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D2.3 Analysis of performance indicators of ILOs/ICOs across countries and domains

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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 (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 2021 in Granada, Spain.

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

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).

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

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 tenders, and industrial services.

Industry Contact Officer (ICO) – 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.

KPI – Key Performance Indicator

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*

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

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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.

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Executive Summary

In this report, 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. This means that we will identify the most important stakeholders of the RIs and their requirements and expectations.

The "Report on the Mapping of Industry as a Supplier and User" (ENRIITC deliverable D2.1) is used as an important source of the analysis. Particularly relevant are the collected responses by ILOs and ICOs about the disciplines they are involved in, and what they experience as what is most expected by their different stakeholders. A possible framework for KPIs has been published by the ESFRI working group in December 2019; "Monitoring of Research Infrastructures Performance", which provides valuable information, as well as relevant reports by the ERIC Forum, such as the "Report on proposed approach and dashboard for common ERIC KPIs". The ENRIITC report D2.1, from now on also referred to as "the survey report" tends to focus on the role of industry as either a supplier or a user of RIs. It is important to note that other perspectives, such as data infrastructures *versus* infrastructures in the physical sciences, and distributed RIs *versus* single-sited RIs should be taken into account, if we are looking at the performance of ILOs and/or ICOs.

The results of the survey report show that we still have to address a number of issues to be able to arrive at a set of policy recommendations for the performance of ILOs and ICOs, which will be the subject of deliverable D3.5. These issues are formulated in section 5 of this report.

Obviously, recommendations should first of all be based on strategic principles. In addition, the current status of how ILOs and ICOs are actually performing, as described in report D2.1, forms a basis. It is concluded that:

- ILOs, employed at government agencies, have a predominant focus on national return on investment (georeturn) and especially consider industry in their role as a supplier for instrumentation and services to RIs. From the ILO perspective, it is logical to also consider the promotion of technology transfer and co-development as part of their activities, however this is hardly part of the mandate issued by their employer.
- For RI-ICOs, georeturn is less relevant. Their focus is on the tools to engage industry as a user. Their perspective is regional or European, rather than national. ICOs fulfill a role in how RIs can live up to the expectations of their stakeholders but their performance against the kind of requirements referred to in section 4 and other expectations is mainly determined by the overall strategy and workplans of an RI. Not only for ILOs, but also for an RI ICO, a clear generic job description is missing. In many cases, the ICOs deployed at the central level are very much dependent on a good collaboration with staff in the national nodes of the RI, which use part of their time towards the ICO role objectives, including engaging industry as user and ensuring an adequate response to the RI tenders for supply or co-development. In fact, the RI ICO-role is mostly fulfilled by more than one person in different offices, including the procurement office, the business development unit and the communication office. A formal network of ICOs across RIs is also completely missing.

Clearly the worlds of ILOs and ICOs are still pretty separated, which may raise a number of questions that have an impact on their (required) performances. Obviously, first of all ILOs and ICOs have a role in carrying out the mission of their organizations. However the ENRIITC investigations (D2.2) highlight specific differences in the employer's expectations from these roles and how little the ILO and ICO functions overlap. It even appears quite clear that the definition of ICO given by the Commission in

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the call for this project may need some adjustment, in virtue of the reality check carried out through D2.2. A policy objective to exploit the "common ground" of ILOs and ICOs shall be better addressed in the context of WP3, with the output of D3.5 ("Policy recommendations for the optimisation of ILO/ICO performance"), together with a novel definition of the ICO, better aligned with the current findings.

Approach to determine Performances

1. Introduction

RIs are the result of large investments for their actual building and sustainable use over many years. Public funding lies at the base of most RIs, often divided among the RI member partners according to GDP level. RIs are expected to work towards multiple objectives and to serve multiple purposes. Their deployment is first of all driven by the desire to enable breakthroughs in fundamental and/or applied sciences.
Governmental authorities expect a return on their public investments, through scientific activity and results, as well as through activities focusing on industry and/or public organisations, either as suppliers, users and co-developers of innovation (building activities, technology development, development of products and services, and knowledge transfer). In this respect, while governments are the major stakeholder in the implementation of RIs, also scientific communities and private entities (such as companies) can all be considered interested parties.

The goal of this report is to present a contextualisation of the concept and role of performance indicators for Industrial Liaison Officers (ILOs) and Industry Contact Officers (ICOs) that are involved in the activities of the Research Infrastructures (RIs), which are part of the European RI ecosystem. This is relevant for the KPI recommendations that will form the basis for ENRIITC deliverable D3.5 "Policy recommendations for the optimisation of ILO/ICO performance" (due date: June 2022).

Rather than focusing on KPIs for individuals, we take as leading principle the performances of the organisations that employ ILOs and/or ICOs, according to their mission and the specific impact objectives, which may relate to collaboration with industry. We will therefore mainly (i) address the mission characteristics of the RIs, (ii) consider RI diversity across countries and disciplines, and (iii) identify the aspects for which RI performance in relation to collaboration with industry could be meaningfully reported and reviewed. An analysis of the requirements and expectations will be the basis for the parameters underlying the recommendations to be presented in ENRIITC deliverable D3.5.

Through our analysis we shall identify:

- the most important stakeholders that bring in the requirements for the performance of RIs that is taking shape through the RI action lines implemented by ICOs and ILOs;

- the main stakeholder requirements, which can generally be related to:
    - the RI objectives and missions
    - the "return on investment" for the participating countries
    - emerging policy expectations regarding the societal impact
    - curiosity-driven research, at the very start of the value chain, as an important driver for innovation
- industry-related KPIs, for both industry as a user and a supplier, i.e. for RI ICOs and RI ILOs
- gaps, open questions and next steps

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2. Methodology and background information

The main source of information for our work is the "Report on the Mapping of Industry as a Supplier and User" (ENRIITC deliverable D2.1). Particularly relevant are the collected responses by ILOs and ICOs about the disciplines they are involved in, and what is expected by their different stakeholders.

Other sources used:

1. The relevant parts of the report presenting a possible framework for KPIs that has been published by the ESFRI working group in December 2019 (Monitoring of Research Infrastructures Performance [2])
2. Relevant reports and position papers by ERIC Forum Implementation Project (such as D4.1: "Report on proposed approach and dashboard for common ERIC KPIs"[3]).

3. Stakeholders and their requirements

Regarding industrial stakeholders, a clear distinction can be observed between their role as users and as suppliers. This is reflected in the distinct role of ILOs and ICOs. ILOs typically play a role in contexts in which industry is a supplier; ICOs serve a major role in contexts in which industry has a role as user or co-development partner.

ILOs

The role of public research institutes and universities is defined in national contexts. These institutes are often supposed to organise the national research communities to make use of the RI, and in doing so also promote industrial collaboration and co-development, often leading to technology transfer as well. Generally speaking, public (research) institutes have a mission to enable breakthroughs and to promote innovation through curiosity-driven or applied research. The survey report seems to indicate that these missions determine to a large extent the focus and performance of ILOs, who are mostly employed by these research institutes.

For publicly funded ILOs, their mission is mainly focused on:

- connecting industrial capabilities with the requirements of scientists and/or the RIs. To a certain extent it depends on the employer of the ILO whether the drive is focused on promoting co-development or on raising return on investment (georeturn),
- identifying and promoting knowledge or technology transfer

ICOs

The staff employed at the RIs with a mission to maintain links with the external ecosystem of industries – the ICOs are mainly oriented at promoting the use of the RI, and trying to arrange for industry-RI partnerships. They are focused on the exploitation potential, and less on the development of the RI. As a consequence, ICOs are not *a priori* involved in procurement activities that for some RIs are part of the processes run.

[2] https://www.esfri.eu/latest-esfri-news/report-esfri-working-group-monitoring-ris-performance

[3] https://www.eric-forum.eu/2019/07/09/eric-forum-position-paper-on-the-development-of-kpis-for-research-infrastructures/

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To establish performance indicators which could simultaneously suit both ILOs and ICOs and the opportunities to collaborate, an area where their mandates overlaps has been identified in the innovation drive that RI should propel. For the purpose, their roles could be considered in the context of the value chain; starting from fundamental (curiosity driven) research, to applied research and using the results, as well as transferring knowledge and technology to other domains. Alignment of activities of ILOs and ICOs can certainly contribute to strengthen the productivity of those value chain- and to the realisation of knowledge transfer and societal impact.

4. Suggested industry-related KPIs for RIs

In recent years, there has been a growing interest among policy makers, funders, and managers of RIs to develop tailored KPIs that would enable the tracking of developments at international, large-scale RIs, and allow for the monitoring of their performance and use of resources. For the collaboration between RIs and industry on the one hand, and ILOs and industry on the other hand, KPIs have been suggested by the ESFRI working group in December 2019, and in relevant reports of the ERIC Forum in the context of H2020. *See sections 3.1 and 3.2*.

Other Europe-wide efforts to develop monitoring instruments tailored to the unique needs of Research Infrastructures (RIs):

- In March 2019, the Organisation for Economic Co-operation and Development (OECD) published a "Reference Framework for Assessing the Scientific and Socio-economic Impact of Research Infrastructures".
- EU funded projects which aimed to develop methodologies and tools to help RIs assess their socio-economic impact and define SEIIs that best match their vision and goals, and encourage the sharing of lessons learned. ACCELERATE and RI-PATHS.

These efforts mainly focus on socio-economic impact (SEI), which are only indirectly relevant for the KPI focus of this report. KPIs focus on the efficiency of processes and the recognition of accomplishments, while SEI indicators mainly track outcomes and long-term effects.)

4.1 ESFRI framework

4.1.1 Introduction

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.

We will focus here on four of the objectives listed and summarise the potential indicators mentioned in the ESFRI working group report:

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

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In the assessment of the usefulness of these indicators for the purpose of developing policy recommendations the following conditions should be kept in mind:

- The level of reporting burden
- Diversity across RIs regarding the relevance of certain objectives
- Legal impediments (e.g. the fact that some RIs are not fully free to undertake commercial activities), either due the characteristics of their service offer (e.g. involving data subject to GDPR constraints, or to generic or country-specific regulations pertaining to the exploitation of results of publicly funded projects).

4.1.2 Objectives relevant in the context of ENRIITC

Objective: Facilitating economic activities
Quantitative KPIs:

- Share of users associated with industry and publications with industry
- Income from commercial activities and the number of entities paying for service

To measure in qualitative terms:

- Partnerships with industry. *Indicator*: Existence of an Industry Engagement Plan and Dedicated Resources.
- Technology transfer. *Indicator*: Existence of a TT-Office and dedicated resources to support its activities.

Objective: Provision of scientific advice
Quantitative KPIs:

- Participation by RIs in policy related activities
- Citations in policy related publications

To measure in qualitative terms:

- Standardisation / regulatory impact. *Indicator:* Impact cases illustrating contribution of RI to standardisation or regulatory development.

Objective: Outreach to the public
Quantitative KPIs:

- Engagement achieved by direct contact
- Outreach through media
- Outreach via the RI's own web and social media

To measure in qualitative terms:

- Extent of outreach and engagement achieved by direct contact (events, visitors, guided tours)
  Indicators:
  (i) Events organised satisfaction - % satisfaction rates of attendees
  (ii) Visitor satisfaction – average % satisfaction rates of visitors

(Sub)Objective: Integration of distributed facilities
To measure in qualitative terms:

- Policies related to integration of distributed RIs. *Indicator:* A single access point to resources of multiple partners of a distributed RI by industry.

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4.2 ERIC Forum – reports and project deliverables

4.2.1 Introduction

For this ENRIITC deliverable we will distil the most relevant statements from Deliverable D4.1 of the ERIC Forum Implementation Project "Report on proposed approach and dashboard for common ERIC KPIs". (Part of D4.1 consists of the White Paper[4] that the ERIC Forum has published in 2019 and that summarises the ERIC Forum position on KPIs.)

The aim of the task that resulted in D4.1 was to support the ERICs in assessing performance relative to their own mission goals and empower them with knowledge to track and monitor KPIs in a regular and consistent way. An important finding reported in D4.1 is that the survey conducted revealed that the motivation of RIs to adopt KPIs varies and that any framework evolving from attempts to harmonise KPI framework should consider the difference between RI types (single-sited vs. distributed) and the scientific domains they represent.

4.2.2 Relevant in the context of ENRIITC

The variation reported on the motivation to adopt performance metrics is particularly true for the KPIs related to socio-economic impact and particularly to collaboration with industry.

Regarding the relation between KPIs and socio-economic impact:

- The purpose of KPIs is to measure performance, evaluate success in delivering results, and monitor progress towards set goals.
- The purpose of indicators assessing socio-economic impact is to evaluate how RIs transform their environment and what influence they have beyond scientific results. Some RIs enable science by producing data which are used for scientific research or by providing access to state-of-the-art instrumentation, so definition of impact can vary across RIs.
- Recognising the difference between KPIs and impact indicators, the ERIC Forum Implementation Project has separate tasks dedicated to each of the tools. A KPI framework should exclude indicators to assess socio-economic impact of RIs.
- KPIs are considered an internal management tool and thus it is more useful to think of performance metrics and qualitative case studies aimed more at external reporting to key stakeholders and monitored over longer timescales.

4.3 Analysis

The indicators summarised in section 4.1 relate of course to RI objectives, but neither for all RI domains nor for all RI stakeholders they are equally relevant. In line with the ERIC Forum position summarised in 4.2, for the policy recommendations it seems crucial to adopt refined performance categories and to clearly distinguish between:

- indicators pertaining to industrial parties as user *versus* industrial parties as supplier
- indicators for data infrastructures *versus* infrastructures in the physical sciences
- indicators for distributed RIs *versus* single-sited RIs

The indicators mentioned in section 4.1 for performance related to uptake by industry (share, use), fee-based services and outreach seem to be conceptually clear enough and their measurement (in case the performance matches an RI's objectives) seems feasible. They are likely to be a useful stepping stone for future policy recommendations. Public outreach can be considered as a prime

[4] https://www.eric-forum.eu/2019/07/09/eric-forum-position-paper-on-the-development-of-kpis-for-research-infrastructures/

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responsibility of the RI. As far as the industry-RI relation is concerned, matters of technology transfer, innovation and societal relevance as a result of collaboration or co-development are important topics. Obviously these outreach topics are of interest for both ICOs and ILOs, and could be taken as one of the topics for which common KPIs could be useful.

Attention for qualitative indicators capturing the potential and actual contribution to innovation policies seems scarce, while the indirect role of objectives and corresponding indicators related to support for curiosity-driven research in the innovation landscape, as well as objectives regarding societal impact, is not captured by the KPI framework referenced.

Further work in the context of ENRIITC WP3 may be needed to identify any further existing or future KPIs or KPI frameworks that are relevant for the collaboration between industry and some RIs and best practices in deploying them.

5. ICOs and ILOs in their environment

Sections 2 and 3 take the mission of the RI and its stakeholder requirements as the main perspective. But what can be observed about the ILO and ICO perspective with respect to their activities, as derived from the survey conducted for the ENRIITC deliverable D2.1?

For D2.1 an analysis was made of the activities of ILOs and ICOs and the opportunities for their collaboration as distinguished by the different roles of industry: as a supplier or as a user of the Research Infrastructure.

Industry as supplier

- The primary supplying-industry sectors (in order of relevance) are: Electrical & Electronic Engineering, Mechanical Engineering, Energy, ICT/Data, Space, Construction, Aeronautics, Pressure Equipment & Gas Appliances, Defence & Automotive;
- On average, ILO activities cover only one RI (a third of ILOs cover more than one);
- ILO performance is measured against several indicators; the most important indicator is national georeturn;
- Technology transfer is perceived as much more important by the ILOs themselves than by their employers, as well as the promotion of industry-RI-university collaborations.

Industry as RI-user

- Main industrial RI-users sectors are currently: Biotechnology (49%), Healthcare Industries (43%), Energy (37%), and Chemical (35%).
- On a second tier: Medical Devices (33%), ICT/Data (31%), Aeronautics (29%), and the Automotive Industry (29%);
- Most popular services requested by industry are: access to facilities, instruments, and testing (53% of RIs); and testing and quality/standards compliance validation (31%).
- Most popular services offered are: access to facilities, instruments, and testing (67% of RIs); access to data; modelling (49% of RIs); and access to specialised training (49% of RIs);
- 61% of the RIs have an industry-strategy, 50% of the RIs employ an ICO, and 35% have an industry advisory board. 64% of the RIs either do not track their income from industry or report zero income from industry;
- RIs with ICOs interact much more with their surrounding ecosystems (cluster organisations, science parks, etc.). They engage much more with larger companies, and slightly more with companies in other countries than where the RI is located; these organisations generate a higher income from industry;

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- RIs with annual operation budgets lower than EUR 5 M most often describe the nature of collaboration with industry clients as mainly being spontaneous one-offs, whilst RIs with an annual budget above EUR 5 M describe it as either a systematic long-term plan/relationship or a mix of the two.

Zooming in on the performances of ILOs and ICOs, this translates into the following observations.

5.1 Observations from D2.1 comparing ILO and ICO activities

- ILOs seem to work most frequently with companies from engineering-intensive industry sectors such as aeronautics, construction, defence, electrical and electronic engineering, energy, mechanical engineering, pressure equipment and gas appliances, space, as well as ICT and data.
- ICOs' activities are mainly in the biotech, food & drink, environment and health care sectors. Although the RIs' activity level is increasing in the chemical, biotechnological, environmental and medical/healthcare industries, this is not yet reflected in the activities as reported by ILOs.
- Asked about common elements of communication with industry, ILOs more frequently pointed to events for industry and databases of companies, while RIs seem to refer preferentially to industry web portals. Reference inventories appear to contain quite typically 100-1000 company records entries, but ILOs and RIs with larger or smaller inventories could also be found.
- Large discrepancies between ILO and ICO practices are found in the use made of facilitators (organisations and networks) to foster industry-RI relations. Technology parks appear to be an area equally relevant to both ILOs and ICOs. However, ILO networks play a more pronounced role than ICO networks as facilitators, while ICOs rely more on Pan-EU innovation-promotion organisations such as: EIT, KICs, EOSC. Developing mutual understanding of the roles and importance of the ILO and ICO functions represents an area of development for ENRIITC subsequent projects.

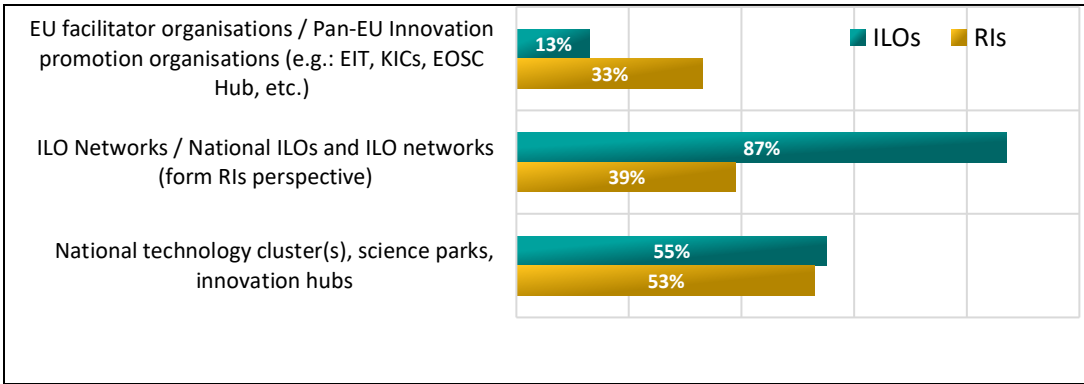

Figure 1: Key entities in process of cooperation between RI and industry in the opinion of ILOs and ICOs

- From the strategic management perspective, cooperation between the industry and the RIs in most cases combines one-off cooperation with a systematic and long-term relationship. However, it should be noted that almost a quarter of RIs and ILOs cooperate with industry exclusively on a spontaneous basis. This may be related to an inability to lower the barriers for stronger relations between RIs and industry. Reported obstacles to industry-RI

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engagement include communication issues, complicated public procurement procedures, complexity and different sets of procurement rules between RIs, one-off contracts and low tender success rates.

- RIs engage industry for joint research, development and innovation (RD&I) through various types of collaboration. EU/publicly funded projects are the most frequent but other types also feature, in significant numbers**.** Transfer of technology/ licensing as a specific means for RD&I is indicated only by 35% of the RIs, which may be related to the fact that RIs rarely own any intellectual property, at least at the central management level.

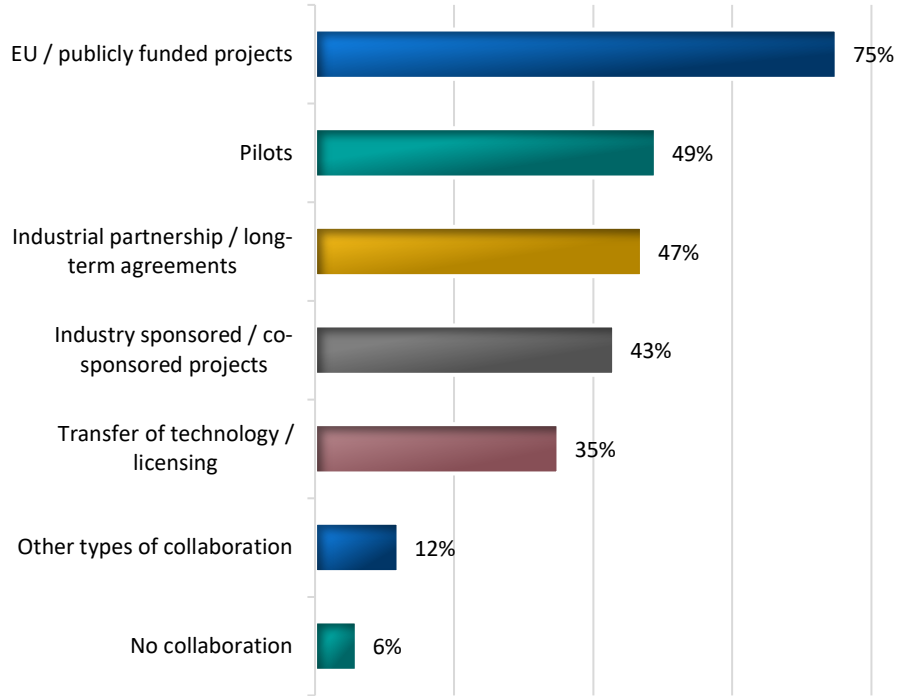

Figure 2: Forms of RI-ICO engagement with industry for joint research, development and innovation

- ILOs were asked to rate the relevance of the Key Performance Indicators, by which their employer measures their activity (ref Fig. 15 in survey report D2.1). 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. When broken down by the different places of employment of the ILO, the results (ref Fig. 16a-16c in survey report) suggest that ILOs employed by governmental agencies are pushed to a greater extent towards improving georeturn than ILOs employed by public research organisations, which focus more on promoting collaborations and technology transfer. ILOs employed by private non-for-profit associations are somewhat in the middle. The opposite occurs with technology transfer, where 13% Governmental Agency employed ILOs rate it as most important, as opposed to 47% for ILOs working in Public Research Organisations. Industry – RI collaborations are also rated higher by ILOs belonging to Public Research Organisations. These are very interesting findings that suggest that the nature of the employer conditions the KPIs of the ILOs, who are more focused on achieving georeturn when employed at Governmental Agencies; they are instead more focused towards RI – Industry collaboration and technology transfer when belonging to Public Research Organisations.

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Looking at the different KPIs ranked according to the importance given by the employer vs. the opinion of the ILO sample (ref. fig 17), georeturn is deemed 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. This may be a perspective for the future role of ILOs to be discussed by ENRIITC, where ILO activity could combine supporting industry as a supplier with promoting industry as a RI user, RI collaborator, and co-creator of value.

- From the ICO perspective, increasing the engagement of industry in EU projects appears as the most effective form of engagement with industry for joint research, development and innovation. Short-term project pilots as well as long-term, strategic partnership are also a favourite form of reciprocal engagement between RIs and industry. Technology Transfer or Licensing is one of the less frequently used forms of collaboration for innovation between RIs and Industry. This may be due to the fact that IPRs and patents are quite rarely associated with the central management of RIs. In fact, even ILOs report technology transfer as a marginally relevant performance indicator by ILOs employers.

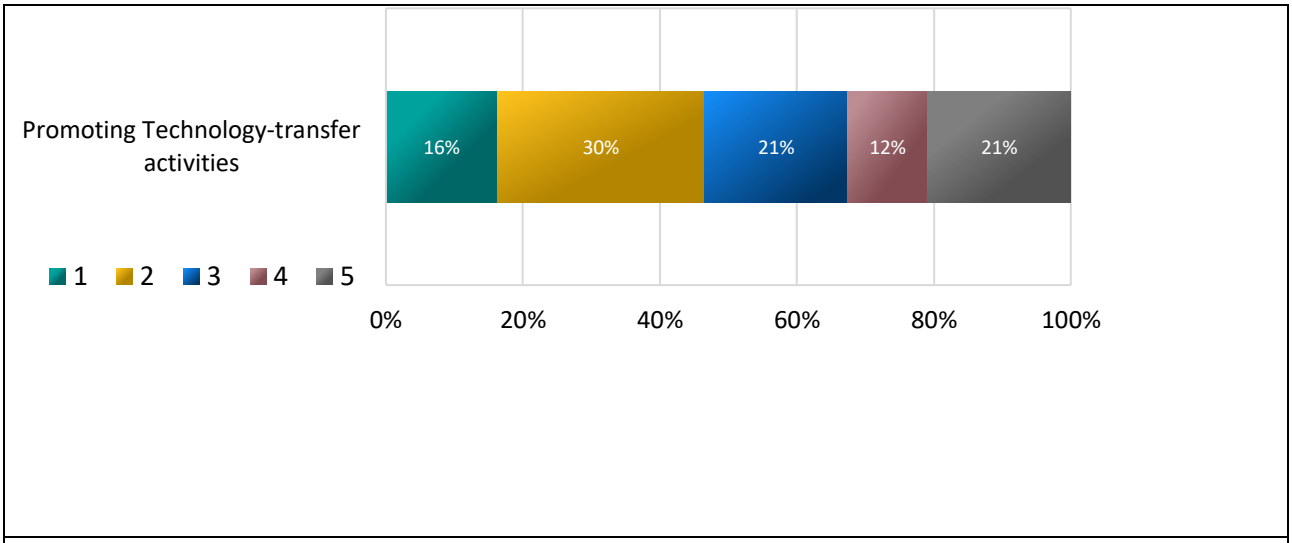

Figure 3: Relevance of promoting technology transfer activities as KPIs by ILOs employers

- Results from the ILO survey also agree on the top measures which would best help develop effective collaboration: EU funding and publicly funded projects are reported in the first place; while other forms of financial subsidies, direct company visits and match-making events are seen as major instruments to support both ILOs and ICOs in their activity to strengthen industry-RI relationships.

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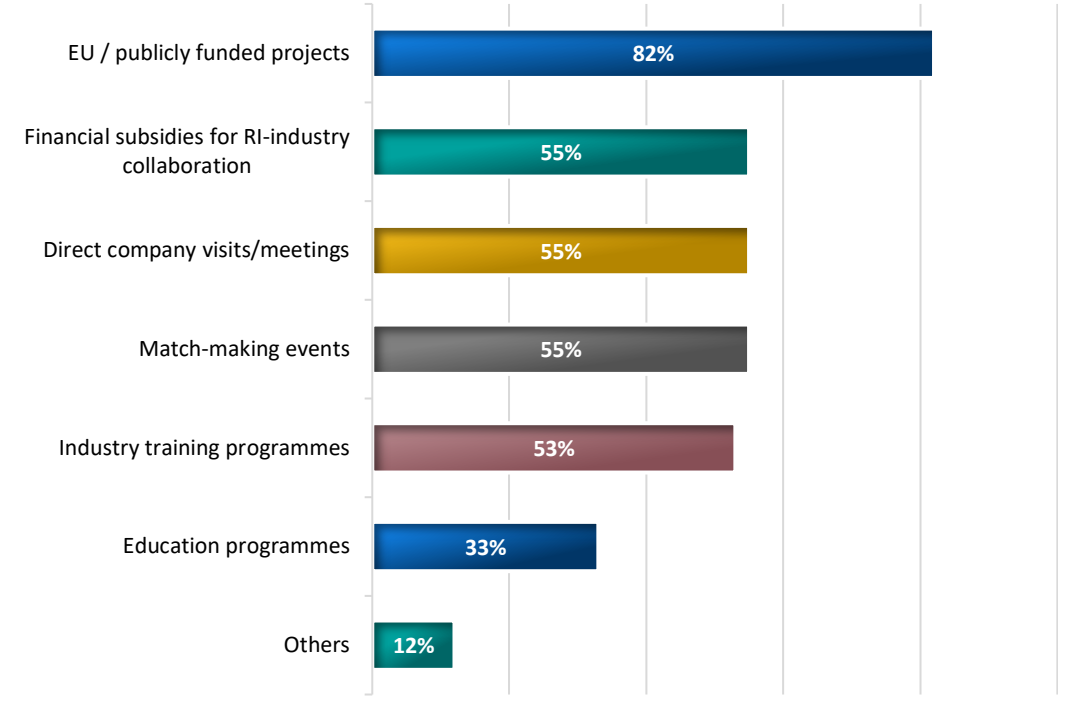

Figure 4: Percentages of ILOs indicating which KPI would help the most to develop collaboration between the RI and industry

The main conclusions that can be derived from these observations are the following, most of them already identified in the survey report D2.1;

5.2 Main conclusions

The expected performance of ICOs and ILOs is largely derived from the objectives of RIs and what the RI stakeholders expect from RIs. Additionally, and especially in the case of distributed RIs, often it is multiple people, employed by different organisations, that together shape the role of interfacing with industry and contribute to the relevant aspects of the interaction, i.e. the supply to the RI and the use of the RI. The same is largely true for ILOs: their performance is determined by the typical needs of the RIs for equipment and facilities, the extent to which the national industry is available and capable to contribute in solving these needs, and the support from local authorities in promoting the desired collaborations.

A clear correspondence between the levels of performance of the RIs on the one hand and those of the ILOs and ICOs on the other, is not always obvious. The question arises if RIs have sufficient and proper counterparts to engage with national ILOs; this would not only require central procurement or communication officers, but enough and dedicated experts/officers to be able to connect and brainstorm with ILOs on the level of science/technology issues, serving the georeturn interests on one hand and the societal needs for research and innovation on the other. Whereas ILOs seem to be increasingly organised in networks, both national and international, ICOs seem to lack a comparable level of organisation. It would be beneficial if models would be available and promoted for the

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exchange of information and best practices between ICOs, both for those who work for the central nodes of distributed RIs and those who are employed by national nodes.

Also, collaboration between ICOs and ILOs is not required by definition to promote impact and innovation. It may depend on the specific disciplines in which the RI is active, as well as on the size of the RI; however, whereas significant differences have been reported among the various disciplines and across the clusters, regarding the way in which ILOs and ICOs perform or collaborate, we have no reason to assume that differences in performance indicators can be attributed specifically to countries in which ILOs or ICOs are active.

While collaboration between ILOs and ICOs cannot be considered a goal in itself, the opportunities for sustained collaboration should be investigated and exploited. A synergistic action between ILO and ICOs may be beneficial to more completely fulfil their functions. To enact this synergy and unlock the potential benefits of this novel collaboration, a strategic approach would be required in contrast to the opportunity-driven character that seems to be predominant now, with a strong focus on tendering or funding projects. This collaboration would need to also be supported by adequate communication tools, shared information repositories and common work practices. Standard job descriptions for both ILOs and ICOs would in any case be essential to focus their activity, identify the common ground, and facilitate collaboration and, possibly, synergistic actions.

While the prime responsibility is with the RIs for meeting the stakeholders' expectations (such as the KPIs mentioned in section 4) and articulating strategic plans that match the RI objectives, ENRIITC will focus on the issues emerging from this analysis, during the preparation of D3.5.

6. Additional issues, open questions, future steps

For the following open issues, the reports summarised above do not provide a clear-cut answer. They will be addressed in the activities towards D3.5 as well.

Obviously, from a managerial perspective and to support internal assessment, ICO and ILO job descriptions should reflect the mission and ambitions of the employer. Harmonised job descriptions will facilitate the collaboration between RIs on the tasks for which ICOs are employed and between ICOs and ILOs (if possible and desired). An important question would then be:

What job descriptions for ILOs and ICOs exist already, what are the elements in these descriptions, and is a certain degree of (European) standardisation possible or desirable?

If there is a case for more collaboration what would be the common innovation agendas, arising from European missions (a.o. Horizon Europe) and goals (a.o. SDGs)?

The difference between distributed and single-sited RIs and data infrastructures *versus* physical sciences infrastructures is likely to impact the policy recommendations in D3.5. The following questions need to be further explored:

What are the conditions under which distributed RIs can optimally organise the communication and exchange of information between the national nodes on potential for collaboration with industry as a user and what is the added value of appointing ICOs on a structural basis?

In which domains would cluster-level activities be beneficial for improved information exchange between the RIs and industry as user?

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How can the outreach of data infrastructures to SMEs and industry in ICT/Data regarding their contribution to innovation and the corresponding knowledge transfer become visible and optimised?

By focusing on innovation and impact, do we have a clear picture of the organisations and institutes that employ ILOs specifically? It seems that there is a certain distinction between the ambition to promote economic value (the relatively short-term return on investment) and the innovation value (requiring a more strategic approach to raise competitiveness in science and technology):

So, what are the different organisations in Europe that employ ILOs, and what are their main drivers?

Zooming in on policies to strengthen competitiveness on the level of science and technology it is good to consider the value of fundamental, curiosity-driven research. To a large extent this drives the development of RIs, yet we may ask ourselves whether the innovation capabilities that follow from this drive are sufficiently exploited:

What policies are followed in the different European countries to explicitly connect and support fundamental research and its challenges to promote innovation through industry-RI collaboration?

Obviously, this question is related to the former question, because it brings demands on the job content of both ILOs and ICOs. And in turn this touches upon the question of "common ground" of ILOs and ICOs:

What do ILOs and ICOs themselves consider as their common ground of performance, and as opportunities to mutually strengthen their capabilities? Perhaps this question was already raised by identifying co-development and knowledge/technology transfer as areas to promote innovation through a stronger industry-RI relationship.

What instruments are already available in Europe and in the European countries to support this? What is the interplay between European and national tools?

Looking at the questions raised above, we may also state that "unknown means unloved". To find common ground and raise performances, ICOs and ILOs should become more acquainted, so:

How to exchange the experiences of ILOs and ICOs in a more systematic way? By training? By setting up specific networks? What could be the role of the RIs to stimulate this exchange?

We would propose to bring these questions forward to the relevant Focus Groups, PERIIA and/or the "#ENRIITCyourCoffee" sessions in the context of this project, and systematically collect the results that are relevant for addressing these issues. These results may then be combined to make well-motivated policy recommendations in D3.5.

7. References

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