years debate regarding the European innovation landscape.

In total, five key strategic initiatives are expressed in the report:

1. Establish a pan-European network of ICOs and ILOs.
2. Adopt a set of core competencies for ICOs and ILOs.
3. Each RI should review and implement specific key actions.
4. Building strategic alliance relationships.
5. Develop a European RI Innovation Strategy.

It is clear that RIs can play a strong role to drive innovation. Regarding the impact that the RIs-Industry relationship could have on society, consider the list presented in the report “ESO’s benefits to society”²⁸:

- Industrial return to Member States.
- Expansion of business activities and commercial.
- Gain from new expertise.
- Regional economic effects in Host Countries.
- Commercial gain for suppliers from improved market position.
- Creation of new jobs, including high-tech.
- Improved industrial collaborations and capabilities to deliver complex solutions..
- Uptake of innovative technologies in various domains.

A clear example of the key role EU RIs already have in responding to the societal challenges is the way in which the European Research Infrastructure for Life Science Data (ELIXIR) has provided open access to data, tools and workflows in the response to the COVID-19 pandemic²⁹.

ELIXIR’s 23 nodes have reacted quickly in supporting the scientific community in the effort against the pandemic setting out three joint priorities:

1. Connecting national COVID-19 data platforms to create federated European COVID-19 Data Spaces;
2. Fostering good data management to make COVID-19 data open, FAIR and reusable over the long term;
3. Providing open tools, workflows and computational resources to drive reproducible and collaborative science.

²⁸ https://www.eso.org/public/archives/brochures/pdf/brochure_0076.pdf

²⁹ <https://www.nature.com/articles/s41431-020-0637-5>

The plan presented in this report intends to level up the capacity of the EU RIs in make an impact on societies by supporting them in developing fruitful relationships with industry. That means to give the RIs the tools and the knowledge needed to become the main engine of the European innovation ecosystem.

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Appendix 1 - Main recommendations from ESFRI

The main recommendations that could ensure the long-term sustainability of RI emerged from the consultation³⁰, are the following:

1. *Ensuring scientific excellence*

The responses highlight the importance of independent peer review as a mean to foster scientific excellence. **Stable long-term funding** is also raised as one of the main drivers for keeping the RI at the forefront of science. In addition, respondents stressed the need for the RI to maintain their attractiveness both as service providers and as employers.

2. *Managing tomorrow's RI*

The respondents acknowledged the need for developing **managerial skills** but did not associate this with the requirement for harmonised accredited curricula. However, respondents highlighted the benefits of **exchange programmes** for managers between RI.

The development of RI user skills & outreach was considered a relevant measure and associated this need to the presence of specific training for RI users, including industry users.

Different measures for increasing RI attractiveness as employer were put forward - most of them related to **working conditions' improvement and career perspectives**.

3. *Unlocking the innovation potential of RI*

The RI innovation potential is widely untapped since both **RI and Industry do not fully perceive the benefits of collaboration**. This requires a **change in the mind-set** of the communities involved in the innovation cycle (RI, Academia and Industry). The responses highlight a need to attract industry both as supplier and as a user of RI through more effective processes such as the co-innovation approach, which would enable to maximise synergies between science and industry, address new markets, promote commercial application of science and facilitate commercial exploitation of research findings.

4. *Measuring the socio-economic impact of RI*

The findings demonstrate the perceived relevance of direct and indirect, tangible and intangible benefits deriving from the use of RI services and instruments. However, the importance of assessing socio-economic impact of RI varies according to the profile of the respondents. As such, funding organisations rank this dimension much higher than the RI operators and the Research Performing Organisations. Moreover, the acknowledgment of the need to **measure impact** has not yet resulted in a systematic assessment and evaluation of such impacts throughout the life cycle of RI.

5. *Exploiting better the data generated by the RI*

Respondents highlighted the need for RI to take responsibility for the **Data Management** dimension with specific reference to the data storage, curation, access, and re-use aspects. The requirement for a more integrated and interoperable approach to the data challenge was also clearly highlighted, keeping into account, whenever necessary, the ethical, privacy, security, and copyright and IPR constraints.

6. *RI Life cycle – Upgrading*

³⁰ ESFRI Scripta Vol. 2: Long-Term Sustainability of Research Infrastructures 2017

The responses demonstrate that RI tend to include upgrading as part of their life-cycle management. Upgrading decisions are mostly based on a landscape analysis, which is developed on a multi-level approach considering inputs from several stakeholders such as users, scientific advisory boards, industry, and funders. At the same time, most RI do not consider international evaluation standards to be necessary in this context.

7. RI Life cycle – Decommissioning

Most of the organisations do not include decommissioning in their lifecycle management and business plan. Among the RI that do plan the decommissioning phase, it appears that channelling the know-how and transferring data are the dimensions that require closer attention.

8. Ensuring sustainable governance of RI

The outcomes of the consultation highlight a requirement to establish better **synergies among national roadmaps** and to have these synchronised with the funding planning processes in the Member States. National processes would need to be inserted into a European strategy, reason for which the EC should take a greater role in monitoring, supporting and facilitating the whole exercise. On the ERICs' further development, as it is still a relatively new legal instrument, there appears to be a general view not to propose immediate changes as much as to continue overseeing its implementation. Simultaneously, the respondents identified a number of areas for further development of the instrument such as **VAT exemption**, extension of the ERIC applicability to EURATOM, to international consortia and to research networks.

9. Funding the construction and operation of RI

The outcomes of the consultation indicate that there is a need to further **stimulate the promotion of the business models development**, the **encouragement of industrial investment** for products and services joint development and the fostering of **new sources of funding**. Among the possible measures identified to overcome such situation are possible tax incentives for (private) investment as well as a wider **awareness/ promotion of RI services**.

10. Structuring the international dimension of RI

The responses highlighted that the international outreach of RI is only limitedly addressed. Improving **cooperation with strategic partners** and stakeholders and promoting it with an effective and multi-channel **communication strategy** are considered the main measures to tackle the challenges posed by the need to better structure the international dimension of RI.

But focusing more on the recommendation on “*Unlocking the innovation potential of RI*”, we can highlight the following outcomes:

- both RI and Industry do not fully perceive the benefits of collaboration
- change in the mind-set of the communities involved in the innovation cycle (RI, Academia, and Industry)
- attract industry both as supplier and as a user of RI through more effective processes:
 - such as the **co-innovation approach**, which would enable to maximise synergies between science and industry, address new markets, promote commercial application of science, and facilitate commercial exploitation of research findings.

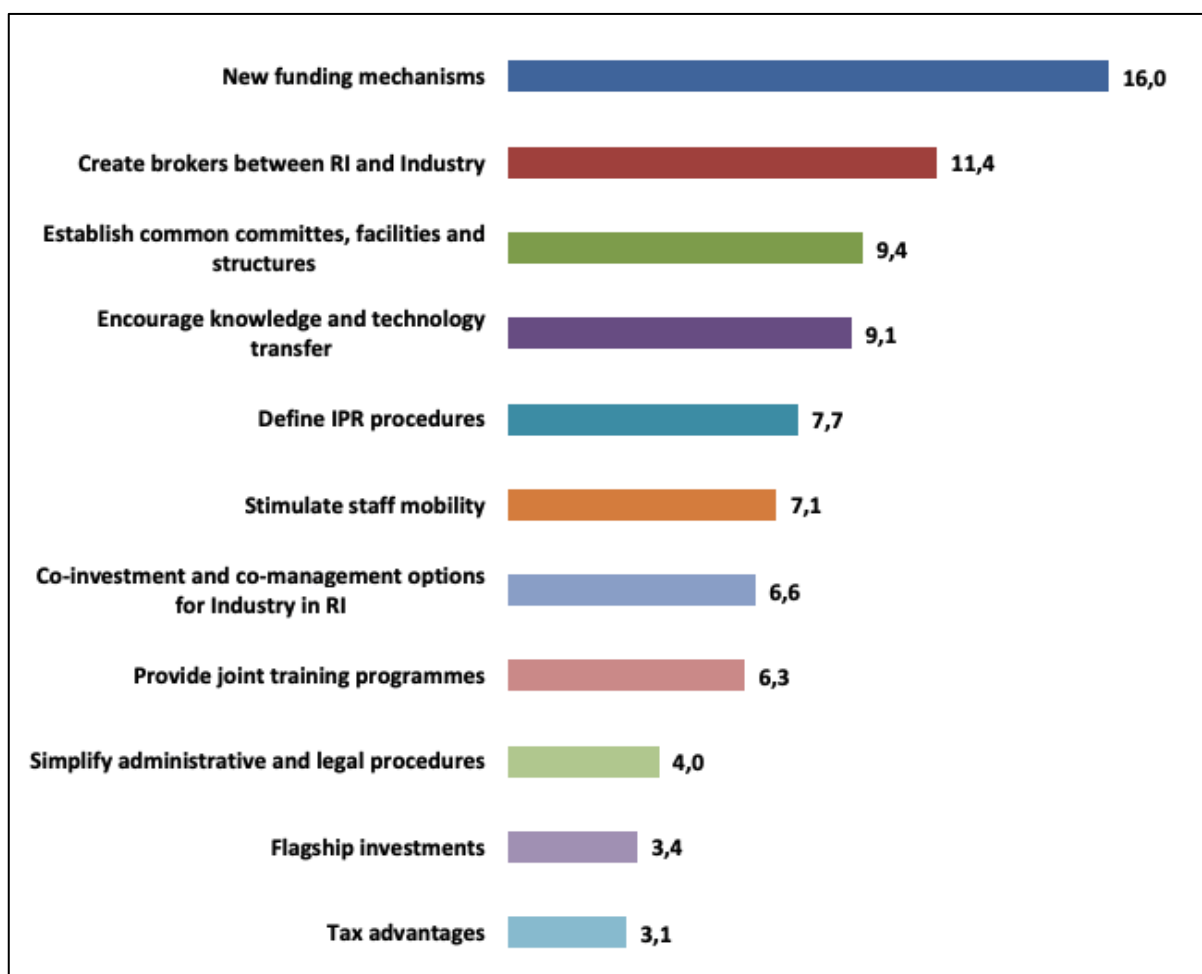


Figure 5 - Initiatives to encourage the cooperation of RI, academia, and industry in the context of open innovation

Keep looking at the same report, respondents were also asked to identify possible measures to be adopted to encourage the cooperation between RI, academia, and industry in the context of open innovation (see Fig. 5).

The most voted answers were:

1. new funding mechanisms
2. create brokers between RI and industry
3. establish common committees, facilities, and structures.

With the model we proposed, we intend exactly to give an answer to the last two points, while the first is not directly in the objectives of this deliverable.

It also interesting to know that among the new funding schemes to be adopted, research performance organisations tended to identify public-private co-investment in an open-innovation process as the most interesting solution.

Other measures emerging from the same consultation include:

- “Subsidy incentive schemes that really favour the innovative industry” [Public research organisation]
- “Funded calls for open innovation” [RI operator – public]
- “Public Private Partnerships Vouchers” [Multiple respondents]
- “Additional resources/programmes for financing joint technology development between RI and industry” [RI operator – public]
- “Support funding of new start-up companies based on inventions” [RI operator – public]
- “Special funds addressed to industry in order to reduce the Risk of its participation in projects or joint research with RI and academia” [Public research organisation]

It has also been asked to indicate the main measures that should be taken to ensure that Europe preserves a competitive advantage for the development of key technologies required for the RI, and respondents attribute a clear role to the EC (Fig. 6) in this domain.

Ensure the long-term sustainability of RIs, unfortunately remains the main issue nowadays. While the clustering of RI belonging to different domains and different countries has been achieved by the EC with the topic INFRAEOSC-04-2018, however the scope of the topic was restricted to the collaboration for developing the thematic marketplace within the EOSC portal.

From this point of view, a much wider scope and goals should be given to ESFRI clusters to shape the future of RIs landscape even beyond EOSC.

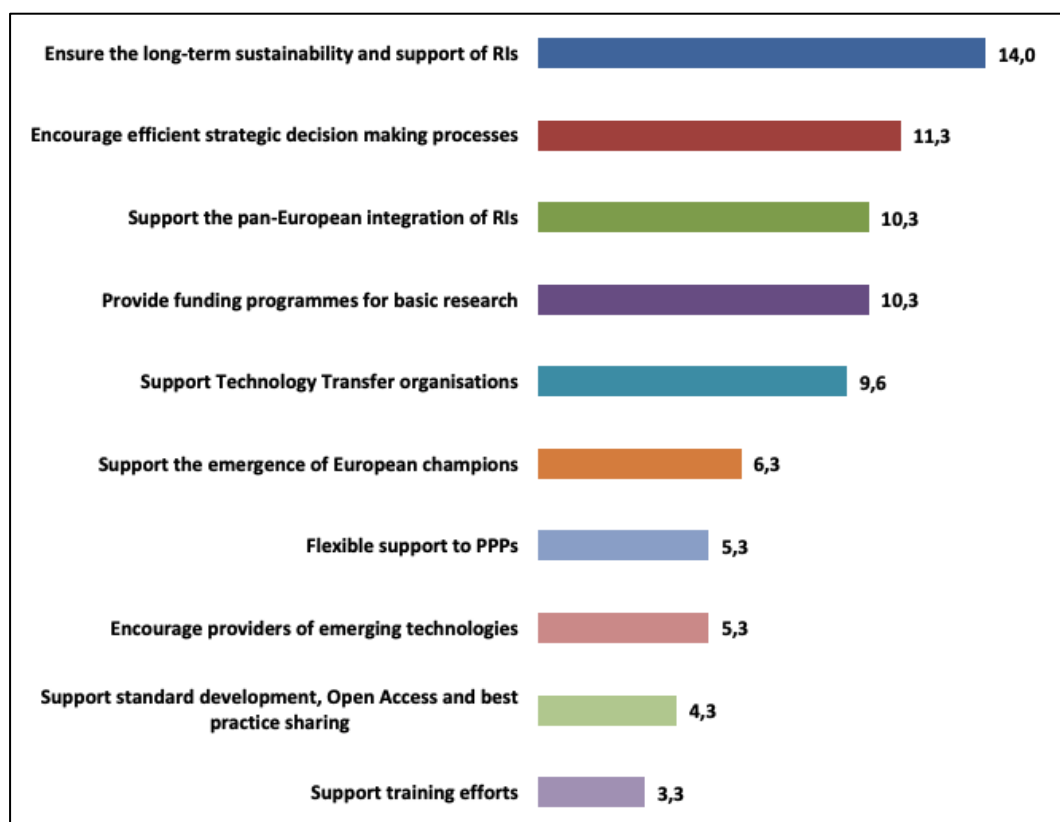


Figure 6 - Measures to ensure that Europe preserves a competitive advantage for the development of the key technologies required for the RI of tomorrow (%)

To summarise the outcomes of the survey in terms of how much the innovation potential of RIs has already been exploited and what are the next steps to exploiting the full potential, it seems that the main point is that both RI and Industry still do not fully perceive the benefits of collaboration with each other. From the survey emerges that to cope with this impasse, it would be required a change in the mind-set of all the communities involved in the innovation cycle (RI, Academia, and Industry). Such cultural change should lead to increased cooperation among RIs and between RIs and industry. The responses also highlighted the need to attract industry both as supplier and as a user of RI through more effective processes such as the open-innovation approach which would enable to maximise synergies between science and industry, address new markets, promote commercial application of science, and facilitate commercial exploitation of research findings.

To integrate and follow up on what has been emerged from the survey, we can give a look to what Prof. Dr. Gabriele von Voigt, from the e-Infrastructure Reflection Group (e-IRG) presented during the II RICH Symposium in Lisbon, 2017 as a good example of what can be done on top of what presented so far to focus a little bit more on the procurement and commercial aspects of the exploitation of the RIs innovation potential:

- Pre-Commercial Procurement: develop innovative solutions for research/public sector.
 - E.g. HelixNebula for innovative cloud solutions.
- Contractual Public Private Partnerships.
 - E.g. PRACE cPPP on HPC brings together key stakeholders (Next generation technologies, Centres of Excellence for applications, Education/Training/Skills).
- Products/services to the market: start-ups, spin-outs, spin-offs, digital innovation hubs.
 - Sixsq.com: start-up from CERN people on cloud middleware/services.
 - Terradue.com: start-up from ESA people on earth sciences.

These examples are obviously tailored for the e-Infrastructure sector but are also quite relevant for the whole RIs landscape.

Regarding the impact of EU funded PCPs on the procurers and the companies involved, updated data³¹ taken from the first 30 PCP projects outcomes whose procurements are ongoing or recently completed show that:

- **Opening a route-to-the market for new market players:** 71,5% of the PCP contract value is awarded directly to SMEs (86% when adding also indirect awarded contract value to SMEs), more than twice the average in public procurement across Europe (29%).
- **Helping also larger market players bring products to the market:** 16% of PCP contracts are won by large companies as single bidder. 19% of PCP contracts are won by consortia of large companies plus SMEs to bring products together to the market.
- **Impact on stimulating cross-border company growth:** 33,1% of PCP contracts are awarded cross-border, 20 times more than the average in public procurement across Europe (1,7%).
- **Bringing research results to the market:** 30% of contracts have universities or research centers as partners in the winning consortia (often together with university startups)

³¹ <https://digital-strategy.ec.europa.eu/en/news/impacts-eu-funded-pre-commercial-procurements>

- **Contribution to growth and jobs in Europe:** Nearly all bidders (99,5%) are doing 100% of the R&D for the PCP contract in Europe
- **Reducing the R&D risk for procurers / encouraging commercialisation of solutions by vendors:** leaving IPR ownership rights with the vendors reduced the R&D cost/risk for procurers on average with 50% as companies see wider commercialisation opportunities

About cPPPs, as stated by the EC³²,

They help to tackle societal challenges, including climate change, and to support energy and resource efficiency, and to boost digital innovation and security.

They also have an impact on the the global technical lead of European based industry, economic growth and creation of new high-skilled jobs in Europe.

The EU contributes with €7.1 billion while the industry is also committed to leverage further investments in research and innovation, work on cutting-edge technologies and ensure the competitive edge of the European industry.

There are ten contractual public-private partnerships (cPPPs) between the EU and business representatives which have strategic importance for European industry, and they are listed below:

- Factories of the Future (FoF): [European Factories of the Future Research Association](#)
- Energy-efficient Buildings (EeB): [Energy Efficient Buildings Association](#)
- European Green Vehicles Initiative (EGVI): [European Green Vehicles Initiative Association](#)
- Sustainable Process Industry (SPIRE): [A.SPIRE](#)
- Photonics: [Photonics21](#)
- Robotics: [euRobotics](#)
- High Performance Computing (HPC): [European Technology Platform for High-Performance Computing](#)
- Advanced 5G networks for the Future Internet (5G): [5G Infrastructure Association](#)
- Cybersecurity: [European Cyber Security Organisation](#)
- Big Data Value: [Big Data Value Association](#)

Finally, it is very much interesting to analyse the recommendations on the same topic developed in the H2020 project Columbus³³, ended in February 2018, and presented in the same document abovementioned, that are the following:

1. Industry must be involved in the entire life cycle and embedded in the governance.
2. Communications and marketing must be active, imaginative and targeted.
3. Develop the user interface with the user in mind.
4. Brokerage.
5. Engage with intermediaries and catalysts.
6. Signpost the landscape for users.
7. Product development should be driven by the user base.

³² <https://ec.europa.eu/programmes/horizon2020/en/contractual-public-private-partnerships>

³³ <https://cordis.europa.eu/project/id/652690>

8. Cultivate creative and innovative ways to facilitate data-sharing by private sector actors.

Regarding point 1, it is reasonable after ten years from the establishment of the first ERIC, namely SHARE-ERIC³⁴, to say that it is high time for the RIs to involve in its consortium not only research institutions but also other stakeholders, to adapt much more the strategic plans to the real needs of the community.

A very good example of that is what happened to the E-RIHS³⁵, the European Research Infrastructure for Heritage Science, consortium in the last ten years. Started as a group of STEAM research organisations focused on the analysis of cultural heritage pieces of art, E-RIHS, starting with the project IPERION CH³⁶, and then with IPERION HS³⁷, began to involve SSH organisation from the GLAM sector, such as museums and archives, to become one of the best example in the ESFRI landscape of a transdisciplinary and inclusive RI. This kind of actions are able to foster enormously the socio-economic impact because they embed in the management board of the RI, core stakeholders which are already part of the innovation cycle. In this way, the decision-making process could built up on the feedbacks and needs of the all supply-chain constituents.

In this respect, the stakeholder engagement plan has a fundamental role in giving the spark to the process of inclusion and involvement of all the key actors.

There are a few key elements should be taken into consideration in developing such a plan:

1. Set the context and the level of engagement
2. Define the WHY, WHO, WHEN and HOW:
 - WHY: reasons for engaging.
 - WHO: map the stakeholders (identity cards, taxonomy and the role they can have in the innovation process) and their needs.
 - WHEN: the timing is a critical success factor in this process.
 - HOW: channels, tools and network to reach them out.

Platform for collaboration

To make the collaboration between RIs and Industry happen, a game-changer could be the adoption of a RIs-Industry permanent collaboration platform managed by the start-up “Innovation and Industry Services Support Central Hub”.

The idea behind it, is to find the way to attract industrial users with an effective tool presenting a clear value proposition offer through a catalogue of services for industry acting as user, co-developer or supplier.

The main aspects to be considered in designing this platform are:

- One-stop-shop: a unique point of sell and contact to cut searching time.
- Develop a smart catalogue of services:
 - With easy overview of the offer with keywords to guide the user through the portal.
 - A cart to build the most suitable offer.

³⁴ <https://www.eric-forum.eu/wp-content/uploads/2020/07/ERIC-Forum-brochure.pdf>

³⁵ <http://www.e-rihs.eu/>

³⁶ <http://www.iperionch.eu/>

³⁷ <http://www.iperionhs.eu/>

- Include a helpdesk to support the user in building complex portfolio of services.

A valuable example of what could be done, is the platform “Way for Light”³⁸, created during the FP7 funded project CALIPSO, to offer a single-entry point for information about the European synchrotrons and free electron lasers.

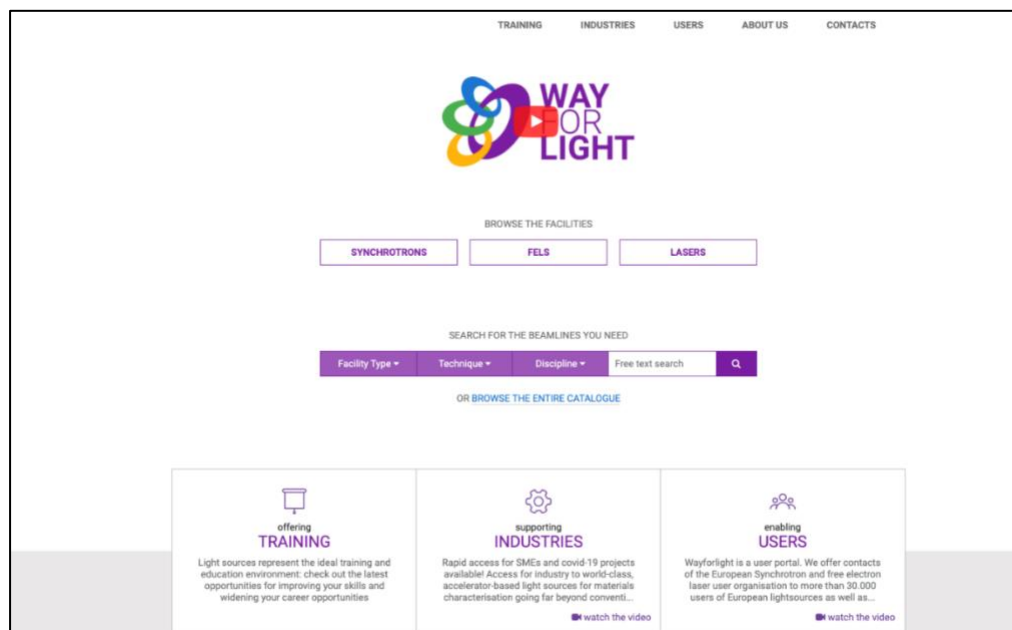


Figure 7: Way for light homepage as an example of single-entry point for industry.

The portal showcase the catalogue of services of the European Lightsources composed of 13 infrastructures quite homogenous in the offer of services. This platform is a quite good examples of making a portal for a group of RIs grouped by similarities. That is for instance the case of what has been done for the topic INFRAEOSC-04-2018³⁹ in building the current five ESFRI clusters.

Regarding Wayforlight, the plan for the future are that it will be interlinked with the global platform Lightsources.org and will be further developed into a European helpdesk within the LEAPS initiative.

Quite remarkable in the “Way for Light” example is the section about training. This section is particularly relevant when the training is devoted to train private researchers or technician on how the tools and multidisciplinary applications or techniques at the facilities work. Indeed, very often there is a huge gap between the methods, timing and processes used by public infrastructures and industry in performing research and innovation activities. Capacity building and human capital formation are key also to reduce the cultural gap, as said in the previous chapters, between RIs and industry and to take into account the different ways in which the everyday work is performed. Having a permanent discussion between RIs and industry is also key to reach a common understanding of the fact that innovation is very much dependent on the economic and social context in which it must happen and that apart from a common playground, it is a matter of finding tailored and local strategies for the finalisation of the dialogue opened at European level.

But let’s give a look to what RIs could offer presenting again some data collected within the ENRIITC D2.1. The majority of RIs provide or could provide:

³⁸ <https://www.wayforlight.eu/en/>

³⁹ https://cordis.europa.eu/programme/id/H2020_INFRAEOSC-04-2018

- support services for feasibility studies (80%)
- pre-competitive research (73%)
- and proof of concept/demonstration (69%)

Most RIs offer (or could offer) services and support at more than one stage of an industry's research. Assistance with commercialisation is much less prominent (22%).

However, there is a 16% of all RIs that do not have a relationship with industry, but 6% of this group have indicated potential areas of support to industry.

These data prove RIs have already enough to offer to industry for a portal to be developed to showcase the services and because of that it could be a real game changer in the field.

Another interesting example is the website⁴⁰ of the H2020 project AMICI⁴¹.

The objective of the AMICI project is to engage the Technology Infrastructure which is currently dedicated to European science-based accelerators and large SC magnets with a new, efficient, and sustainable collaboration/production model by means of Cooperation and Innovation.

In particular, the AMICI Innovation-related activities aim at transferring the knowledge and know-how of research laboratories to industry and creating new products and new applications of direct benefit to society.

A further example of a platform promoting the relationship with industry is the Imperial.tech⁴² operated by the Imperial Enterprise Division at Imperial College London.

The available technologies listed on the website have been developed by Imperial College London and are offered for commercial use under licence from Imperial College Innovations Limited.

Particularly interesting in this portal is a clear and user-friendly catalogue of available technologies ready to be exploited by private entities.

Instead, a good example of a pre-procurement platform is the ESONET Yellow Pages⁴³ that aim to organise the information concerning on-the-shelf products provided by the private sector for the development and maintenance of Deep-Sea Observatories. It includes a range of equipments, from simple, isolated sensors or parts, to communication systems or even integrated Observatories.

ESONET Yellow Pages also aims to foster the feedback from the scientific community in what concerns the experience with a specific product, addressing reliability for long-term operations and the use in real deep sea or coastal conditions.

⁴⁰ <http://eu-amici.eu/home>

⁴¹ <https://cordis.europa.eu/project/id/731086>

⁴² <https://www.imperial.tech/about/>

⁴³ <https://www.esonetyellowpages.com/>

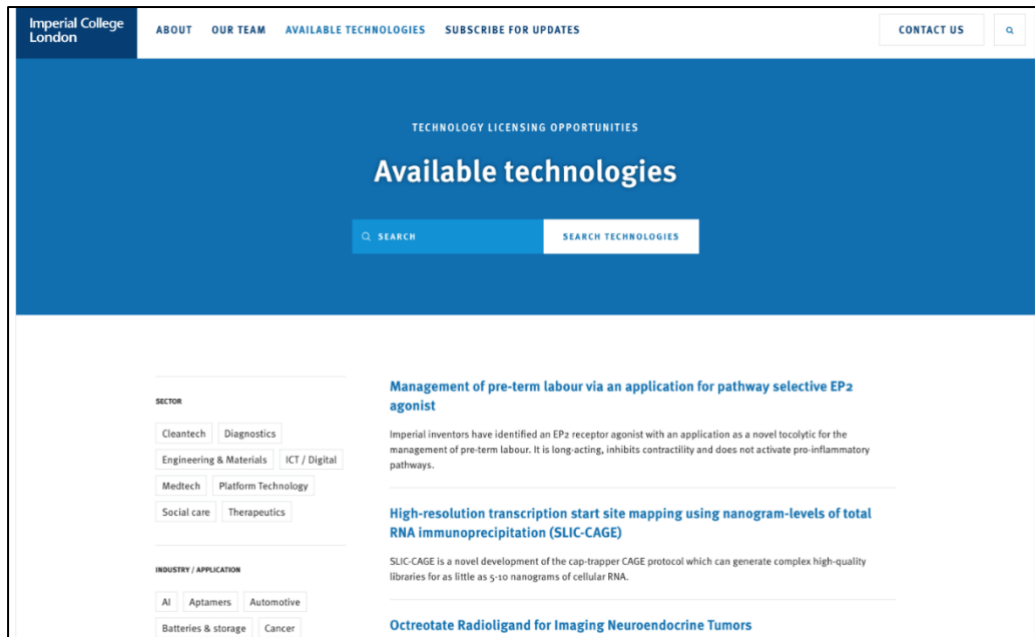


Figure 8: Portal showcasing technologies for industry from Imperial College London.



Figure 9: Joint homepage between different initiatives.

Research Infrastructure – Business Forum

What we want to analyse in this chapter is the possible constituency of a permanent RI-Industry Forum with the goal of set a series of occasions for RI and industry to meet, ranging from workshops, brokerage events, knowledge alliances, focuses and working groups, to support ongoing dialogue between the two parties.

A good example of that kind of forum is the University-Business Forum⁴⁴ (DG Education and Culture) that offers a platform for networking and exchanging of ideas and good practices by bringing together:

- higher education institutions
- companies
- business associations
- public authorities
- policymakers

The University-Business Forum provides a unique opportunity for discussion, the sharing of experience, the exchange of good practices, networking and mutual learning and has sparked the development of several new EU initiatives including the Knowledge Alliances.

Another very useful tool created in connection with the University Business Forum are the Knowledge Alliances⁴⁵ developed within the Erasmus+ programme. Knowledge alliances are transnational projects which bring higher education institutions and business together to work on common issues.

They aim at:

1. Boosting innovation in higher education, business and in the broader socio-economic environment:
 - jointly developing and implementing new learning and teaching methods (like new multidisciplinary curricula, learner-centred and real problem-based teaching and learning)
 - organising continuing educational programmes and activities with and within companies
 - jointly developing solutions for challenging issues, product and process innovation (students, professors and practitioners together)
2. Developing entrepreneurial mindset and skills:
 - creating schemes of transversal skills learning and application throughout higher education programmes developed in cooperation with enterprises aiming at strengthening employability, creativity and new professional paths
 - introducing entrepreneurship education in any discipline to provide students, researchers, staff and educators with the knowledge, skills and motivation to engage in entrepreneurial activities in a variety of settings

⁴⁴ <https://www.ub-cooperation.eu/index/reports>

⁴⁵ https://ec.europa.eu/programmes/erasmus-plus/opportunities/knowledge-alliances_en

- opening up new learning opportunities through the practical application of entrepreneurial skills, which can involve and/or lead to the commercialisation of new services, products and prototypes, to the creation of start-ups and spin-offs
3. Stimulating the flow and exchange of knowledge between higher education and enterprises:
- study field related activities in enterprises that are fully embedded in the curriculum, recognised and credited
 - set-ups to trial and test innovative measures
 - exchanges of students, researchers, teaching staff and company staff for a limited period
 - involvement of company staff into teaching and research

In the framework of the RIs-Business Forum as part of the annual activity it could be useful to develop events similar to what happens in ECCSEL ERIC during the “ECCSEL Industrial CCUS Workshop”⁴⁶ to discuss the different points of view in the innovation process and to find a common Knowledge Exchange strategy to collaborate in exploiting the excellent research developed in both sectors.

In these interactive events, RIs and potential industrial partners get together to identify points of contact in break-out sessions focused on specific and of common interested topic.

As stated in the “The state of University-Business cooperation in Europe, final report”⁴⁷ produced by the University-Business Forum:

The results showed that, given the right circumstances, UBC can be a highly positive activity for all parties involved. Particularly, businesses are starting to realise the benefits of partnering or working with HEIs as a source of future-oriented innovation as well as talent development that can build a competitive advantage. Moreover, since the last study in 2010-11, there is evidence that HEIs are being increasingly seen as a source of talent, entrepreneurship and a lead player in regional development.

And that is what could be achieved for RIs in a such permanent Forum, to build the trust by getting acquainted during several meetings and on a long and committed process.

This is exactly one of the main points missing right now to start building a fruitful collaboration between RIs and industry. A change of mind-set that could happen not in months but in years of frequent and structured meetings.

Talent development

Another aspect that could be a strong motivation in fostering the relationship between RIs and industry, as said before, is the role that RIs could have in the talent development, picking young researchers from Academia, and training them on the latest technologies to eventually transfer this knowledge to industry.

⁴⁶ <https://www.eccsel.org/news/ccus-workshop-of-2019/>

⁴⁷ https://www.ub-cooperation.eu/pdf/final_report2017.pdf

Indeed, coming back again on the results of the “Report on the Consultation on Long Term Sustainability of Research Infrastructures”⁴⁸ respondents were also asked to map all socio-economic impacts of RIs.

Five categories were identified and ordered according to their occurrence:

- **Economic impacts:** this category includes impacts in terms of additional jobs for scientists, technicians and administrative staff working within RI (7.6%) and of the improvement of employment conditions (2.1%). In addition it includes the multiplier effect on local economy in terms of increased community services, housing, tourism and so on (8.1%).
- **Societal impacts:** the use of RI services can lead to innovative products and services able to improve living conditions and to contribute to solving societal challenges (e.g. through medical instruments, treatments, diagnostics for health care monitoring and active aging assistance, environmental benefits such as the lowering of CO2 emission, recreational activities, etc.) (13.5%).
- **Scientific impacts:** these include the effects that the use of RI may have on scientific productivity and reputation and are linked to the increased number of international articles published, of patents granted and of PhD dissertation completed (10.4%).
- **Human resource impacts:** they include the capability of RI to attract talent and impact on training and skills development (10.1%). Staff recruitment, and exchange programmes (also between RI and industry) are seen as mechanisms that contribute to knowledge transfer.

The last point is the one we want to talk about here.

While it is pretty clear the role RIs could have in train Academia researchers to give them the knowledge for working in a commercial environment, it seems far less clear to the policy makers the importance of developing a strong exchange programme for personnel between RIs and RIs and industry for fostering the knowledge transfer.

A very good example of what can be done in talent development is the work carried out by the European Southern Observatory⁴⁹ (ESO).

In this respect, ESO plays a pivotal role in attracting and developing the talent base required to maintain European astronomy research and technology at world-leading levels. The training in astronomy and engineering at ESO provides skills and critical thinking that are beneficial for pursuing a range of careers.

ESO has trained over 260 students from more than 40 countries in science and engineering in the last 10 years alone. ESO has hosted over 150 postdoctoral fellows from more than 30 countries since 2010 alone. ESO has trained over 90 interns in science writing, graphic design, astronomy, engineering, and administration since 2010.

And below what Didier Queloz, Nobel Prize Laureate in Physics 2019 said⁵⁰ about the importance ESO had in his carrier:

⁴⁸ https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/lts_report_062016_final.pdf

⁴⁹ <https://www.eso.org/public/>

⁵⁰ https://www.eso.org/public/archives/brochures/pdf/brochure_0076.pdf

“ESO was the key to the success of my career and gave me the opportunity to be involved in building cutting edge instrumentation and access to a wide community. In the end, 90% of my papers are related to ESO.”

In general, people who study or work at ESO go on to have successful careers in astronomy and engineering, as well as in operations, information technology, education, business development, programme and project management, and media and communications. When they go on to work in Member States, in industry or academia, after their time at ESO they enrich national systems with the technical skills and collaborative approach they acquired.

Case Studies and success stories

Another interesting aspect of the AMICI portal mentioned above, is the section about the Success stories⁵¹. As said in the chapter about the roadmap, it is key to be able to present success story to funders to demonstrate what is the real impact on society of the work carried out in together with industry.

SUCCESS STORIES

INNOVATION



The AMICI Innovation-related activities aim at transferring the knowledge and know-how of research laboratories to industry and creating new products and new applications of direct benefit to society. For that purpose, Industry will access a pool of technical platforms made available by European Research Institutes such as test beam facilities, cryogenics, magnet and RF facilities and test benches, laboratories for material analysis and vacuum technology, for chemistry and surface characterization, for beam electronics and instrumentation, clean rooms and assembly halls including the equipment and the associated human expertise.

-  [THE STFC/ TeVv COLLABORATION BRINGS BENEFITS FOR BOTH PARTIES](#)
-  [TESTING NEW SECURITY TECHNOLOGIES WITH VELA](#)
-  [ENABLING ADVANCED ONCOTHERAPY TO GET NEW PROTON THERAPY SYSTEM TO MARKET](#)
-  [THE SUCCESSFUL TEST OF THE FIRST TWO SILHUB® IONS SOURCES BUILT BY PANTECHNIK](#)
-  [INFN/ROLLING COLLABORATION BRINGS BENEFITS TO BOTH PARTIES](#)
-  [INFN/CECOM COLLABORATION BRINGS BENEFITS FOR BOTH PARTIES](#)

INDUSTRIALIZATION



The AMICI Industrialization-related activities aim at keeping European industry at the forefront of the international competition, in terms of technology, quality and costs, in view of the construction of future scientific research instruments, in Europe and elsewhere. This will be achieved by fostering collaboration initiatives and opportunities between Industry and the TI that include: research and development of key technology prototypes, test and verification of industrial products, professional training and apprenticeship, certification studies and training (e.g. vacuum, cleanliness, welding, etc.), harmonization and standardization studies (e.g. cryogenics, material, etc.).

-  [SUCCESSFUL COLLABORATIONS AROUND THE ESS RESEARCH INFRASTRUCTURE](#)
-  [NEW EUROPEAN STANDARD 'HELIUM CRYOSTATS - PROTECTION AGAINST EXCESSIVE PRESSURE'](#)
-  [SUCCESSFUL COLLABORATIONS AROUND THE EU-XFEL INFRASTRUCTURE: THE POINT OF VIEW OF THE DEUTSCHE ELEKTRONEN SYNCHROTRON DESY IN HAMBURG, GERMANY](#)
-  [DESY RAD AND SERVICE CONTRACTS](#)
-  [SUCCESSFUL COLLABORATIONS BETWEEN INDUSTRY AND RESEARCH INSTITUTES: THE POINT OF VIEW OF COMPANIES](#)

Figure 10: Success stories published on the platform AMICI.

⁵¹ http://eu-amici.eu/industry_involvement/success_stories

The section about Success Stories in the AMICI portal has been divided in two sub-section:

- The AMICI Innovation-related activities aim at transferring the knowledge and know-how of research laboratories to industry and creating new products and new applications of direct benefit to society.
- The AMICI Industrialisation-related activities aim at keeping European industry at the forefront of the international competition, in terms of technology, quality and costs, in view of the construction of future scientific research instruments, in Europe and elsewhere.

It is quite remarkable the amount of success stories presented in this section and the reader easily perceives the huge impact of the activity carried out by CERN together with its industrial partners.

Another example is the report “ESO’s benefits to society”⁵² in which it is very well explained that ESO activity has been the following impacts on society:

- Science and engineering
- Economy and innovation
- Talent development
- Education and outreach
- International collaboration and policy

In addition, in the report are presented the following case study:

- **Laser guide stars:** To correct for the blurring effect caused by the Earth’s atmosphere, telescopes require guide stars — bright stars that are affected by turbulence in the same way as the object under study. However, in most cases, natural stars that can be used as guides are not available in the regions of the sky astronomers are investigating. Instead, light from sodium lasers on the telescope is used to excite sodium atoms in the Earth’s atmosphere, artificially creating a bright, guide star. ESO, partially supported by EU grants, worked with Toptica AG in Germany to develop compact 20 W lasers, and later licensed the technology to Toptica and Canada-based MPB Communications. This was the first transfer of patented technology from ESO to industry and provides opportunities both for industry to market the technology and for ESO to have a supplier for future requirements. Laser systems are currently in operation on ESO’s VLT and will be used on the ELT in future. Other telescopes worldwide also employ the technology. In addition to their application in astronomy, the high-powered lasers have uses in the fields of space situational awareness and optical satellite communications.
- **Pioneering solution for precision measurements:** ESO’s collaboration with German company Etalon on a technology for high precision measurements is a success story and an example of how ESO’s benefits to industry bring direct economic impacts. While the technology (now called Absolute Multiline Technology) was not originally developed for telescopes, ESO engineers extensively tested, verified and validated the measuring system, showing it could be employed in telescopes. This opened up a new market for the Absolute Multiline Technology, allowing the company to sell this product for application in telescopes at ESO and elsewhere. The technology will be used on the US-led Giant

⁵² https://www.eso.org/public/archives/brochures/pdf/brochure_0076.pdf

Magellan Telescope and is also employed by French company SafranReosc, in the production of the segments that make up the primary mirror of ESO's ELT.

- **ESO Supernova Planetarium & Visitor Centre:** The ESO Supernova Planetarium & Visitor Centre, located in Garching, Germany, includes a planetarium with state-of-the-art projection technology and a free exhibition. It offers free education programmes, with special shows, guided tours for children, and workshops and educational material for teachers. These educational tours offered to school children help to show the scale and importance of the research done with ESO telescopes and highlight the role of science, thus making an impact on future career choices. Since its opening in 2018, over 132 000 people have attended the planetarium shows and more than 13 000 went on guided tours. The ESO Supernova was designed as the first opensource digital planetarium in the world to reach audiences beyond the centre's immediate vicinity. By developing and offering planetarium shows free of charge, the ESO Supernova provides planetariums worldwide with access to high-quality shows that they can use to inspire local audiences.

Success stories are very much effective in communicating some aspects of the socio-economic impact on society of the RIs activity, that is relevant for European citizens and funders to evaluate the ROI, where possible, for feeding the decision-making process. A great example of this assessment has been made by M. Florio, S. Forte, E. Sirtori in the paper "Forecasting the socio-economic impact of the Large Hadron Collider: A cost–benefit analysis to 2025 and beyond"⁵³.

⁵³ <https://doi.org/10.1016/j.techfore.2016.03.007>

Appendix 2 - Targets – Interest groups

In the review of the current state of affairs, several current and potential interest groups and stakeholder were identified and studied via homepages and knowledge embedded at the ENRIITC partners. A selection of interest groups is presented in the non-exhaustive list below as reference examples.

EIT European Institute of Innovation and Technology⁵⁴

The European Institute of Innovation and Technology (EIT) is an independent body of the European Union set up in 2008 to spur innovation and entrepreneurship across Europe.

EIT seeks to offer businesses new opportunities to commercialise the most up-to-date and relevant research findings and thereby give Europe first-mover advantage in the latest technological and non-technological fields as well as in open innovation.

In return, research organisations benefit from additional resources, an enhanced networking capacity, and new research perspectives stressing interdisciplinary approaches in areas with strong societal and economic relevance. EIT's headquarters are in Budapest, Hungary.

Based in Berlin, EIT's KICs are Europe's largest public-private innovation partnership working together to address the European societal challenges. KICs drive innovation through creative partnerships large and small, local and global, between the private, public and academic sectors.

Its partners bring their industry experience to the community and are connected through centers across Europe.

EUROCHAMBRES Federation of National EU Chambers of Commerce⁵⁵

Established in 1958 as a direct response to the creation of the European Economic Community, the Association of European Chambers of Commerce and Industry, EUROCHAMBRES, acts as the eyes, ears and voice of the business community at EU level.

Based in Brussels, EUROCHAMBRES represents over 20 million businesses in Europe through 45 members (43 national associations of chambers of commerce and industry and 2 transnational chamber organisations) and a European network of 1700 regional and local chambers. More than 93% of these businesses are small and medium sized enterprises (SMEs). Chambers' member businesses employ over 120 million people.

BUSINESS EUROPE⁵⁶

BUSINESS EUROPE is a leading advocate for growth and competitiveness at European level, standing up for companies across the continent and campaigning on the issues that most influence their performance. Business International speaks for all-sized enterprises in 34 European countries whose national business federations are its direct members.

Headquartered in Brussels, the organisation works on behalf of its member federations to ensure that the voice of business is heard in European policymaking. It interacts regularly with the European Parliament, Commission and Council as well as other stakeholders in the policy community. It also

⁵⁴ <https://eit.europa.eu/who-we-are>

⁵⁵ <https://www.eurochambres.eu/>

⁵⁶ <https://www.businesseurope.eu/mission-and-priorities>

represents European business in the international arena, ensuring that Europe remains globally competitive.

Business Europe wants the European Union to regain its global innovation leadership, scaling up investment in R&D combined with a more qualitative approach, building a true culture of innovation and science-based policy making, encouraging reasonable management of risk, removing obstacles to commercialisation of research results, building innovation clusters and networks between companies and research institutes, enhancing the regulatory framework supporting innovation and streamlining EU funding mechanisms.

ENEP European Network of Environmental Professionals⁵⁷

ENEP is the European Network of Environmental Professionals (previously known as EFAEP - The European Federation of Associations of Environmental Professionals).

Its membership represents 22 European Environmental Organisations and over 45,000 individual professionals. ENEP is the leading environmental professional networking organisation across Europe.

FEANI, Federation of National European Engineering Associations⁵⁸

Founded in 1951, the European Federation of National Engineering Associations (FEANI) represents 350 member national engineering associations in 32 European countries, all of which are recognised in their countries as the representatives of the engineering profession at the national level. Through these national associations, FEANI represents the interests of approximately 3,5 million professional engineers in Europe.

FEANI is a founding member of the World Federation of Engineering Organisations (WFEO) and collaborates with many other organisations dealing with engineering and technology issues and engineering education.

Based in Brussels, FEANI is officially recognised by the EC as representing the engineering profession in Europe. The federation also has consultative status with UNESCO, UNIDO and the Council of Europe.

EIB European Investment Bank⁵⁹

The European Investment Bank (EIB) is the European Union's bank. Based in Luxembourg, it is the only bank owned by and representing the interests of the European Union Member States. It works closely with other EU institutions to implement EU policy. As the largest multilateral borrower and lender by volume, EIB provides finance and expertise for sound and sustainable investment projects which contribute to furthering EU policy objectives. More than 90% of its activity is focused on Europe but it also supports the EU's external and development policies.

Supporting investment that is geared towards innovation, skills and greater competitiveness is part of EIB's mission to foster sustainable growth and jobs in Europe. In 2015, EIB supported innovation and skills with EUR 18.7bn of EIB Group loans in Europe, out of which EUR 16.13 billion were provided by the EIB and the remaining EUR 2.54 billion by the European Investment Fund (EIF). Europe is facing a major challenge in terms of competitiveness and innovation. This is why the EIB Group is partnering with others to help innovators turn good ideas into business realities. It supports innovative projects from large-scale research and RIs to small, hi-tech start-ups and specialised spin-offs.

⁵⁷ <http://www.efaep.org/>

⁵⁸ <https://www.feani.org/>

⁵⁹ <https://www.eib.org/en/index.htm>

Insurance Europe Federation⁶⁰

Insurance Europe is the European insurance and reinsurance federation.

The insurance industry is the largest institutional investor in Europe, making insurers important providers of the investments needed for economic growth. Insurance and reinsurance are global businesses, and European (re)insurers are an international success story. Today, around a third of all internationally active insurance groups are headquartered in the EU, and Europe is the global leader in reinsurance, writing around half of the world's reinsurance business. The European insurance sector is also a significant employer, both in terms of direct and indirect employment.

Insurance Europe collects and analyses data about the European insurance sector. It publishes yearly reports with an overview of the European insurance market, as well as on specific insurance business lines. The data is collected from Insurance Europe members in the European Union (excluding Lithuania), Switzerland, Iceland, Norway, Liechtenstein and Turkey.

Through its 34 member bodies, the national insurance associations, Insurance Europe represents all types of insurance and reinsurance undertakings, eg pan-European companies, monoliners, mutuals and SMEs.

Insurance Europe, which is based in Brussels, represents undertakings that account for around 95% of total European premium income. Insurance makes a major contribution to Europe's economic growth and development. European insurers generate premium income of almost €1.170 bn, employ over one million people and invest nearly €9.900 bn in the economy.

THE CARBON DISCLOSURE PROJECT - CDP⁶¹

The Carbon Disclosure Project (CDP) uses the power of measurement and information disclosure to improve the management of environmental risk. By leveraging market forces including shareholders, customers and governments, CDP has incentivised thousands of companies and cities across the world's largest economies to measure and disclose their environmental information. It puts this information at the heart of business, investment and policy decision making.

Based in London, CDP holds the largest collection globally of self reported climate change, water and forest-risk data. Through its global system companies, investors and cities are better able to mitigate risk, capitalise on opportunities and make investment decisions that drive action towards a more sustainable world.

CDP in pills:

- CDP works with thousands of companies to tackle climate change;
- CDP works with 822 institutional investors holding US\$95 trillion in assets to help reveal the risk in their investment portfolios;
- CDP drives more sustainable water use by business;
- Some 89 purchasing organisations are using the global CDP system to mitigate environmental risk in their supply chains;
- CDP's forest program works with companies to address deforestation risks.

CLIMATE ACTION NETWORK EUROPE - CAN EUROPE⁶²

⁶⁰ <https://www.insuranceeurope.eu/>

⁶¹ <https://www.cdp.net/en>

⁶² <https://caneurope.org/>

Climate Action Network (CAN) Europe is Europe's largest coalition working on climate and energy issues. With over 120 member organisations in more than 30 European countries - representing over 44 million citizens - CAN Europe works to prevent dangerous climate change and promote sustainable climate and energy policy in Europe.

CAN's mission is to support and empower civil society organisations to influence the design and development of an effective global strategy to reduce greenhouse gas emissions and ensure its implementation at international, national and local levels in the promotion of equity and sustainable development.

ETUC Association of European Trade Unions⁶³

Based in Brussels, the European Trade Unions Association (ETUC) comprises 89 national trade union confederations in 39 countries, plus 10 European trade union federations. ETUC believes that Europe's existing economic model is unsustainable for the environment, for society and for the economy. There is no question of choosing between employment and environmental protection. Europe has the means and the obligation to pursue both objectives. There can be no employment or social justice on a devastated planet. Improving energy and natural resource efficiency also means cutting production costs and boosting the development and durability of European companies. Exploring the synergies between environmental and economic policy could create millions of jobs in improving energy efficiency, developing renewables, and moving to a circular economy.

The recent COP21 Paris agreement framed what the global action against climate change will look like in the future. Keeping in mind its strengths and weaknesses, the ETUC and its affiliates will work to transform the political success of COP21 into a long-term success for the planet and for workers and their communities.

BDV Big Data Value Association⁶⁴

The Big Data Value Association is a fully self-financed non-for-profit organisation under Belgian law. Currently there are 24 founding members from large and SME industry and research. The BDVA is the industry-led contractual counterpart to the EC for the implementation of the EU's Big Data Value Public-Private Partnership initiative.

The Big Data Europe (BDE) Project is designed to enable European companies to build innovative multilingual products and services based on semantically interoperable, largescale, multilingual data assets and knowledge, which are currently available in various licenses and business models. In this context, BDE aims to collect ICT infrastructure requirements from data-intensive science practitioners, in order to tackle the wide range of societal challenges that arise in the seven areas of Climate, Energy, Food, Health, Transport, Security and Social Sciences.

European Alliance⁶⁵ / Future Earth⁶⁶

European Alliance is a bottom-up network of the European global change research national committees of the International Council for Science, ICSU. Based in Helsinki, European Alliance facilitates science-driven discussion on European interests and priorities in global change research and promotes European level stakeholder engagement in the new global change research initiative, Future

⁶³ <https://www.etuc.org/en>

⁶⁴ <https://www.bdva.eu/>

⁶⁵ <http://ea-globalchange.org/index.php/who-we-are>

⁶⁶ <https://futureearth.org/>

Earth. To find out more about national committees in each member country, see the European Alliance member list.

The aim of the European Alliance is to build an active network of national committees which implement the co-design objective of Future Earth at the national and regional level. Sustainability problems are in many senses global, but the solutions are most often local and depend significantly on local conditions. The national committees of the European Alliance constitute an extensive network of experts and researchers working with global change issues in international cooperation. They provide understanding about local factors by acting as a link between the science community and the local decision-makers and stakeholders who are instrumental in implementing the solutions and adapting them to local needs.

Appendix 3 - Pan-European sectoral industry associations

In the review of the current state of affairs, a choice of industry associations were identified and studied via homepages. A selection of industry associations are presented in the non-exhaustive list below as reference examples.

EUROPEAN FARMERS AND AGRI-COOPERATIVES ASSOCIATION - COPA-COGECA⁶⁷

Industry sector: AGFOOD

COPA (Committee of Professional Agricultural Organisations) is made up of 60 organisations from the countries of the European Union and 36 partner organisations from other European countries such as Iceland, Norway, Switzerland and Turkey. COPA's broad membership allows it to represent both the general and specific interests of farmers in the European Union. Established in 1958, COPA is recognised by EU authorities as the organisation speaking on behalf of the European agricultural sector as a whole.

COGECA (General Confederation of Agricultural Cooperatives in the European Union) represents the general and specific interests of some 40,000 farmers' cooperatives employing some 660,000 people. COGECA's members account for a global annual turnover in excess of EUR 300 billion throughout the enlarged Europe. COGECA is recognised by the European Institutions as the main representative body and voice of the entire European agricultural and fisheries cooperative sector. COPA-COGECA is based in Brussels.

FEDERATION OF EUROPEAN AQUACULTURE PRODUCERS - FEAP⁶⁸

Industry sector: AGFOOD

Established in 1969, the Federation of European Aquaculture Producers (FEAP), is the united voice of the European aquaculture production industry, being the Federation of National aquaculture associations in Europe that represent professional fish farming.

With 26 members drawn from 22 States across the European continent, FEAP represents more than 2 million tons of produce, an ex-farm value in excess of € 8 billion and 100,000 direct jobs in coastal and rural areas. FEAP has its headquarters in Liege, Belgium.

EUROPEAN SPACE INDUSTRIES ASSOCIATION – EUROSPEACE⁶⁹

Industry sector: ICT, SPACE

Based in Paris, Eurospace is the trade association of the European Space Industry. Eurospace member companies today represent 90% of the total turnover of the European Space Industry.

Eurospace members are the main European space systems manufacturers and launch services providers. They range from large satellite systems integrators to smaller equipment manufacturers, small systems manufacturers, service operators to launch systems architect and launcher elements manufacturers or engineering and software services. Launch service provider Arianespace is also a member.

The Eurospace membership covers 14 European countries.

⁶⁷ <https://copa-cogeca.eu/>

⁶⁸ <https://feap.info/>

⁶⁹ <https://eurospace.org/>

Eurospace is part of the Aerospace and Defence Industries Association of Europe (ASD) which represents the aeronautics, space, defence and security industries in Europe in all matters of common interest with the objective of promoting and supporting the competitive development of the sector. ASD's membership is composed of major European aerospace and defence companies and national associations. In 2014 over 3000 aeronautics, space and defence companies in these countries employed more than 795,000 people and generated a turnover of €199.4 billion.

BLUE MINING DEEP SEA MINING CONSORTIUM⁷⁰

Industry sectors: MINING, MARINE

Blue Mining is an international European partnership of 19 large industry and research organisations on various maritime fields of expertise focused on developing solutions that will bring sustainable deep sea mining a big step closer. The Blue Mining consortium addresses all aspects of the deep sea mining value chain, from resource discovery to resource assessment and from exploitation technologies to the legal and regulatory framework.

EUROPEAN CHEMICAL INDUSTRY COUNCIL - CEFIC⁷¹

Industry sector: CHEMICALS, MATERIALS

As the voice and forum of the European chemical industry, the European Chemical Industry Council (CEFIC) is a committed partner to EU policymakers, facilitating dialogue with industry and sharing its broad-based expertise. CEFIC represents 29,000 large, medium and small chemical companies in Europe, which directly provide 1.2 million jobs and accounts for 17% of world chemical production. Based in Brussels since its founding in 1972, it interacts every day on behalf of its 650 members with international and EU institutions, non-governmental organisations, the international media, and other stakeholders. Its members and affiliates constitute one of the most active networks of the business community, complemented by partnerships with industry associations representing the numerous sectors in the value chain.

Representing the entire range of chemicals production, Cefic is active in 7 programs covering: Energy and Climate Action; Industrial Policy; Legislation & Institutional Affairs; Product Stewardship; Research & Innovation; and, Public Affairs Sustainability.

EUROPEAN ENGINEERING INDUSTRIES ASSOCIATION - EUNITED⁷²

Industry sector: ENGINEERING, AUTOMATION, ROBOTICS

The European Engineering Industries Association (Eunited) is the only direct company membership association supporting the global competitiveness of European equipment suppliers. It represents companies that design and produce specialist machinery and equipment operated in advanced factories all over the world to produce, to automate and monitor, to transport, to recycle, to power, or for cleaning and maintenance purposes. A vast range of industrial and consumer goods and innumerable processes along complex supply chains (from extraction to re-use) depend on advanced manufacturing equipment, which largely determines performance in terms of productivity, energy and resource utilisation.

⁷⁰ <https://blueminig.eu/>

⁷¹ <https://cefic.org/>

⁷² <https://www.eu-nited.net/eunited+aisbl/global-competitiveness-complex-supply-chains-advanced-manufactur/index.html>

ENUnited provides a channel for companies to communicate with the European Institutions and partner organisations and to articulate the role of equipment suppliers in technical standards development, policy formulation, trade issues and legislation.

Within a single European association, member companies are organised in six sectors which are Robotics, Cleaning, Metallurgy, Municipal Equipment, Valves and Vehicle Cleaning.

ELECTRONICS INDUSTRY ASSOCIATION EUROPEAN DIVISION - SEMI EUROPE⁷³

Industry sectors: MICROELECTRONICS, NANOTECHNOLOGIES (multisectoral)

SEMI is the global industry association serving the manufacturing supply chain for the micro- and nano-electronics industries, including semiconductors, photovoltaics (PV), high-brightness LED, flat panel displays (FPD), micro-electromechanical systems (MEMS), printed and flexible electronics, related micro- and nano-electronics.

SEMI's European headquarters are in Berlin. Its members are responsible for the innovations and technologies that enable smarter, faster, more powerful, and more affordable electronic products and devices that bring the power of the digital age to more people every day.

EUROPEAN ELECTRONIC COMPONENT MANUFACTURERS ASSOCIATION - EECA⁷⁴

Industry sectors: MICROELECTRONICS, SEMICONDUCTORS

Under the EECA umbrella organisation, there are 2 autonomous industry associations, the EUROPEAN SEMICONDUCTOR INDUSTRY ASSOCIATION (ESIA) and the EUROPEAN PASSIVE COMPONENTS INDUSTRY ASSOCIATION (EPCIA) with members coming from the manufacturing and related industries as well as from national associations.

EUROPEAN SEMICONDUCTOR INDUSTRY ASSOCIATION - ESIA⁷⁵

Industry sectors: MICROELECTRONICS, SEMICONDUCTORS

The European Semiconductor Industry Association (ESIA) is the voice of the Semiconductor Industry in Europe. Based in Brussels, its mission is to represent and promote its members and common interests of the Europe-based semiconductor industry towards the European Institutions and stakeholders in order to ensure a sustainable business environment and foster its global competitiveness.

The industry is ranked as one of the most R&D intensive sectors by the EC and supports around 200,000 jobs directly and more than 1,000,000 indirect jobs in Europe. The global turnover of the semiconductor sector alone was around €230 billion in 2013 while the value of products comprising micro- and nano electronic components represents around € 1,250 billion. The impact of micro- and nano-electronics on the whole economy is estimated at 10% of worldwide GDP.

EUROPEAN PASSIVE COMPONENTS INDUSTRY ASSOCIATION - EPCIA⁷⁶

Industry sectors: MICROELECTRONICS, SEMICONDUCTORS

⁷³ <https://www.semi.org/en>

⁷⁴ <https://www.eusemiconductors.eu/epcia>

⁷⁵ <https://www.eusemiconductors.eu/esia>

⁷⁶ <https://www.eusemiconductors.eu/epcia>

The European Passive Components Industry Association (EPCIA) represents and promotes the common interests of the passive components manufacturers active in Europe to ensure an open and transparent market for passive components in Europe as part of the global marketplace.

Supported by EPCIA's members - large companies and a great number of SMEs (small and medium sized enterprises) - the passive component industry has accumulated considerable competence and know-how over the years. For example, it has been capable of producing the sophisticated parts required for the European world-leading mobile phone and automotive industries. Electronic systems and equipment, as well as electronic components, are undergoing crucial changes.

Increasing performance and miniaturisation are becoming standard requirements, as are decreasing prices. European industry has been able to face up to these challenges successfully.

EUROPEAN SHIPS AND MARITIME EQUIPMENT ASSOCIATION - SEA⁷⁷

Industry sectors: SHIPPING, TRANSPORTATION

SEA Europe, the European Ships and Maritime Equipment Association is the voice of the European maritime technology industry. Based in Brussels, SEA Europe promotes and supports European business enterprises which are involved in the building, construction, maintenance, repair and R&D of all types of ships and other relevant maritime structures, including the complete supply chain of systems, equipment and services.

EUROPEAN SHIPOWNERS' ASSOCIATION - ECSA⁷⁸

Industry sectors: SHIPPING, TRANSPORTATION

Based in Brussels, the European Community Shipowners' Associations (ECSA), founded in 1965 is the trade association representing the national shipowners' associations of the EU and of Norway, equivalent to over 40% of the world fleet by gross tonnage. The EU shipping industry contributes 145 billion euros to the EU GDP and provides 2.3 million Europeans with promising careers both onboard and ashore.

ECSA promotes the interests of European shipping so that the industry can best serve European and international trade and commerce in a competitive free enterprise environment to the benefit of shippers and consumers and help formulate EU policy on critical maritime transport-related issues.

PORT EQUIPMENT MANUFACTURERS ASSOCIATION - PEMA⁷⁹

Industry sectors: PORTS, WATERWAYS, COASTAL

Advanced equipment and technology underpin the performance of today's seaport, marine and intermodal terminal industries. The London-based Port Equipment Manufacturers Association (PEMA) represents the interests of equipment and technology suppliers on a worldwide basis, providing a platform to inform, educate and promote best practice, both within the industries we serve and externally with port and terminal operators and other key stakeholders.

The members of PEMA are companies involved in the design, manufacture or supply of port equipment and technology, covering port and terminal equipment; components and attachments for

⁷⁷ <https://www.seaeurope.eu/>

⁷⁸ <https://www.ecsa.eu/>

⁷⁹ <https://www.pema.org/>

port equipment; technology that controls or interfaces with port equipment; consultants in port and terminal equipment design, specification and operations.

SOLARPOWER EUROPE - EUROPEAN PHOTOVOLTAIC INDUSTRY ASSOCIATION⁸⁰

Industry sectors: ALTERNATIVE ENERGY

SolarPower Europe, the new EPIA (European Photovoltaic Industry Association), is a members-led association representing organisations active along the whole photovoltaic industry value chain. With headquarters in Brussels, its aim is to shape the regulatory environment and enhance business opportunities for solar power in Europe.

EURELECTRIC EUROPEAN ELECTRICITY INDUSTRY ASSOCIATION⁸¹

Industry sectors: POWER, ELECTRICITY

The European Electricity Industry Association (EURELECTRIC) represents the common interests of the electricity industry at pan-European level, plus its affiliates and associates on several other continents. Based in Brussels, its members represent the industry in 32 European countries.

Sustainability is at the core of the power sector's activities. EURELECTRIC's work in this area focuses on climate change, energy efficiency, environmental protection, health and safety, and resource efficiency. Its mission is to contribute to the development and competitiveness of the electricity industry, to provide effective representation for the industry in public affairs and to promote the role of a low-carbon electricity mix in the advancement of society.

EUROPEAN CROP PROTECTION INDUSTRY ASSOCIATION - ECPA⁸²

Industry sectors: AGFOOD

The European Crop Protection Industry Association (ECPA) represents the crop protection industry in Europe. Headquartered in Brussels, ECPA's members develop innovative and science-based solutions that keep crops healthy and contribute to provide Europeans a safe, affordable, healthy, and sustainable food supply.

ECPA encourages sustainable farming practices and the responsible use of crop protection technology important for the sustainable intensification of agriculture.

EUROPEAN STEEL INDUSTRY ASSOCIATION - EUROFER⁸³

Industry sectors: STEEL

EUROFER, the European Steel Industry Association is located in Brussels and was founded in 1976. It represents 100 per cent of steel production in the European Union.

EUROFER members are steel companies and national steel federations throughout the EU. The major steel companies and national steel federations in Switzerland and Turkey are associate members.

The European steel industry is a world leader in its sector with a turnover of about 170 billion euros and direct employment of about 330 thousand highly skilled people, producing on average 170 million

⁸⁰ <https://www.solarpowereurope.org/>

⁸¹ <https://www.eurelectric.org/>

⁸² <https://croplifeeurope.eu/>

⁸³ <https://www.eurofer.eu/>

tonnes of steel per year. More than 500 steel production sites in 24 EU Member States provide direct and indirect employment and a living for millions of European citizens. Closely integrated with the European manufacturing industries, steel producers provide the basic material for innovation, growth and wealth in Europe.

EUROPEAN NON-FERROUS METALS ASSOCIATION - EUROMETAUX⁸⁴

Industry sectors: METALS, RAW MATERIALS

Brussels-based Eurometaux, the European Non-Ferrous Metals Industries Association, is the voice of the European non-ferrous metals industry. Eurometaux asserts the contribution of the European industry and its products to sustainable development, as well as its members' and the industry's views and positions, whenever the opportunity to do so arises across all sectors of society.

Eurometaux 's priority policy areas are:

- Climate change and energy policy – impact of the enforcement of EU climate change policy;
- Security of raw materials supplies: EU Raw Materials Initiative;
- EU chemicals policy – REACH implementation;
- EU policies on recycling, sustainable use of resources, sustainable consumption and production;
- EU trade policy and trade defence actions.

EUROPEAN PETROLEUM REFINING INDUSTRY ASSOCIATION - FUELSEUROPE⁸⁵

Industry sectors: ENERGY, OIL & GAS

FuelsEurope, the European Petroleum Refining Industry Association is the voice of the European petroleum refining industry. Established in 1989, it represents the interests of Companies conducting refinery operations in the EU with the EU Institutions.

FuelsEurope is a division of the European Petroleum Refiners Association, an AISBL operating in Belgium. The association's members are all the 41 companies that operate petroleum refineries in the European Economic Area. FuelsEurope works in close cooperation with the National Oil Industry Associations (NOIAs) of individual EU member states.

INTERNATIONAL ASSOCIATION OF OIL AND GAS PRODUCERS - IOGP⁸⁶

Industry sectors: ENERGY, OIL & GAS

The International Association of Oil & Gas Producers (IOGP) is the voice of the global upstream industry. IOGP members produce more than a third of the world's oil and gas.

They operate in all producing regions: the Americas, Africa, Europe, the Middle East, the Caspian, Asia and Australia.

With headquarters in London and offices in Brussels, IOGP serves industry regulators as a global partner for improving safety, environmental and social performance. IOGP is dedicated to identifying and spreading good environmental practice wherever the upstream industry operates. Its work includes:

- Ensuring continued access to new and known hydrocarbon sources;

⁸⁴ <https://eurometaux.eu/>

⁸⁵ <https://www.fuelseurope.eu/>

⁸⁶ <https://www.iogp.org/>

- Environmental management and reporting;
- Gaseous emissions management;
- Monitoring regulatory developments and developing advocacy positions.

CONFEDERATION OF EUROPEAN PAPER INDUSTRIES - CEPI⁸⁷

Industry sectors: PULP & PAPER

The Confederation of European Paper Industries (CEPI) is a Brussels-based non-profitmaking organisation grouping the European pulp and paper industry and championing this industry's achievements and the benefits of its products. Through its 18 member countries (17 EU members plus Norway) CEPI represents some 515 pulp, paper and board producing companies across Europe, ranging from small and medium sized companies to multi-nationals, and 950 paper mills. Together CEPI's members, networks, and corporate partners represent 23% of world production.

EUROPEAN FEDERATION OF PHARMACEUTICAL INDUSTRIES AND ASSOCIATIONS - EFPIA⁸⁸

Industry sectors: PHARMACEUTICALS

The European Federation of Pharmaceutical Industries and Associations (EFPIA) represents the pharmaceutical industry operating in Europe. Through its direct membership of 33 national associations and 41 leading pharmaceutical companies, Brussels-based EFPIA is the voice on the EU scene of 1,900 companies committed to researching, developing and bringing to patients new medicines that will improve health and the quality of life around the world.

THE EUROPEAN BIOTECHNOLOGY NETWORK - EBE⁸⁹

Industry sector: BIOTECHNOLOGY

The European Biotechnology Network (EBE) is the European trade association that represents biopharmaceutical companies of all sizes operating in Europe. EBE's focuses on enhancing emerging healthcare technologies and promoting science innovation in Europe via expertise in SME eco-system funding & innovation model and emerging biotech & science - regulatory advancement and advocacy. EBE is based in Brussels.

EUROPEAN TOUR OPERATORS INDUSTRY ASSOCIATION - ETOA⁹⁰

Industry sector: TOURISM

Founded in 1989, the European Tour Operators Association (ETOA) is the leading industry association of European tour operators and tourism suppliers. Over 800 members contribute more than 15 billion euros of business within Europe and include tour and online operators, intermediaries and wholesalers, European tourist boards, hotels, attractions and other tourism suppliers.

ETOA offers an unparalleled networking/contracting platform for tourism professionals via the organisation of numerous high profile B2B events. ETOA provides advocacy support on a European level, high profile industry campaigns and B2B marketing representation opportunities; all in order to promote Europe as a number one tourism destination.

⁸⁷ <https://www.cepi.org/>

⁸⁸ <https://www.efpia.eu/>

⁸⁹ <https://european-biotechnology.net/>

⁹⁰ <https://www.etoa.org/>

EUROPEAN TRAVEL AGENTS AND TOUR OPERATORS ASSOCIATIONS - ECTAA⁹¹

Industry sector: TOURISM

The European Travel Agents and Tour Operators Associations (ECTAA) represents the national associations of travel agents and tour operators of 27 EU Member States, of 2 EU accession countries as well as of Switzerland and of Norway. ECTAA also has 3 international Members: Tunisia, Morocco and Israel. See here for a listing of ECTAA full members.

ECTAA is recognised in Brussels by industry and decision-makers alike as the main representation of European Travel Agents and Tour Operators, acting as a consultation partner on any policy that may have an impact on Travel Agents' and Tour Operators' activities and on tourism in Europe generally.

euROBOTICS⁹²

Industry sectors: ROBOTICS, AUTOMATION

euRobotics is a Brussels based international non-profit association of all stakeholders in European robotics. With over 250 members, euRobotics is building upon the success of the European Robotics Technology Platform (EUROP) and the academic network of EURON and is poised to become the sole main voice of the European robotics community as a whole.

EUROPEAN REMOTE SENSING INDUSTRY ASSOCIATION - EARS⁹³

Industry sectors: EARTH OBSERVATION REMOTE SENSING

The European Association of Remote Sensing Companies (EARS) is a professional industrial body (trade association) with the mission to foster growth of the Earth observation (EO) services sector. Based in Brussels, EARS is actively involved in coordinating and strengthening the EO chain and promoting the European geoinformation industry.

The 74 full members of EARS are companies supplying services in the growing market for the exploitation of EO data. Their main activities are acquiring and supplying data from satellite or airborne platforms and /or their conversion into geo-information products suitable and accessible for their clients.

European Satellite Applications Industry Association – EURISY⁹⁴

Industry sectors: Satellite applications (multisectoral)

The mission of Eurisy, the European Satellite Applications Industry Association is to raise awareness of emerging satellite application advances and solutions taking place in numerous areas, from transport to risk management, from habitat protection to energy, from climate change to the Internet of Things, to name a few.

Eurisy's members include most Space Agencies and governmental offices in charge of space affairs in Europe, and international organisations dealing with space matters. On the basis of its direct field work with end-users, Eurisy provides feedback to decisionmakers on possible measures to overcome obstacles to the diffusion of space-derived innovation in society.

⁹¹ <https://www.ectaa.org/en>

⁹² <https://www.eu-robotics.net/eurobotics>

⁹³ <https://ears.org/>

⁹⁴ <https://www.eurisy.eu/>

Appendix 4 - Pan-European research and technology organisations

In the review of the current state of affairs, the landscape of pan-european RTOs were studied. Two examples are presented in the non-exhaustive list below as reference examples .

The European Secretariat for Cluster Analysis (ESCA)⁹⁵

The European Secretariat for Cluster Analysis (ESCA) is the one-stop shop for promoting [Cluster Management Excellence](#) through **benchmarking** and **quality labelling** of cluster management organisations worldwide. The Berlin-based organisation coordinates a [network of around 200 cluster experts from more than 30 countries](#), which offer benchmarking and labelling services on behalf of ESCA. In addition, ESCA provides hands-on advice to cluster managers on cluster development and supports cluster policy makers and programme owners with advice on cluster programme development.

ESCA is an offspring of the 2009 European Cluster Excellence Initiative (ECEI), a pan-European initiative by the European Commission with the aim to create more world-class clusters across the EU by strengthening cluster management excellence. ESCA was established in November 2010 by one of the 13 European project partners, [VDI/VDE Innovation + Technik GmbH](#).

EARTO, European Association of Research and Technology Organisations⁹⁶

Founded in 1999, EARTO promotes RTOs and represents their interest in Europe. EARTO network counts over 350 RTOs in more than 20 countries. EARTO members represents 150.000 of highly-skilled researchers and engineers managing a wide range of innovation infrastructures.

The mission of EARTO is to promote and defend the interests of RTOs in Europe by reinforcing their profile and position as a key player in the minds of EU decision-makers and by seeking to ensure that European R&D and innovation programmes are best attuned to their interests; to provide added-value services to EARTO members to help them to improve their operational practices and business performance as well as to provide them with information and advice to help them make the best use of European R&D and innovation programme funding opportunities.

⁹⁵ ECEI Bronze Label, Complete cluster list: <https://www.cluster-analysis.org/benchmarked-clusters/?complete=1>

⁹⁶ <https://www.earto.eu/>