The European Network of Research Infrastructures and Industry for Collaboration

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D3.5 Policy recommendations for the optimisation of ILO/ICO performance

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Definitions and abbreviations

Big Science – Big Science is a label commonly used for legal entities which build and manage large-scale international research infrastructures that require expensive physical instrumentation, and where the scope and cost of the investment exceeds the capability of just one country. Typically several countries (called member states) join forces to finance such infrastructures. They are usually found in the ESFRI Physical Sciences & Engineering domain, and examples are particle accelerators and telescopes. Examples are: CERN, ESO, ESRF, and ITER.

BSBF - Big Science Business Forum, a conference and exhibition event bringing together mainly Big Science, and their industries. The first meeting took place in 2018 in Denmark. The second meeting is planned for October 2023 in Granada, Spain.

EC – European Commission. The European Commission is the EU's politically independent executive arm. It is alone responsible for drawing up proposals for new European legislation, and it implements the decisions of the European Parliament and the Council of the EU.

ENRIITC - The European Network of Research Infrastructure and Industry for Collaboration

ENVRIplus - a Horizon 2020 project which ran from 2015 to 2019 and brought 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.

EOSC – The *European Open Science Cloud (EOSC)* is an environment for hosting and processing research data to support science, research and innovation in Europe. The ambition of EOSC is to provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and re-use data, tools and services for research, innovation and educational purposes.

ERA - The European Research Area (ERA) is the ambition to create a single, borderless market for research, innovation and technology across the EU. It helps countries be more effective together, by strongly aligning their research policies and programmes. The free circulation of researchers and knowledge enables; better cross-border cooperation; building of critical mass; continent-wide competitionERIC - The European Research Infrastructure Consortium (ERIC) is a specific legal form that facilitates the establishment and operation of Research Infrastructures with European interest. The ERIC allows the establishment and operation of new or existing Research Infrastructures on a non-economic basis. The Commission provides practical guidelines to help potential applicants. The ERIC becomes a legal entity from the date the Commission decision setting up the ERIC takes effect. An ERIC can carry out some limited economic activities related to this task.

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ESFRI Research Domain – The European Strategy Forum of Research Infrastructures (ESFRI) has identified six main thematic domains (aka science clusters) of research (ESFRI Strategy Report and Roadmap 2018; p. 38)[1]: Energy (ENE), Environment (ENV), Health & Food (H&F), Physical Sciences & Engineering (PSE), Social & Cultural Innovation (SCI, aka SSH), and – since 2017 – Data, Computing and Digital Research Infrastructures (DIGIT).

EU - European Union

Georeturn – The financial return of a member country on the investment in developing and operating research infrastructures.

[1] http://roadmap2018.esfri.eu/media/1048/rm2018-part1-20.pdf

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IAC – the *Research Infrastructure Industry Advisory Committee* is a distinct advisory body made up of 5-7 multi-disciplinary, gender-balanced representatives of key industry and technology sectors relevant to the mission of the RI. It reports directly to the RI Assembly of Members.

Industry Liaison Officer (ILO) – Expert staff working at Government agencies or Research institutes in the member states to stimulate the collaboration amongst the national industry and the international RIs, providing advice on business opportunities, R&D collaborations, calls for tender, and industrial services.

Industry Contact Officer (ICO) – Research Infrastructure staff responsible for strengthening and coordinating cooperation strategies and activities with Industry;

KPI – Key Performance Indicator

NextGenerationEU - Europe's €800+ billion recovery programme of grants and loans which aims to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. Member States are working on their recovery and resilience plans to access the funds under the Recovery and Resilience Facility of the programme.

NSF - The National Science Foundation (NSF) is an independent agency of the United States government that supports fundamental research and education in all the non-medical fields of science and engineering.

OECD - The Organisation for Economic Co-operation and Development (OECD is an intergovernmental organisation with 38 member countries founded in 1961 to stimulate economic progress and world trade.

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 n the form of a European association.

Research Infrastructures (RIs) – Research Infrastructures are facilities that provide resources and services for research communities to conduct research and foster innovation. RIs can be used beyond research, e.g. for education or public services and they may be **single-sited RIs** *(a single resource at a single location – SSRI),* **distributed RIs** *(a network of resources geographically separated, often providing virtual digital services – DSRI)*. Research Infrastructures include: major scientific equipment or sets of instruments; collections, archives or data; computing systems and communication networks; and any other research and innovation infrastructure of a unique nature which is open to external users.

RTO - Research Technology Organisation

SME - Small and Medium size Enterprise

Technology Infrastructures (Tis) - Technology infrastructures are facilities, equipment capabilities and support services required to develop, test and upscale technology to advance from validation in a laboratory up to higher Technology Readiness Levels (TRLs) prior to competitive market entry. They can have public, semi-public or private status. Their users are mainly industrial players, including SMEs, which seek support to develop and integrate innovative technologies towards commercialisation of new products, processes and services, whilst ensuring feasibility and regulatory compliance.

Technology readiness levels (TRLs) are a method for estimating the maturity of technologies during the acquisition phase of a program. TRLs enable consistent and uniform discussions of technical maturity across different types of technology. TRL is determined during a technology readiness assessment (TRA) that examines program concepts, technology requirements, and demonstrated technology capabilities. TRLs are based on a scale from 1 to 9 with 9 being the most mature technology.

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Executive Summary

ERA expectations regarding the return to stakeholders of EC RI investments have shifted considerably since the ENRIITC project was originally conceived four years ago. In pre-corona days, the EC and ESFRI concentrated mainly on strengthening RIs' scientific relevance - refining and implementing the Roadmap, growing the ERIC system and bolstering and consolidating the European research landscape RI activities beyond the serving of researchers such as collaborations with non-academic stakeholders and cooperation with industry was desirable, but only considered secondary by ESFRI which was concerned first and foremost with boosting European scientific skilfulness.

At the time of this report, faced also with effects of the war in Ukraine, inflation and raw material bottlenecks, Member States are grappling with the delivery of ambitious *Next Generation EU* post-pandemic recovery projects along with the energy crisis and green transition. Interest is strong in also exploiting the innovation potential of RIs increasingly recognised as potential key partners for the myriad of companies developing cutting-edge new health, green and digital transformation applications and services in key industrial sectors.

In this scenario of heightened expectations and new opportunities for both RIs and companies, the ENRIITC "hub and spoke" model presented in D3.1, of pan-EU, one-stop-shop innovation officers' multiplier network and support service working specifically to spur new ESFRI RIs-industry connections is poised to play an increasingly key role. This report examines the main elements of ENRIITC's approach and offers a set of recommendations in the form of a *vademecum* of practical steps and KPIs.

We consider it as crucial that the activities of RIs are considered as part of an international innovation ecosystem. This also means that measures to be taken to improve innovation should transcend national policies. For this deliverable this means in particular that we need clear definitions for ICOs and ILOs, adopt the main requirements for their job content on a European level and use a limited set of appropriate KPIs accordingly. During our work for this deliverable we noted that there is an increasing ambition for ILOs to work in a European context, and exchange experiences and best practices. We consider this as essential to improve the innovation ecosystem. It also introduces the challenge to strike a proper balance between national interests and the European ambitions. It goes without saying that many of the complex challenges that Europe is facing require real international collaboration. We could argue that state aid, national legislation and georeturn to some extent are hampering the development of the RI innovation ecosystem in that sense. And it is obvious that this also affects the collaboration between ILOs and ICOs, both between themselves and mutually. We have tried to define the KPIs as much as possible on a European level, avoiding national perspectives.

Finally, we have also seen that many reports and analyses have been issued in recent years about the development of RIs to contribute to innovation (e.g. ref. 19 that applies mainly to Big Science). Our first recommendation would therefore be to shift focus now from analysis to action.

1. Methodology and background information

This report builds on the results of the ENRIITC survey of ILOs/ICOs, *D2.1 Report on the mapping of industry as a supplier and user*, and deliverable *D3.2 Analysis of performance indicators of ILOs/ICOs across countries and domains*. D3.2 describes the context in which ILOs and ICOs operate. The performances of the organisations that employ ILOs and/or ICOs, according to their mission and the specific impact objectives, are taken as leading principle.

As was highlighted in D2.1, ILOs are national representatives predominantly focused on "upstream" work by helping companies become suppliers of goods or services to RIs. The priority for their employers is raising the georeturn/value of national contracts and also strengthening the supplier base for the RI. Neither they nor their employers focus as yet very much on developing downstream innovation opportunities, i.e. spurring technology transfer, co-creation and commercialisation.

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The same is generally true for ICOs of both single-sited and distributed RIs. As evidenced by ENVRIplus and the ENRIITC D2.1 mapping, the few ICOs in the ecosystem do not work a lot with innovation. Instead ICOs focus their efforts with industry mainly on boosting companies' access and use of RI data and hardly at all yet on building innovation cooperation relationships with industry. This, of course, is a generalisation, and there are exceptions, but it is particularly the case in many of the distributed RIs in the less than 5M€ annual budget range in fields such as the social sciences and humanities, ecology and environment, life sciences and food etc. with under-expressed innovation potential and where industry tends to be a more distant interlocutor. Such RIs constituted two thirds of the ICO industry-relations poll respondents in D2.1.

In this deliverable report, the performances of ILOs and ICOs are further investigated and elaborated. Previous reports and findings about the collaboration between industry and Ris were analysed in combination with the new data generated by ENRIITC. Especially useful were the results of the ENRIITC Deliverable D3.3 *Strategy for training of ILOs/ICOs and outreach towards industry*, in which soft and hard skills for ILOs/ICOs were noted. Furthermore, we made use of the experiences of ILOs and ICOs as well as various other stakeholders that were discussed in the context of ENRIITCyourCoffee sessions. We concluded that representatives and stakeholders of distributed RIs were less well represented in the survey, compared to single-sited RIs. So, we especially paid attention to the case of distributed RIs using recent reports and deliverables from ENRIITC and also from ESFRI, the OECD, ENVRIplus, Accelerate, RI-Paths and other relevant initiatives (see Bibliogaphy).

The results presented in this report is a set of recommendations for new KPIs for both ICOs and ILOs fitting the new political RI-investments agendas of the ERA, taking into consideration opportunities for enhanced collaborations between them, particularly in actively pursuing downstream collaboration opportunities with industry. In the present conceptual phase, most of the KPIs have a qualitative character, but this may be transformed into quantitative indicators in the specific cases.

2. Developments and trends

In the past decades many Research Infrastructures (RIs) were created to enable and facilitate European collaboration to perform excellent science. The development and use of these RIs was, and still is, mainly driven by curiosity, or by the need to solve complex societal challenges. Generally speaking, collaboration with industry was required for the realisation of the advanced technical installations that are often part of an RI. However, realising societal impact from industrial usage of the RI or RI-industry collaborations for innovation was rarely part of the initial ambitions of RIs.

However, societal impact and innovation are nowadays *a priori* key requirements to develop, operate and sustain RIs. Today, Member States are grappling with the delivery of ambitious *Next Generation EU* post-pandemic recovery projects. Interest is strong in exploiting the innovation potential of RIs which are increasingly seen as potential key advisors and partners for the myriad of SMEs developing cutting-edge new health, green and digital transformation applications and services in key industrial sectors. In this scenario of heightened expectations and new opportunities for both RIs and companies, ENRIITC's model of a pan-EU, one-stop-shop network and support service for innovation working specifically to facilitate RIs-industry connections (see details in D3.1 and 3.2) can play a key role.

Based on a "hub and spoke" organisational approach (see Appendix 2), the ENRIITC model calls for a central pan-EU RI Innovation facility or "Hub" being established by ENRIITC's 11 partners and 60+ Associates to offer a wide range of industry partnering support services to the individual RIs out in the field- the "Spokes". At the heart of this system is the ENRIITC Network of RI Industrial Liaison and Contact Officers, ILOs and ICOs, drawn from across Europe who administer the hub and coordinate and deliver innovation and industry-liaison activities at the headquarters and facilities of the individual RIs in close collaboration with RI science, communications and procurement colleagues.

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In the appreciation of the results of ENRIITC, and of this deliverable in particular, it is important to note that ENRIITC can distinguish itself by being a community that is composed of many (fundamental) science domains on the one hand, ranging from the Physical Sciences and Engineering (PHE) to the Social Sciences and Humanities (SSH), and industry, as a supplier or user, on the other. This also means that there is a great variety in the need to engage with industry. An important aspect of the community however is that it is science-driven and that collaborations need to sustain over long periods of time to effectively boost innovation, which is not always obvious from the start of research. With this in mind we have looked at the performances and KPIs that are relevant for ILOs and ICOs to jointly contribute to the challenge to promote innovation.

From our research for this deliverable we find that some elements are especially important to be able to exploit the opportunities to promote innovation in an RI ecosystem. First of all we have to acknowledge the fact that we are dealing with an ecosystem, meaning that there are many players, stakeholders and interests that have to get aligned over relatively long periods of time. Strategic policies for innovation are key. Next there should be the notion that innovation already starts at the backend of the value chain; industry should be aware of the science ambitions and the upstream phase (development of enabling technologies, low TRL, high risks) that follows. This will make it easier to develop continuity and perspective to close the gap from upstream to downstream (technology transfer, product development, higher TRLs).

Our research also underscored the importance of strong alliances in such an holistic ecosystem approach – between RIs in and across domains so as to offer companies a full range of coordinated, complementary services and with key facilitator and aggregator organisations such as Technology Infrastructures, RTOs, Research University Associations and Digital Innovation Hubs ideally positioned to greatly facilitate targeted contact with industry via their well-established and trusted industry networks.

Lastly, it also evidenced the benefits of closer and more continuous collaboration and exchanges between ILOs and ICOs. Downstream innovation partnering with industry presents challenges for both groups which makes it important to nurture opportunities for sharing of experiences and best practices between the two networks, a process the ENRIITC Innovation Hub can play a valuable role in facilitating.

3. Measuring ILO performance

Main conclusions from D2.1 and D2.3

In D2.3, an analysis was made about the performance of ILOs both from the perspective of the ILOs themselves and their employers. This was based on the answers from the survey D2.1. For details we refer to D2.3.

To summarise the findings (ref. D2.1; fig 15, 16a,b), the most important KPI indicated by ILOs is “raising georeturn/value of national contracts”. The promotion of industry-RI-university collaborations is also of some importance, as well as improving the supplier base for the RI. The results suggest that ILOs employed by governmental agencies are focused more on improving georeturn than ILOs employed by public research organisations, which focus more on promoting collaborations and technology transfer. Industry-RI collaborations are also considered more important by ILOs belonging to public research organisations.

Looking at the different KPIs ranked according to the importance given by the employer vs. the opinion of the ILOs (ref. ENRIITC D2.1; fig 17), georeturn is considered as important both by the employers and by the ILOs. However, technology transfer activities and encouraging the industry use of the RI are among the less relevant KPIs in the employers’ view, although ILOs certainly recognise the relevance of the technology transfer activities.

Obviously these findings reflect the different interests of the various stakeholders in the RI ecosystem. It also clearly indicates that they are acting predominantly from a national perspective. To further improve European innovation and collaboration in the ecosystem one might argue that the performance of ILOs should be standardised on a European level, and should enable a proper synergy with the performance of ICOs. This is in agreement with Strategic recommendation #1 from D3.3:

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Strategic recommendation #1: The role of ICO and ILO should be defined at a European level including the identification of Key Performance Indicators.

Duties, job descriptions and competencies

It is important to note that in the present situation, ILOs appear in many guises. We found examples of "Industrial Liaison Officers"with this designation employed at RIs or at national institutes (both governmental and research). Examples of names that are used; "Officer for Industry and Innovation", "Innovation Officer", "Innovation and External Relations Officer", "Industry and Innovation Officer". It illustrates the need for standardisation and for a definition that corresponds both to the duties that should be performed and the perspective from which they are carried out. In this deliverable we refer to ILOs as officers that are appointed or employed at national level with the purpose of engaging the national supplier industry.

The term "innovation" seems to be a common denominator when ILOs talk about their job content. In that sense there is an eye for linking the fundamental science ambitions to societal and economic impact. Each stakeholder is, however, concentrating on its own mission and responsibilities, and incentives for strategic collaborations, especially in the upstream part of the innovation pathway are still poorly developed. ILOs have an ideal position in the value chain, and, given sufficient time and resources, we are convinced that a huge impact towards innovation can be achieved through their efforts.

Our data seem to suggest that many engineers and scientists focus their duties on the prime objectives of their country or research organisation in the development or in using the science facilities. In most cases the ILO activities do not translate into a full time job. In some job descriptions the requirement of being able to "manage time" is explicitly mentioned, illustrating the fact that the ILO job is encompassing many aspects. The recognition that ILOs can contribute more to technology transfer and innovation as a scientist or engineer also seems to hint at the opportunity to improve on "job satisfaction". National or European ILO-networks can obviously also contribute to that. As an example, ITER/Fusion for Energy (F4E) has defined a Liaison Officers Network, with the aim "to ensure a proper flow of information between F4E and potential contractors". F4E invites each member state to nominate an Industrial Liaison Officer who shall be entitled to act on behalf of that member. Clearly this is primarily aimed at making companies available to develop the facilities, in the interest of both ITER and the resources in each member country. Other research facilities, mainly in the area of Big Science, act in a similar way. Knowledge transfer and/or co-creation/development are however not always an explicit part of job descriptions. Nevertheless, the organisations ESA and CERN have developed knowledge transfer programs, where the countries can even start national Business Incubator Centres to facilitate the transfer of knowledge to industry. These programs create the opportunity to close a gap between fundamental high risk developments, and the prospects for more societal and economic impact.

Both in D2.1 *Report on the mapping of industry as a supplier and user*, D2.3 *Analysis of performance indicators of ILOs/ICOs across countries and domains* and D3.3 *"Strategy for training of ILOs/ICOs and outreach towards industry"* it was noted that ILOs have very different backgrounds and may be either government officials, researchers, or staff in business-oriented positions. In fact, knowledge from all these sectors is relevant in order to fulfill the ILO-function. Despite of this complex mix of policy, science, and business, most ILOs (80% as reported in D2.1) have not received any special training. Obviously these trainings should correspond closely to the requirements we set for the activities and KPIs of ILOs. In D3.3 these requirements were identified as soft and hard skills.

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Soft skills	Hard skills
•Communications, including internal RI communications •Management skills •Networking and collaboration skills	•Business knowhow to be able to perform consultancy and support on procurement and tenders •Understanding industry collaboration in the innovation eco-system and possibilities for EU funding •Organisation of brokerage events (see D3.4) and organisation tools (e.g. use of databases) •insight into the operations of the RI from both technical and policy perspective (including rules and regulations) •Industry collaborating models including Technology transfer processes •Negotiations, IPR, and the legal aspects of contracts

Since RI-industry engagement is significantly science-driven, we also have to keep in mind that a solid science and engineering background is important to be able to act as an ILO. Many job descriptions also require broad experience in a representative (science-to-business) marketing environment. From that point of view, ILO activities have to support excellence in science (Nobel prize enabling) and should reach out for the required industry to support that goal.

The RI perspective

In general, the mission of an RI is to push boundaries in science, by offering state-of-the art facilities that transcend the capabilities of single countries to develop and/or operate. International cooperation is key. It is in the interest of an RI to show and illustrate breakthroughs in scientific discovery as a real added value. The industry is involved in both upstream an downstream activities, as supplier, co-developer and user. For the upstream part, companies are required to (co-)develop the required (enabling) technologies, by definition starting from low TRLs, and to apply results in other science domains and market areas. From that perspective RIs are looking at ILOs first of all to support them in finding the proper companies to develop the RI and the required technologies.

The national perspective

The member countries financing the RI have to account internally for a return on investment. The most obvious and straightforward way to show this is the total contract value for companies from that country that act as suppliers for the RI. Transfer of knowledge and technology is much more difficult to measure, and is also subject to failure. The revenues of participating in RIs can often only be illustrated after many years of operation, although the impact can be high. ILOs working at governmental agencies are supposed to contribute to optimising the return on investment, on the short term in line with the interest of the RI. Purchases from high-tech Big Science markets made to the national industry are estimated to have a societal impact representing a value that is a factor of 4-5 higher than the direct value of the purchase (based on reports from 2007-08 about, respectively, ESA and the Danish memberships – see Bibliography 15 and 16). This innovation effect is, however, not being monitored. Instead, there is a very narrow focus on georeturn, which could, in principle, come from purchase of toilet paper, which rarely leads to innovation and societal impact. It is thought provoking that out of the national investments into international RIs, only additionally 0-1% are invested into ILOs to secure the optimal industrial impact (and thereby the ROI) of the total investments. Especially, when seen in the context of the huge potential impact indicated by the ESA studies.

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The ILO perspective

Since many ILOs have a background either as a scientist or engineer (or both), their intrinsic motivation goes beyond the mere improvement of national return on investment. In particular the ILOs working at research institutes are able to also discover the opportunities for technology transfer and innovation. This is the territory where ICOs and ILOs should meet, exchange ideas and effectively pursue these, both in the interest of the RI and the capability of the member countries to strategically invest in innovation.

Towards KPIs for ILOs

The results of D2.1, D2.3 and D3.3 seem to indicate that there still is not much focus on the (risky) upstream stream part of the value chain (innovation pathway), which is also a reason that "science" seems to need industry more than the industry needs science (as was found for instance in publications of the Danish and the Dutch a few years ago, ref. 17 and 18). For industry, (big) science is often just another market, that is interesting if it can contribute to short term contracts, rather than to develop long term international competitiveness. The latter requires strategic investments and the support of both ILOs and staff within the organisations (as ICOs) to envision the opportunities, and promote innovation from the early start of project development and collaboration.

In that sense, looking for support to enable this (like European funding opportunities) is as important for ILOs as for ICOs, but from a significant different perspective. A collaboration between ICOs and ILOs will be able to make a difference, if supported by the proper funding mechanisms to be applied on the entire value chain. An example can be found in the Netherlands. The Dutch ILO-net combines ILOs with different "targets", from raising georeturn (assigned to specific research facilities like CERN, ITER or ESA) to promotion of co-development and knowledge transfer (in the direct interest of research institutes). A proper connection to ICOs, however, is lacking.

For an effective collaboration between RIs and industry it seems that national ILO-networks can play a crucial role. To put the national goals in perspective, a pan-European collaboration seems equally important. This adds to the skills that ILOs should have or develop;

1. To have roots and experience in a science and technology environment,
2. To have a long term vision on the development of science and technology (knowledge of science-to-business marketing)
3. Being able to operate in a highly international and multidisciplinary environment.

Once more it can be concluded that the job of ILO requires an internationally acknowledged status. That does not necessarily mean that each ILO would be doing the same things. However, it may be important to also establish acknowledged and specific "home bases" for RI and industry engagement. In the space sector, many countries have "space agencies" for that purpose, but these are not always rooted in the (fundamental) sciences. Home bases for the national contributions to RIs could pursue two major goals explicitly; organising the (national) science communities and involving industry in the upstream part of the value chain, specifically in new science or technology projects. These home bases should be funded accordingly. Moreover, it would be the logical place to employ (full time) ILOs, since they would serve the national interests (science participation in RIs and return on investment), and promote technology transfer and innovation on a European level.

Considering these considerations the following 6 KPIs for ILOs seem necessary and sufficient;

KPI 1: Maintain a national database (as part of a joint European database) of companies with relevant skills and capabilities, in collaboration with fellow European ILOs and ICOs,

Impact: This would make it much easier to find proper partners for collaborations across the entire value chain.

KPI 2: Actively support the creation and maintenance of technology roadmaps, based on national strengths, and validate them with the needs from RIs,

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Impact: This would serve the need for companies in each member state to anticipate on future tenders, leading to more continuity and perspective, and diminishing risks.

KPI 3: Organise brokerage meetings between national and international industry and RI representatives, partly on location of the RI ("industry days"),

Impact: This will increase mutual understanding about requirements and abilities, bridging cultural differences and establishing personal relations with the proper employees, leading to increased collaborations. Supporting pan-European events such as Big Science Business Forum will also assist the ILOs in the international brokerage function.

KPI 4: Maintain an overview of (national and international) funding opportunities for RI-industry engagement.

Impact: Funding is at the base of collaborations, in particular on the upstream part of the value chain (innovation pathway), where risks can be high. Good knowledge about upcoming opportunities will facilitate early and well-prepared initiatives for collaboration.

KPI 5: Organise stakeholder meetings with the innovation ecosystems surrounding the RIs to exchange best practices and new opportunities for engagement,

Impact: Since there are many different stakeholders in the RI ecosystem, it is mandatory to exchange views, create awareness and pursue policies to develop and sustain the ecosystem across borders and domains.

KPI 6: Support SMEs in their response to tenders, and (in close collaboration with ICOs) create and use opportunities to bridge the gap between upstream and downstream (knowledge transfer and product development) activities.

Impact: Many companies (in particular SMEs) experience difficulties in complying to tender requirements. Besides easing these requirements ILOs can help to facilitate the tender process, diminishing the company's efforts to respond on tenders. Moreover, it can increase early identification of opportunities for knowledge transfer and product development relevant for the market(s) in which the company is active.

All these "KPIs" are measurable to a certain extent, and they obviously correspond to the hard and soft skills already mentioned. It is however important to note that these KPIs should be embedded in a well-defined ecosystem of RI-industry engagement and that they should serve the ambition to support long term (strategic) collaborations to better exploit complete innovation pathways. That would create the added value for a truly competitive European ecosystem around RIs.

These KPIs may also serve the aim to shift away from too strong interests and ambitions on a national level. In that regard, we consciously did not include a KPI for georeturn. By definition, the RI ecosystem is international. Also considering the many different players and stakeholders in this ecosystem, and their mutual dependence, it is in our opinion not possible to allocate a proper KPI for georeturn to a single (national) ILO. Sufficient georeturn is, in other words, not a single responsibility, but should be seen as a result of a collective effort of a national ecosystem (if existing). One could even argue that "georeturn" is somewhat hampering the idea of "open innovation", leading for instance to non-level playing fields in Europe. It affects the ability for ILOs and ICOs to collaborate more extensively. This is something to think about further in pursuing a European ecosystem for RI-industry engagement. The national emphasis on return on investment (georeturn) may be reduced through incentives to also promote innovation in broad European collaborations, in which it should be easier for European industry to engage from the very beginning.

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4. Measuring ICO performance

Main findings from D2.1 and D2.3

As already noted in *D2.3 Analysis of performance indicators of ILOs/ICOs across countries and domains*, the "provisional" framework for KPIs that has been published by the ESFRI working group in December 2019 can be considered as a starting point for describing the relevant mission characteristics of the RIs and the diversity across countries and disciplines. This framework identifies the aspects for which performance in relation to collaboration with industry and the promotion of innovation could be meaningfully reported and reviewed. The relevance of the ESFRI framework, in spite of the provisional character, is stemming from the fact that ESFRI is a major stakeholder for many of the European RIs.

In particular in D2.3 we put focus on four of the objectives that are relevant for the ENRIITC context:

- Facilitating economic activities
- Provision of scientific advice
- Outreach to the public
- Integration of distributed facilities.

This section highlights key aspects of the ICO's role and duties drawing from the extensive analysis done in ENRIITC but also by the OECD, the NSF, ENVRIplus and other studies and papers on the subject of approaches to strengthening RI cooperation with industry (see Appendix 4). It offers RIs, particularly distributed RIs, a set of concrete pointers and recommendations selected by ENRIITC on key competencies, job descriptions, duties and performance objectives to consider in recruiting and engaging a professional ICO and organising and structuring an effective RI-wide industry-engagement function and outreach programme.

The ENVRIplus "RI Innovation Preparedness Roadmap"

In the course of our research, we found that ENVRIplus is a particularly valuable source of information that adds to our findings in ENRIITC. The ENVRIplus "RI Innovation Preparedness Roadmap" described in D18.5, and cited in both ENRIITC *D3.1 Strategy to exploit the innovation potential of RIs* and *D3.2 Strategy for innovation and industry-RI cooperation*, showed how many of the larger Landmark RIs from the Environment domain have as yet scarce knowledge and experience working consistently with the private sector. In the ENVRIplus RI survey table below of 2019, updated in ENRIITC in 2022, only 3 out of 10 Landmark RIs from the Environment domain polled employed full-time ICOs and only 2 had an industry strategy! Moreover, looking at the bigger picture and the entire 2021 ESFRI Roadmap with its 60 projects and all of the Landmark RIs, only 16 RIs currently employ fulltime ICOs of which 10 of are in Digital and Physical Sciences & Engineering domains which are naturally closer to industry (see Appendix 4).

Table: Survey of online ENVRI Innovation-Preparedness information and services targeting Industry
source: ENVRIplus (D18.5) - updated July/2022

Environmental Research Infrastructures:	EISCAT	EPOS	EMSO	IAGOS	ICOS	LIFEWATCH	EURO-ARGO	EMBRC	ACTRIS	ANAEE
ICO and/or RI Innovation and Industry Liaison Services Center	✗	✗	√	✗	✗	√	✗	√	✗	√
Communications Officer w commercial experience	✗	✗	✗	✗	✗	√	✗	✗	✗	✗

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Environmental Research Infrastructures:	EISCAT	EPOS	EMSO	IAGOS	ICOS	LIFEWATCH	EURO-ARGO	EMBRC	ACTRIS	ANAEE
RI Annual Innovation and industry Engagement Strategy & Action Plan	✗	√	✗	✗	✗	✗	✗	√	✗	√
RI website Innovation Menu Tab: Services & Information for Industry	✗	√	✗	✗	√	✗	✗	√	√	√
Active Industry Advisory Committee	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Online Industry-Cooperation Use Cases and Success Stories	✗	✗	✗	✗	✗	✗	✗	✗	√	√
RI annual staff innovation Training Program	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Online Program of RI-industry joint workshops and brokerage events	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗

As noted in several of the 17 key actions for RIs listed in ENRIITC D3.2 and described in D3.3 on the role of ICOs, having an ICO in the RI staff becomes particularly relevant to addressing the objectives in the table. ICOs play an essential role in stimulating effective and tighter RI links with industry. They lead the design and implementation of an RI innovation and industry relations strategy and action plan and can be instrumental (assuming top-down support) in promoting an innovation mentality and team-work spirit among RI managers and staff and across the RI nodes and service facilities. As members of the ENRIITC Pan-EU Network of RI Industry Liaison Officers, they have the opportunity to constantly learn from each other and from their ILO/ICO colleagues, exchanging information on awareness and communication strategies, procurements activities and industry requirements to raise the effectiveness of their role and to maximise the impact of the RI on society.

Competencies, title and job descriptions

With the heightened emphasis on demonstrating socio-economic relevance and innovation, many RIs who have not yet done so are now for the first time actively considering engaging an ICO and launching structured RI-wide industry-engagement functions. In fact, it has been a major accomplishment of ENRIITC that these discussions are now ongoing and that the ENRIITC reports provide a solid basis for the considerations. The pointers and recommendations listed below focuses on the essentials of which RIs need to be most aware. Our hope is that they can constitute a shortcut in getting a basic RI innovation action plan up and running more quickly as well as useful information for those RIs already with active programmes. Finally, the preliminary network of ICOs and ILOs established by ENRIITC will offer support and guidance for ICOs across the ESFRI domains.

ICO core competencies

In the absence of a baseline set of ICO core competencies defined at the EU level, the description provided below of suggested ICO "soft and hard" skills identified by the ENRIITC D2.1 mapping survey and presented in the ENRIITC D3.3 RI training deliverable offers a good starting point for specifying qualities and aptitudes to look for in ICO candidates:

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RI INDUSTRY CONTACT OFFICER (ICO) **SOFT SKILLS**

01	Communication	• Storytelling • Presenting • Reporting
02	Leadership	• Conflict management • Negotiation • Decision making
03	Critical thinking	• Problem-solving • Troubleshooting • Thinking outside the box
04	Creativity	• Brainstorming • Lateral thinking • Open-mindedness
05	Teamwork	• Interpersonal skills • Team building • Empathy
06	Management	• Time management • Risk management • Project management
07	Integrity	• Work ethic • Result-oriented • Perseverance
08	Positive attitude	• Cooperation • Enthusiasm • Patience
09	Marketing	• Development of the offer • Engagement • Digital marketing

RI INDUSTRY CONTACT OFFICER (ICO) **HARD SKILLS**

01	Fundraising	• At local level • At national level • At European level
02	International networking	• Collaboration skills • Building new relationships • Stakeholder engagements
03	Technical and policy insight into the RI	• Knowledge of technology transfer procedures • How to write licence agreements • MOU and NDA
04	Knowledge about industry collaboration models	• Spin-off • Start-up • Companies accellerators/incubators
05	Event organisation	• B2match • Workshop • Hackathon
06	Communication	• How to target private partners • Success stories • Digital procurement
07	IPR and GDPR	• TNA tailored to industry • IPR management • Database management

Source: ENRIITC D3.3

In an idealised frame, ICOs need to be highly competent, 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. ICOs must also have adequate legal and economic competence to judge whether a research outcome, tool or process is patentable or not, sufficient marketing and business skills in order to find commercial partners and good negotiation and social skills to be able to finalise an advantageous agreement. Taken together, such staff are very hard to recruit and, in reality, ICOs are today often researchers turned towards business, bringing their RI knowledge to the support of industry and innovation needs.

In order to successfully develop and implement an RI innovation and industry engagement strategy and action plan, an ICO should have the following personal characteristics:

- Ability to earn respect and standing to act as an internal champion and external ambassador of the industry and innovation portfolio;
- Capacity to grasp technical concepts quickly, and work with others to translate these into commercially viable proposals;
- Solid understanding of the supply sector and industrial value chains for research infrastructures;
- Experience in working with international, cross-functional teams;

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- Excellent oral and written English communication, presentation and liaison skills;
- Ability to work with the RI legal office in negotiating and overseeing successful contractual agreements and processes (e.g. intellectual property agreements, patent, copyright, trademark, service mark, trade secret, confidentiality agreements, sponsored research agreements, material transfer agreements, technology licences, etc.);
- Ability to guide RI communications officers in developing effective PR messaging and tools in support of industry-partnering activities;
- Ability to organise periodic industry advisory committee meetings and workshops, events with RI industry partners;
- Ability to prepare periodic reports, use cases and success stories on RI innovation collaboration with industry together with the RI communications office for RI management, ESFRI and funding bodies at national and European levels.

The Job Title

Before discussing duties, a word concerning the Industry Contact Officer (ICO) job title choice:
As noted above from D3.1, a priority ENRIITC recommendation is that every RI should have someone *on* staff responsible for establishing and maintaining a liaison between the RI and its industrial users, innovation facilitators, partners and sponsors.

In ENRIITC, the title **Industry Contact Officer (ICO)** is applied to "research Infrastructures 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".

This in contrast to industry-liaison employees working at government agencies, those which ENRIITC currently calls ILOs, whose mandate is focused predominantly not on the success of "their" RI, but on securing strong national geo-return from their RIs. In our view, these require a different title and job description altogether from RI officers and their roles should be treated separately.

Throughout the ENRIITC project, the title terms have caused confusion among the stakeholders, be they the RIs themselves, funders or industry. Agreeing on the job terminology is a prerequisite for developing a much-needed standardised approach to salary levels, incentives and pension terms in order to professionalising RI innovation staff positions and careers in the EU.

The Job Description

As detailed in D2.3, an EU-wide standard for ICO (and ILO) positions does not exist yet. ENRIITC points to this ICO/ILO professionalisation gap as a major impediment to achieving the new ERA vision of a pan-EU approach to RI-industry cooperation. Correcting it can be one of the first actions of the ENRIITC Pan-EU Innovation Hub once it is up and running. In the meantime, key aspects of the profession like job descriptions, status in the organisation, salary levels, career growth, job mobility, incentives, etc. have not been set yet. To avoid recruitment processes being arbitrary with employers continuing to adopt different, unequal, selection processes and terms, we offer the following generic RI industry liaison officer job description first developed in ENVRIplus as a good starting point for RIs looking to launch a competition to engage a professional ICO:

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A Sample RI Industry and Innovation Officer Job Description

XYZ RI invites applications for a position of a **Senior Industry and Innovation Officer.**
Supported by EU-funding, XYZ is developing an innovation framework that is part of its management system. An Innovation and Industry Liaison and Technology Transfer function is being established and the Officer will be in charge of developing and implementing an RI innovation strategy and action plan focused on strengthening cooperation with industry.

Description of directorate/division
The Senior Officer for Industry and Innovation will report to the Director General. He/she will work in a team specialised in innovation and industry relations spread across the distributed infrastructure.

Description of main responsibilities
Establishing of an innovation culture at XYZ RI;
Rolling out the XYZ RI innovation strategy, refining as appropriate and ensuring the buy-in of internal and external stakeholders;
Working with XYZ staff and partners to help turn innovative scientific and engineering technologies into new products and services;
Identification of strategies for transferring technologies to industry including supporting proof-of-concept activities to potential end-users;
Negotiating appropriate licensing contracts in conjunction with the legal function at XYZ;
Setting-up a strategic roadmap for technological up-grades at XYZ in cooperation with industry;
Developing and implementing of a long-term strategy to utilize the innovation potential of the industry liaison network at XYZ;
Fostering cross-border collaboration between industry liaison officers in the various member country facilities and across ESFRI domains;
Establishing an effective XYZ Industry Advisory Committee.

Qualifications
We expect the applicants to have the following experience and qualifications:

- Proven professional experience (7-10 years) establishing and deploying an innovation programme at a research infrastructure or similar organisation;
- Post-graduate academic degree or equivalent work experience in a subject relevant to the portfolio of the tasks;
- Ability to earn respect and standing to act as an internal champion and external ambassador of the industry and innovation portfolio;
- Strong interest in technology trends and quick grasp of technical concepts;
- Solid understanding of the supply sector for research infrastructures and of the downstream data applications market;
- Successfully negotiating and licensing commercial and IP contracts with industry;
- Proven project management skills, including responsibilities for financial management and reporting;
- Experience in working with international, cross-functional teams;
- Ability to facilitate student/industry relations through internships, student participation in joint projects with industry, fellowships, seminars, career placement, etc.;
- Adaptable, flexible, entrepreneurial, highly motivated, and capable of successfully pushing the industry and innovation programme of XYZ forward;
- Excellent oral and written English communication skills. Fluency in a second main European language a plus.

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Duties and KPIs

In establishing key duties and KPIs for ICOs, the perspective of the RI presented in *D3.2 Strategy for innovation and industry-RI cooperation* was chosen, since, by definition, ICOs are employed at RIs. The four key action areas of an effective RI industry-liaison and innovation programme identified in D3.2 are:

1. Boosting RI organisational support for innovation
2. Engaging the innovation ecosystem
3. Defining and communicating industry collaboration models
4. Leveraging funding structures for increased industry collaboration

For each of the four areas, D3.2 proposed a set of specific priority actions – 17 in total – for the ICO to select from in designing and delivering a tailored RI industry engagement action plan. In this report, we focus on the most important of these proposed actions – those that best lend themselves to being applied to different RIs and and to being paired easily with KPIs to gauge the ICO's progress.

Leading organisational support for innovation
The ICO's main job is to lead the design and implementation of a RI-wide innovation and industry engagement strategy and action plan with its wide and varied range of associated aims and duties matching the ambition and interests of the specific RI. Of these, the most fundamental include building a strong, unitary industry and innovation friendly mentality throughout the RI and particularly in the geographically-dispersed facilities, building a cohesive, RI-wide industry-engagement action programme in collaboration with the RI procurement and engineering departments as well as to engage scientific staff able to support industrial services from the RI. The ICO should also engage in the ENRIITC ILO/ICO Network and develop a strong role as a pro-active "spoke" of the ENRIITC RI innovation network and service Hub & Spoke model presented in *D3.1 Strategy to exploit the innovation potential of RIs.* The main duties also include positioning the RI as a leading and ready advisor, reference authority and co-creation partner for companies active in EU and national innovation projects, maintain a strong RI visibility and profile in the ERA and innovation-related initiatives of ESFRI, EOSC, the ERIC Forum, Data Spaces, run the RI industry advisory committee and the industry contact office.

Engaging the innovation ecosystem
An important aspect of the ICOs role is strengthening the position of his/her RI in the overall EU innovation ecosystem by seeking close alignment and coordination with other RIs in related domains and clusters and by developing strong links directly to industry and to key industry-liaison intermediaries, facilitators and partners. The latter in particular can be very useful in helping the ICO garner intelligence on industry needs more efficiently and in steering introductions to particular companies or groups of companies.

Examples from ENRIITC D3.1 of key organisations ICOs could look to establishing particularly close ties with include:

- the European Association of Research Technology Organizations (EARTO) which represents over 350 RTOs in more than 20 countries;
- the League of European Research Universities (LERU) and European University Association (EUA), associations which represent the top European research universities;
- the European Institute of Innovation and Technology (EIT) which has a network of more than 2900+ partners across Europe, including 8 thematic Knowledge and Innovation Communities (KICs), 1700 SMEs, 450 universities, 420 research centres, 280 cities, regions and NGOs and 64 thematic innovation hubs;
- Digital Innovation Hubs (DIHs) with their wide geographic reach and close ties to EOSC, Data Spaces and other key EU and national innovation programmes;
- EIROforum, the European Intergovernmental Research Organisation Forum brings together eight of Europe's largest research organisations and coordinates industry aspects of Big Science facilities;

In addition, in the case of distributed RIs, the ICO needs to pay very close attention to coordinating closely and constantly with the geographically dispersed facilities and to making sure that there always be a strong, unified,

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shared commitment and harmonised approach to RI priorities and actions by the RI central office and the nodes. To achieve this, the ICO must ensure close and constant cooperation between the RI innovation office staff and members out in the field of the various RI service groups important for pursuing close relations with industry, most notably communications, procurement and engineering.

Lastly, the ICO can play an important role stimulating close exchanges of ideas and experiences with the ILO community in the ENRIITC ICO/ILO Network and Hub, particularly on themes regarding procurement and working with industry as a supplier as well as on how to boost downstream co-creation collaboration opportunities with industry which remains a big challenge for both ICOs and ILOs.

Defining and communicating industry collaboration models

Also key in the ICO's efforts to strengthen the RI's position with industry as a readily-accessible top-class EU science and technology consultancy and reference authority in its field are the more technical, day to day knowledge and technology transfer aspects of the job. These include scouting, packaging and promoting RI in-house S&T solutions and HR expertise to industry with the help of science, engineering and procurement colleagues – to communicating clear RI contractual models and cooperation policies (see D3.2) to prospective supplier and partner companies including the provision of accessible, up to date, information on confidentiality and non-disclosure agreements, licensing, intellectual property protection, liabilities, test-bed logistics and hosting regs, relevant standards and ethics – all matching to the RI ambitions and interests.

Leveraging funding opportunities and structures for increased industry collaboration

A constant challenge that the ICO and RI innovation teams face is developing an effective system to boost companies' awareness of the value of RI cooperation – from assessing and understanding industry's needs, to communicating potential RI solutions and collaboration opportunities, to establishing regular joint innovation training and staff exchange programmes, to identifying and leveraging EU, regional and national SME funding programmes and tapping into concrete projects. Moreover, the ICO ideally should do these things in close coordination with RIs from like domains and clusters so as to offer companies as comprehensive and complementary a catalogue of RI value-added, research and technology solutions and tools as possible.

Based on the observations and recommendations in the above sections, the following 7 KPIs are proposed:

KPI 1: Oversee preparation of an annual RI innovation and industry engagement strategy and action plan and contribute to the Director General's annual strategic and operational reports to member funding agencies, and EC and ESFRI if required.

Impact: This will set the course of action for increasing RI cooperation with industry with clear objectives and action steps aimed at securing strong and consistent buy-in from stakeholders and partners.

KPI 2: Organise regular periodic meetings of the RI innovation and industry service group (central office and facilities innovation staff together with relevant internal collaborators, such as communications, procurement and engineering).

Impact: This will ensure strong and constant coordination of key functional officers and teams involved in delivering the RI industry engagement strategy: the ICO, communications, engineering and procurement – both those based in the central RI management office and those in the facilities/nodes in the case of distributed RIs.

KPI 3: Organise annual physical RI-industry innovation workshops with at least 30% participants from industry. Events may have a special focus on relevant local, national or international innovation ecosystems.

Impact: It is important to raise the visibility of the RI's potential for engagement with industry both at local, national and international scale, including EU innovation agencies such as EARTO, EOSC DIH and EIT KICs and, ideally, also the media.

KPI 4: Maintain a strong web-based RI-industry cooperation profile (own pages or relevant portals such as CatRIs or similar) with up-to-date content to attract prospective industrial suppliers and users including success stories,

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information on training, exchanges and workshops, contract, procurement and FAQs or similar. Be accountable for maintaining the part of the RI catalogue of services dedicated to industry.

Impact: It is essential that business and not only researchers be able to relate to information on the RI's mission, activities and plans published on the RI website. Such content needs to be readily accessible and understandable and presented in such a way as to raise companies' interest and stimulate their desire to find out more about opportunities for pursuing active collaboration.

KPI 5: Operate an innovation advisory board (IAC) and engage them twice per year. Prepare a written report for RI management on the feedback from the IAC. (see IAC duties in Appendix 3).

Impact: A strong and effective IAC is essential to help design and deliver a successful RI industry-engagement program and maintain strong and direct connections with the private sector.

KPI 6: Operate an active outreach programme to industry, targeting both large companies and SMEs, and other organisations (such as RTOs and intermediaries) including brokerage events, outcalls and conferences on the RI value proposition. 1-1 interactions and visits from companies should also be part of the programme.

Impact: Such events and interactions constitute the core job of the ICO as they are main way to increase industry awareness of RI activities and value-added leading to dialogues between the ICO team and companies regarding opportunities for collaboration. Moreover, they are invaluable in helping keep the RI updated on industry needs and trends.

KPI 7: Maintain close foresight, in collaboration with the RI European programme officers (if existing), on EU-level programmes and Horizon Europe, EOSC and data spaces initiatives and calls targeting industry (climate, health, economic recovery, digital transformation).

Impact: This will ensure that the RI is always up-to-date on current and new EU-funded projects which offer the greatest scope for boosting cooperation with industry, particularly with SMEs.

Social Sciences and Humanities (SSH) distributed RIs and cooperation with Industry

The European Commission has flagged as a priority the inclusion of SSH research topics in Horizon Europe calls. These are embedded as a cross-cutting issue in all the main Horizon Europe pillars and objectives. The aim is to fully integrate SSH into the STEM (science, technology, engineering and mathematics) disciplines to fully tackle the complex societal challenges of European societies.

> *"Social sciences and humanities research will be fully integrated into each of the priorities of Horizon Europe and each of the specific objectives and will contribute to the evidence base for policy making at international, Union, national, regional and local level. In relation to global challenges, social sciences and humanities will be mainstreamed as an essential element of the activities needed to tackle each of the global challenges to enhance their impact."*
> https://www.net4society.eu/en/SSH-Integration-in-Horizon-Europe-1844.html

SSH encompass a wide range of disciplines, including sociology and economics, psychology and political science, history, linguistics and cultural sciences, law and ethics. Contributions from these research fields are essential to generate new knowledge, support evidence-based policymaking, develop key competences and produce interdisciplinary solutions to both societal and technological issues. This is particularly true in cooperation between RI and Industry where socio-economic impact means not just technology but also the relationship between humankind and technology, something only SSH can address.

The integration of SSH themes into the myriad technological innovation projects funded by Horizon Europe and the EU's multi-billion-euro Next Generation recovery and digital transformation programmes offer rich opportunities for close collaboration between SSH RIs and industry.

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An example in point is in the area of artificial intelligence where Landmark SSH RI, CLARIN ERIC, is launching an industry engagement initiative to actively position itself as a close partner and advisor for European SMEs working on natural language processing (NLP) applications (see Appendix 5). CLARIN's expertise and support can be invaluable to companies in a whole host of hot development areas such as automatic speech recognition and transcription, text mining, automatic translation and data analytics across a wide range of industry sectors.

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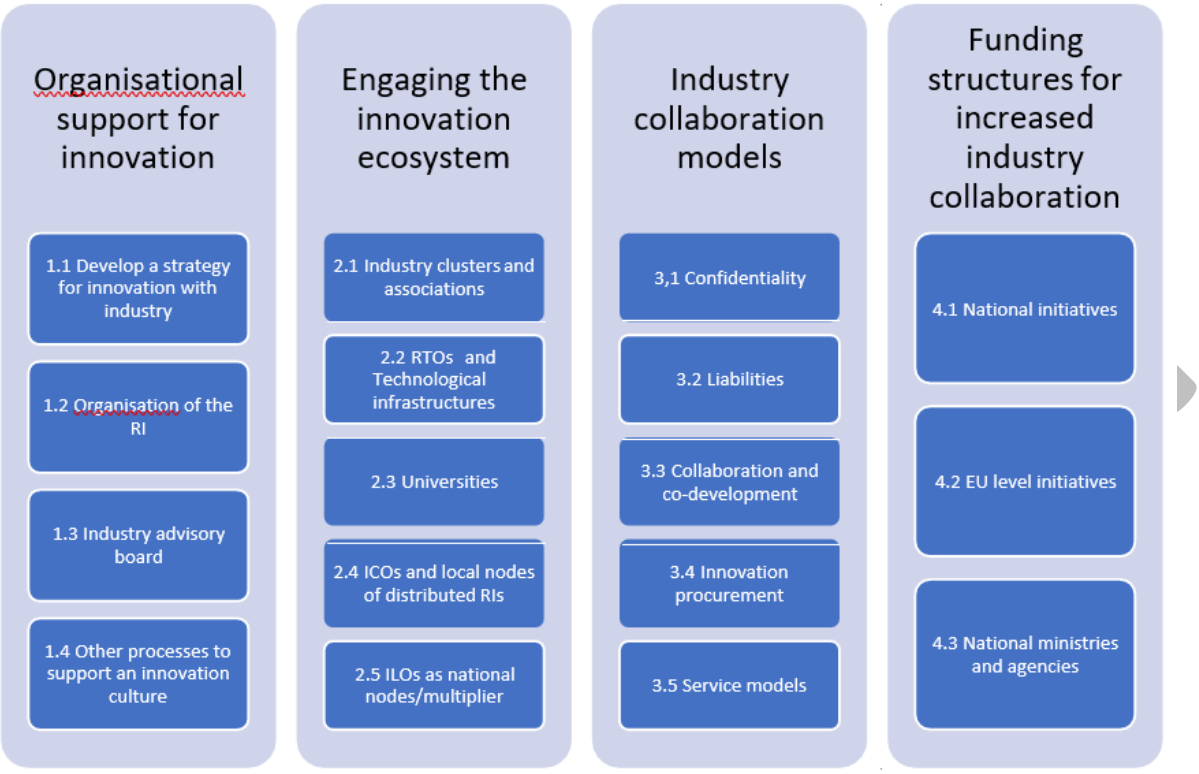
Appendix 1 D3.2 list of recommended RI-industry partnering priority areas and actions

ENRIITC D3.2

4 key areas and 17 actions recommended to help RIs develop systemic innovation-partnering industry-liaison programs



Source: ENRIITC D3.1 *Strategy to Exploit RIs Innovation Potential*

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Appendix 2 The ENRIITC pan-EU RI innovation network and services "Hub & Spoke" model

Based on a "hub and spoke" approach, the ENRIITC RI Innovation Network model calls for a central pan-EU RI Innovation facility or "hub" being established based on ENRIITC's 11 partners and 60+ Associates to offer a wide range of industry partnering support services to the individual RIs out in the field- the "spokes". Heart of this system is the ENRIITC Network of Industrial Liaison and Contact Officers (ILOs and ICOs) drawn from across Europe who administer the hub and coordinate and deliver innovation and industry-liaison activities at the headquarters and facilities of the individual RIs in close collaboration with their RI Communications and Procurement colleagues.

ENRIITC Pan-European "Innovation and Industry Services Central Support Hub"

Hub Services to RI and ERA stakeholders

- Define and update the training path and opportunities for ICOs and ILOs;
- Offer an exchange platform for collaboration between ILOs/ILOs on innovation;
- Coordinate the support offer provided to ICOs and ILOs;
- Offer 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;
- Help professionalize the ICO and ILO position and role
    - Clarify job titles
    - Define standard job requirements and description
    - Set core duties and KPIs
- Work with ESFRI to define RI socio-economic impact monitoring and assessment criteria
- Communications: setting calendar of regular contributions to ESFRI Roadmap RIs news, pr, and success stories; spotlights on trends, technologies and star RI technological innovation personnel
- Establish and manage the EU RI-Industry Innovation Portal
- Coordinate RI contributions to development of EOSC and Data Spaces
- Launch Pan-EU RI Innovation and Industy Engagement Training Strategy and domain/cluster Training Action Plans
- Support the optimization of ICO and ILO duties and performance objectives. Disseminate guidelines and Best Practices in support of key activities such as:
    - Upstream – industry as a supplier (chance to learn actively from ILOs):
        - nurture industry as a technology supplier
        - build a coordinated industry engagement approach with the Procurement Office
        - Communications: communicate RI development trends, objectives, plans and successes to industry
        - position RIs as ready references and advisors in support of innovating SMEs active in development of data driven green, climate, post-pandemic recovery, digital transformaton applications
        - assist SMEs with S&T project proposals and processes
    - Downstream – industry as a user and innovation co-creator:
        - spur an RI-wide innovation mentality
        - identify and package opportunities for knowledge transfer and innovation
        - maximize inter and intra domain innovation services synergies and interoperability
        - define and communicate the different Industry Collaboration Models and Forms.
        - promote Transparency: clarifying forms of relationships with industry (types of agreements/contracts/policies (IPR etc.)"

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Appendix 3 The RI Industry Advisory Committee (IAC)

An important responsibility of the ICO is assisting the RI Director General/Executive Director in recruiting and maintaining an effective and efficient RI Industry Advisory Committee.

The IAC ideally is a distinct body made up of 5-7 multi-disciplinary, gender-balanced representatives of key relevant industry and technology sectors, but it also can be a sub-group of the main RI Science and Technology Committee.

(see also ENRIITC D3.2 1.3)

Duties and value-added of the RI Industry Advisory Committee (IAC)

The IAC first and foremost serves as an invaluable objective advisor and critic from industry's point of view on industry and innovation aspects of key RI reports and publications, most notably the RI Strategy, the Business Plan, the Industry-Engagement Action Plan and innovation-related content in Annual Reports to the EC and ESFRI.

The IAC plays an important role in:

- attracting adequate industry participation at RI conferences, workshops and brokerage events – often a challenge;
- recruiting top-class RI staff, including candidates for Director General, with good private sector experience and reputations (not always easy);
- providing access to rich, hard-to-reach, private-sector potential investors, sponsors, advocacy partners etc.
- strengthening private sector awareness of the value of the RI and of opportunities for collaboration and exchanges.

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Appendix 4 ESFRI 2021 ROADMAP RIs WITH FULL TIME ICO STAFF

ESFRI Research Infrastructures Roadmap 2021 - Projects & Landmarks

Domain	RI name	full name	type	legal status	ICO?	RI name	full name	type	legal status	ICO?
DIGIT										
	EBRAINS	European Brain Research Infrastructure	distributed	AISBL, 2019	X	PRACE	Partnership for Advanced Computing in Europe	distributed	AISBL, 2010	√
	SLICES RI	Scientific Large-scale Infrastructure for Computing/ Communication Experimental Studies	distributed		X					
	SoBigData++	European Integrated Infrastructure for Social Mining and Big Data Analytics	distributed		X					
ENERGY										
	IFMIF-DONES	International Fusion Materials Irradiation Facility - DEMO Oriented NEutron Source	single-sited		X	ECCSEL ERIC	European Carbon Dioxide Capture and Storage Laboratory Infrastructure	distributed	ERIC, 2017	√
	MARINERG-i	Marine Renewable Energy Research Infrastructure	distributed		X	EU-SOLARIS	European Solar Research Infrastructure for Concentrated Solar Power	distributed	ERIC Step2	X
						JHR	Jules Horowitz Reactor	single-sited	JHR CA, 2007	X
ENVIRI										
	DANUBIUS-RI	International Centre for Advanced Studies on River-Sea Systems	distributed	ERIC Step1	X	ACTRIS	Aerosols, Clouds and Trace Gases Research Infrastructure	distributed	ERIC Step2	X
						EISCAT_3D	Next generation European Incoherent Scatter radar system	single-sited	EISCAT SA, 1975	X
	DiSSCo	Distributed System of Scientific Collections	distributed		X	EMSO ERIC	European Multidisciplinary Seafloor and water-column Observatory	distributed	ERIC, 2016	√
	eLTER RI	Integrated European Long-Term Ecosystem, critical zone and socio-ecological system Research Infrastructure	distributed		X					
						EPOS ERIC	European Plate Observing System	distributed	ERIC, 2018	X
						EURO-ARGO	European contribution to the International Argo Programme	distributed	ERIC, 2014	X
						IAGOS	In-service Aircraft for a Global Observing System	distributed	AISBL, 2014	X
						ICOS ERIC	Integrated Carbon Observation System	distributed	ERIC, 2015	X
						LifeWatch ERIC	e-Infrastructure for Biodiversity and Ecosystem Research	distributed	ERIC, 2017	X
HEALTH & FOOD						LIFE SCIENCES				
	EIRENE RI	Research Infrastructure for EnvIRonmental Exposure assessmeNt in Europe	distributed		X	ANAEE	Analysis and Experimentation on Ecosystems	distributed	ERIC Step2	√
						BBMRI ERIC	Biobanking and BioMolecular Resources Research Infrastructure	distributed	ERIC, 2013	X
	EMPHASIS	European Infrastructure for Multi-scale Plant Phenomics and Simulation	distributed		X					
						EATRIS ERIC	European Advanced Translational Research Infrastructure in Medicine	distributed	ERIC, 2013	√
	EU-IBISBA	European Industrial Biotechnology Innovation and Synthetic Biology Applications	distributed		X					
						ECRIN ERIC	European Clinical Research Infrastructure Network	distributed	ERIC, 2013	X
	METROFOOD-RI	Infrastructure for promoting Metrology in Food and Nutrition	distributed		X					
						ELIXIR	A distributed Infrastructure for life-science data	distributed	ELIXIR CA, 2013	√
						EMBRC ERIC	European Marine Biological Resource Centre	distributed	ERIC, 2018	√
						ERINHA	European Research Infrastructure on Highly Pathogenic Agents	distributed	AISBL, 2017	X
						EU-OPENSCREEN	European Infrastructure of Open Screening Platforms for Chemical Biology	distributed	ERIC, 2018	√
						EURO-BIOIMAGING	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences	distributed	ERIC 2019	√
						INFRAFRONTIER	European Research Infrastructure for the generation,	distributed	GmbH, 2013	√
						INSTRUCT ERIC	Integrated Structural Biology Infrastructure	distributed	ERIC, 2017	√
						MIRRI	Microbial Resource Research Infrastructure	distributed	ERIC Step2	
PHYSICAL SCIENCES & ENGINEERING	(Astronomy & Particle)					PHYSICAL SCIENCES & ENGINEERING	(Photon Neutron and Radiation)			
	ELT	Extremely Large Telescope	single-sited	ESO-	X	CERIC ERIC	Central European Research Infrastructure Consortium	multiple-sited	ERIC 2014	√
	EST	European Solar Telescope	single-sited		X	EuPRAXIA	European Plasma Research Accelerator with Excellence in Applications	distributed		X
	ET	Einstein Telescope	single-sited		X	ELI ERIC	Extreme Light Infrastructure	single-sited	ERIC, 2021	X
	CTA	Cherenkov Telescope Array	single-sited	gGmbH, 2014	X	EMFL	European Magnetic Field Laboratory	distributed	AISBL, 2015	√
						ESRF EBS	European Synchrotron Radiation Facility Extremely Brilliant	single-sited	ESRF	√
	KM3NeT 2.0	KM3 Neutrino Telescope 2.0	distributed		X	European	European Spallation Source ERIC (ESS)	single-sited	ERIC, 2015	X
	SKAO	Square Kilometre Array Observatory	single-sited	SKAO, 2011	√	XFEL	European X-Ray Free-Electron Laser Facility	single-sited	European XFEL	√
						FAIR	Facility for Antiproton and Ion Research	single-sited	GmbH, 2010	X
						HL-LHC	High-Luminosity Large Hadron Collider	single-sited	CERN	√
						ILL	Institut Max von Laue - Paul Langevin	single-sited	ILL	√
						SPIRAL2	Système de Production d'Ions Radioactifs en Ligne de 2e	single-sited	GANIL	√
SOCIAL & CULTURAL INNOVATION										
	E-RIHS	European Research Infrastructure for Heritage Science	distributed		X	CESSDA ERIC	Consortium of European Social Science Data Archives	distributed	ERIC, 2017	X
	EHRI	European Holocaust Research Infrastructure	distributed		X	CLARIN ERIC	Common Language Resources and Technology Infrastructure	distributed	ERIC, 2012	X
	GGP	The Generations and Gender Programme	distributed		X	DARIAH ERIC	Digital Research Infrastructure for the Arts and Humanities	distributed	ERIC, 2014	X
	GUIDE	Growing Up in Digital Europe: EuroCohort	distributed		X	ESS ERIC	European Social Survey	distributed	ERIC, 2013	X
	OPERAS	OPen scholarly communication in the European Research Area for Social Sciences and Humanities	distributed	AISBL, 2019	√	SHARE ERIC	Survey of Health, Ageing and Retirement in Europe	distributed	ERIC, 2011	
	RESILIENCE	RElligious Studies Infrastructure: tooLs, Innovation, Experts, coNNections and Centres in Europe	distributed		X					

X = 44 TOTAL
√ = 16 TOTAL

of which 10 RIs in DIGITAL and PHYSICAL SCIEN listed in rose-colored sections)

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Appendix 5 SSH RI, CLARIN ERIC's, *Industry Engagement Action Plan*

CLARIN stands for "Common Language Resources and Technology Infrastructure". In 2012 CLARIN ERIC was established as a legal entity with the mission to create and maintain a digital infrastructure to support the sharing, use, and sustainability of language data (in written, spoken, or multimodal form) available through repositories from all over Europe, in support of research in the humanities and social sciences and beyond.

As a Landmark research infrastructure, CLARIN aims to reach beyond scientific excellence to act also as a leading RI driver of innovation in the new ERA, providing expert advice and support on all aspects of basic and applied language technologies to European industry, particularly to SMEs developing Artificial Intelligence and Machine Learning applications in EU Digital Transformation and Recovery Plan innovation projects across a wide range of industrial sectors.

The CLARIN ERIC Industry Engagement Action Plan 2022-2024

Actions proposed by CLARIN's ICO to boost the RIs position as a leading advisor and partner for European SMEs working on EU recovery and digital transition language processing projects include:

1. Establish a *CLARIN Industry & Innovation Task Force/Service Group* with 5-7 members from CLARIN Office and key Centres with expertise in technology responsible for drafting the CLARIN **Industry Engagement and Innovation Strategy and Action Plan** to boost CLARIN socio-economic relevance and visibility with industry;

2. Scout, map and package CLARIN top in-house language tech solutions, tools and processes of potential interest to SMEs to present to leading EU artificial intelligence intermedieary companies like Spain's VICOMTECH and/or Italy's CELI, in key CLARIN member countries. According to FORTUNE *, the global natural language processing (NLP) market is projected to grow from USD 20.98 billion in 2022 to USD to 127.26 billion in 2028 at a CAGR of 29.4% during the period.

3. In close consultation with CLARIN national Member Representing Entities, draft an Annual Strategy and Action Plan at positioning CLARIN as a leading EU SSH language research and technology reference Authority and Consultancy/Advisory at the service of SMEs active in Next Generation EU digital transformation/modernization innovation Projects in leading CLARIN Member countries;

4. Under the aegis of ESFRI, SSHOC, the ENRIITC Network Hub and the ERIC Forum build on the ENRIITC Industry Workshop of last March 2022 to launch an SSH-domain wide Innovation Training Program in collaboration with DARIAH, CESSDA, ELG, ELRC, ELEXIS and other leading SSH-cluster players as a first step towards a future integrated SSH-cluster industry engagement strategy; and,

5. Harmonize CLARIN distributed facilities' online presence, labelling and messaging regarding innovation and collaboration with industry and launch a pan-RI program of regular CLARIN staff team building events and incentives to strengthen the RIs innovation mentality.

* https://www.fortunebusinessinsights.com/industry-reports/natural-language-processing-nlp-market-101933

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Appendix 6 KPIs Summary Table

		KPI	impact
ILOs	1	Maintain a national database (as part of a joint European database) of companies with relevant skills and capabilities, in collaboration with fellow European ILOs and ICOs.	This would make it much easier to find proper partners for collaborations across the entire value chain.
	2	Actively support the creation and maintenance of technology roadmaps, based on national strengths, and validate them with the needs from RIs	This would serve the need for companies in each member state to anticipate on future tenders, leading to more continuity and perspective, and diminishing risks.
	3	Organize brokerage meetings between national and international industry and RI representatives, partly on location of the RI ("industry days"),	This will increase mutual understanding about requirements and abilities, bridging cultural differences and establishing personal relations with the proper employees, leading to increased collaborations. Supporting pan-European events such as Big Science Business Forum will also assist the ILOs in the international brokerage function.
	4	Maintain an overview of (national and international) funding opportunities for RI-industry engagement	Funding is at the base of collaborations, in particular on the upstream part of the value chain (innovation pathway), where risks can be high. Good knowledge about upcoming opportunities will facilitate early and well-prepared initiatives for collaboration.
	5	Organize stakeholder meetings with the innovation ecosystems surrounding the RIs to exchange best practices and new opportunities for engagement.	Since there are many different stakeholders in the RI ecosystem, it is mandatory to exchange views, create awareness and pursue policies to develop and sustain the ecosystem across borders and domains.
	6	Support SMEs in their response to tenders, and (in close collaboration with ICOs) create and use opportunities to bridge the gap between upstream and downstream (knowledge transfer and product development) activities.	Many companies (in particular SMEs) experience difficulties in complying to tender requirements. Besides easing these requirements ILOs can help to facilitate the tender process, diminishing the company's efforts to respond on tenders. Moreover, it can increase early identification of opportunities for knowledge transfer and product development relevant for the market(s) in which the company is active.
ICOs	1	Oversee preparation of an annual RI innovation and industry engagement strategy and action plan and contribute to the Director General's annual strategic and operational reports to member funding agencies, and EC and ESFRI if required.	This will set the course of action for increasing RI cooperation with industry with clear objectives and action steps aimed at securing strong and consistent buy-in from stakeholders and partners.
	2	Organise regular periodic meetings of the RI innovation and industry service group (central office and facilities innovation staff together with relevant internal collaborators, such as communications, procurement and engineering).	This will ensure strong and constant coordination of key functional officers and teams involved in delivering the RI industry engagement strategy: the ICO, communications, engineering and procurement – both those based in the central RI management office and those in the facilities/nodes in the case of distributed RIs.
	3	Organise annual physical RI-industry innovation workshops with at least 30% participants from industry. Events may have a special focus on relevant local, national or international innovation ecosystems.	It is important to raise the visibility of the RI's potential for engagement with industry both at local, national and international scale, including EU innovation agencies such as EARTO, EOSC DIH and EIT KICs and, ideally, also the media.
	4	Maintain a strong web-based RI-industry cooperation profile (own pages or relevant portals such as CatRIs or similar) with up-to-date content to attract prospective industrial suppliers and users including success stories, information on training, exchanges and workshops, contract, procurement and FAQs or similar. Be accountable for maintaining the part of the RI catalogue of services dedicated to industry.	It is essential that business and not only researchers be able to relate to information on the RI's mission, activities and plans published on the RI website. Such content needs to be readily accessible and understandable and presented in such a way as to raise companies' interest and stimulate their desire to find out more about opportunities for pursuing active collaboration.
	5	Operate an innovation advisory board (IAC) and engage them twice per year. Prepare a written report for RI management on the feedback from the IAC. (see IAC duties in Appendix 3).	A strong and effective IAC is essential to help design and deliver a successful RI industry-engagement program and maintain strong and direct connections with the private sector.
	6	Operate an active outreach programme to industry, targeting both large companies and SMEs, and other organisations (such as RTOs and intermediaries) including brokerage events, outcalls and conferences on the RI value proposition. 1-1 interactions and visits from companies should also be part of the programme.	Such events and interactions constitute the core job of the ICO as they are main way to increase industry awareness of RI activities and value-added leading to dialogues between the ICO team and companies regarding opportunities for collaboration. Moreover, they are invaluable in helping keep the RI updated on industry needs and trends.
	7	Maintain close foresight, in collaboration with the RI European programme officers (if existing), on EU-level programmes and Horizon Europe, EOSC and data spaces initiatives and calls targeting industry (climate, health, economic recovery, digital transformation).	This will ensure that the RI is always up-to-date on current and new EU-funded projects which offer the greatest scope for boosting cooperation with industry, particularly with SMEs.

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