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Deliverable Report: "ENRIITC Report on the Mapping of Industry as RI-supplier and RI-user (D2.1)"

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Definitions

"**Big Science**" – Big Science organisations are a common term used for legal entities which build and manage large-scale international research infrastructures, where the scope and cost of the investment exceeds the capability of just one country. Thus, several countries (member states) join forces to finance the infrastructure. These 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 with great success. 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 of research (ESFRI Strategy Report and Roadmap 2018; pg. 38)[1]: Energy (ENE), Environment (ENV), Health & Food (H&F), Physical Sciences & Engineering (PSE), Social & Cultural Innovation (SCI), and – since 2017 – Data, Computing and Digital Research Infrastructures (DIGIT).

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

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

The 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.

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

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),* or virtual *(the service is provided electronically – DSRI)*. Research Infrastructures include: major scientific equipment or sets of instruments; collections, archives, or scientific data; computing systems and communication networks; and any other research and innovation infrastructure of a unique nature which is open to external users.

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

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Abbreviations

BSBF	Big Science Business Forum
CERN	Conseil Européen pour la Recherche Nucléaire
CDTI	Centre for the Development of Industrial Technology (CDTI)
DSRI	Distributed Research Infrastructure
DTI	Danish Technological Institute
KICs	Knowledge and Innovation Communities
EATRIS	European infrastructure for translational medicine
EIT	European Institute of Innovation & Technology
EMSO	European Multidisciplinary Seafloor and water column Observatory
ENRIITC	European Network of Research Infrastructures & Industry for Collaboration
EOSC	European Open Science Cloud
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategic Forum on Research Infrastructures
ESO	European Southern Observatory
ESRF	European Synchrotron Radiation Facility
ESS	European Spallation Source
F4E	Fusion for Energy
FTE	Full time equivalents
IAC	Industry Advisory Committee
ICO	Industry Contact Officer
ILO	Industry Liaison Officer
LE	Large Enterprise
NWO	The Dutch Research Council
PERIIA	Pan-European Research Infrastructure ILO Organisation
PSE	Physical Sciences & Engineering
RI	Research Infrastructure
SME	Small or Medium Enterprise
SSRI	Single-sited Research Infrastructure
SZN	Stazione Zoologica of Naples
WPT	Wrocław Technology Park

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1. Executive Summary

The Role of Research Infrastructures in the new European Research Area

Research infrastructures (RIs) are setup to help scientists make excellent research, but also operate in complex innovation ecosystems where industry plays an increasingly important role. Improving the cooperation between RIs and industry is key to boosting competitiveness and innovation in Europe. As mentioned in the ESFRI White Paper 2020, RIs "constitute a powerful resource for industry." Funders and policymakers expect RIs to enable fundamental and applied science, as well as to deliver research results that can help improve the quality of European citizens, having impact in shorter time scales.

A strong network of state-of-the-art RIs has helped Europe to secure a leading role in research and innovation worldwide. RIs are one of the major successes of the European Research Area (ERA). European science needs to continue advancing at a rapid pace in order to keep Europe's prominent position in an increasingly competitive global environment. This was also noted by the European Commission in its recently released document "A new ERA for Research and Innovation,"[2] which proposes a new vision for the ERA. One of the four objectives mentioned in the document, i.e. to translate research and innovation results into the economy, is closely linked to the aims pursued by the ENRIITC project, which includes, amongst other things, improving the environment for business R&I investments.

Diverse European RI landscape

Researchers in Europe have access to excellent RIs, which are active in all fields of science. The European Strategy Forum on Research Infrastructure (ESFRI) regularly evaluates the landscape of European RIs and publishes a Roadmap that guides national governments in their decision-making regarding RI funding. The latest ESFRI Roadmap (2018) groups RIs into six science areas: Energy (ENE); Environment (ENV); Health & Food (H&F); Physical Sciences & Engineering (PSE); Social & Cultural Innovation (SCI); and – since 2017, Data, Computing and Digital Research Infrastructures (DIGIT).

RIs in the category of Physical Sciences & Engineering are amongst the most mature RIs in Europe. The establishment of some of them dates back to the 1950s and new ones continue to be created, e.g. European Council for Nuclear Research – CERN (1953), European Southern Observatory – ESO (1962), The European Synchrotron Radiation Facility (1987), International Thermonuclear Experimental Reactor – ITER (2007), or the European Spallation Source – ESS (2010). They are mostly single-sited Big Science facilities, and some of them function as treaty organisations with their own procurement rules. Big Science requires big annual budgets. For example, in the case of CERN this is around CHF 1 billion. The member states who fund large-scale RIs are often promised a fair return on investment, which is secured through the involvement of national suppliers and industries for delivery of technical components and

[2] https://op.europa.eu/en/publication-detail/-/publication/f8f19fc4-2888-11eb-9d7e-01aa75ed71a1/

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services. The concept of Industry Liaison Officers (ILOs) was first introduced in relation to large-scale RIs to ensure efficient communication between them and the supplier base in the different member states.
Following the establishment of the ERA, in 2000, and of ESFRI, in 2002, a number of new, mostly distributed RIs was created in other scientific domains than physics. As not-for-profit organisations, RIs are dependent upon funding from member states and other public and private entities to secure their long-term sustainability.

Role of Industry Liaison and Contact Officers

To facilitate an effective communication between RIs and national industries, two particular roles were created by RIs and Member States: Industry Liaison Officers (ILOs) and Industry Contact Officers (ICOs).

ILOs are officially appointed by each member state of an RI to stimulate the collaboration between the national industry and the RI, providing advice on business opportunities, R&D collaborations, and calls for tenders. In contrast, ICOs are employed by an RI and are charged with developing business relations with all potential industrial suppliers of innovative components or services as well as encouraging the economical use of their facility by companies.

Purpose of mapping within the framework of ENRIITC

Funded by Horizon 2020, one objective of the ENRIITC project is to provide a platform for ILOs and ICOs to meet and discuss areas of common interest. The project aims to build a permanent pan-European network of ILOs and ICOs and enable industry to become a fuller partner of RIs whether as a user, supplier, or co-creator.

Work Package 2 (WP2) of the project has been set up to map the key elements needed to enact and sustain the ENRIITC network. To this end, WP2 conducted two surveys, targeting the ILOs and ICOs in Europe. The results presented in this deliverable inform the ENRIITC project of the current state of play and support the development of strategic recommendations within the framework of WP3 and actions planned as a part of WP4.

Methodology

The two ENRIITC surveys primarily targeted ILOs and ICOs that work at or are appointed to a specific international RI. In addition, ILOs and ICOs from national RIs were invited to participate. All ILOs and ICOs from the project consortium had the opportunity to add questions to the surveys and provide their feedback. The surveys were then tested on a target audience from outside the consortium to collect additional input and check details such as logical sequencing, language understanding, functionality of the survey tool, etc. Finally, the surveys were rolled out in June and July 2020. To secure as large a participation as possible, they were promoted through ENRIITC communication channels and also distributed with the help of strategic external players such as ESFRI, PERIIA, and the ERIC Forum.

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Profile of Respondents of the ILO Survey

The number of responses to the ILO survey was 56% higher (47 responses) than the key performance indicator (30 responses) set by the consortium to measure the success of the survey. Given that answers were provided by ILOs from 20 different countries, it can be concluded that the results represent a robust basis for the characterisation of the European ILO community. However, since the number of participants per country was rather small (Figure ES.1), country-specific conclusions cannot be drawn. Nearly all participating ILOs (96%) are employed by a single institution. Most of them belong to either governmental agencies (38%), public research organisations (38%), or non-profit associations (19%). The remainder is employed either by RIs or private commercial institutions.

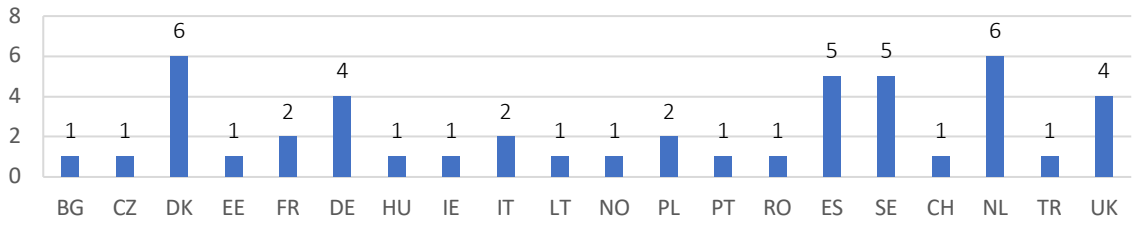

Figure ES.1 - Number of Respondent ILOs per Country

Profile of Respondents of the ICO Survey

The ICO survey was answered by 51 respondents, being ICOs or RI staff responsible for industry collaborations. The respondents represent 44 different institutions active in a variety of scientific disciplines (Figure ES.2). Around 55% of the surveyed institutions have been in operation for more than three years. Currently, 16% are in the operations spin-up phase and 14% in the preparatory phase. Seventy-six percent of the RIs are on the ESFRI Roadmap 2018 either as Landmarks (56%) or Projects (36%). The research domain of Physical Sciences & Engineering was most strongly represented (33%), followed closely by the Health & Food domain (27%). Nearly two thirds of the surveyed RIs (65%) are distributed facilities, with the remainder (35%) being single-sited.

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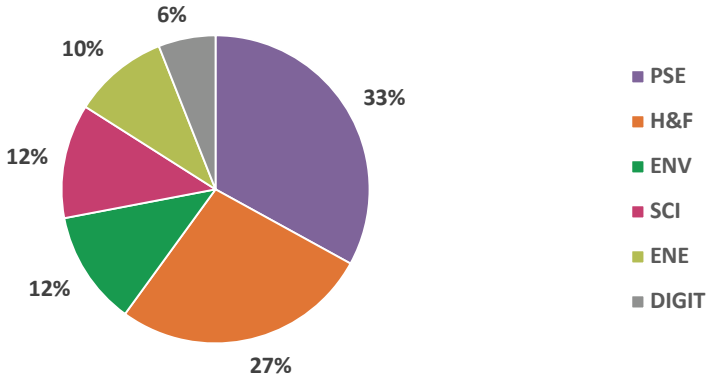

Figure ES. 2: Chart showing to which ESFRI Research Domain the RI Belongs.

Key Results

A selection of key findings from the two surveys is presented below. Further details on each of the finding as well as additional results are presented in the chapter "Results and Discussion," of this deliverable report.

Industry as a RI-supplier - Five Selected Key Findings of the ILO Survey

- The primary industries working as suppliers to RIs are (in order of relevance): Electrical & Electronic Engineering, Mechanical Engineering, Energy, ICT/Data, Space, Construction, Aeronautics, Pressure Equipment & Gas Appliances, Defence & Automotive;
- On average, most ILOs cover only one RI, with 33% of the ILOs covering more than one;
- ILO performance is measured against several indicators where, by far, the most important one focuses on the goal to raise national georeturn;
- Technology transfer is perceived as much more important by the ILOs than by their employers, as well as the promotion of industry-RI-university collaborations.

Industry as a RI-user - Five Selected Key Findings of the ICO Survey

- The sectors of the RIs primary (>34%) industrial users are: 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%);
- There is a good correlation between the services offered by the RIs and the request from industry. The most popular services requested are: access to facilities, instruments, and testing (53% of RIs); and testing and quality/standards compliance validation (31%). The 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);

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- Over the sampled population, approximately half of the RIs employ an ICO. It is positive that 61% have a strategy for working with industry, but only 35% have an industry advisory board. Sixty-four percent of the RIs do not track their income from industry (or report zero income);
- 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 that where the RI is located; although the number of clients is similar to RIs without ICO, these organisations generate a higher income from industry;
- RIs with annual operation budgets lower than EUR 5 M most often describe the nature of collaboration with industry clients as mainly being one-off impromptu, 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.

The results of the survey will be used to develop a strategy to maximise RI engagement with industry planned within the framework of ENRIITC WP3. The aim of WP3 is to nurture best practices and concepts among RIs, and to develop strategies, tools, branding, and marketing materials to support RI-industry interactions. The set of best practices and strategies developed under WP3 will be implemented through pilot events and activities in WP4. The experience and lessons learned from WP4 will be used as a feedback loop to fine-tune the work carried out in WP3.

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2. Introduction and Methodology

Background and Context

Research Infrastructures (RIs) play an increasingly important role in the EU innovation ecosystem. Pan-EU initiatives, such as the Innovation Union policy or the European Strategy Forum on Research Infrastructures (ESFRI), play a crucial role in enabling industry to become a fuller partner of RIs, whether as a supplier, user, or co-developer.

To facilitate an effective communication between RIs and industries, two particular roles were created by member states and RIs: Industry Liaison Officers (ILOs) and Industry Contact Officers (ICOs). ILOs are officially appointed by each member state of an RI to stimulate the collaboration amongst the national industry and the RIs, providing advice on business opportunities, R&D collaborations, calls for tenders, and industrial services. In contrast, ICOs are employed by RIs and tasked with developing business relations between the RI and industry. Normally, the focus of the ICO is on industrial usage of the RI, but the role may also include collaboration with industrial suppliers of innovative components or services (procurement function) or technology transfer with industry.

In order to boost RI-industry partnerships, the activities of Industry Liaison Officers (ILOs) and Industry Contact Officers (ICOs), need to be strengthened. Building on their mandate, ICOs and ILOs can help increase awareness amongst industry representatives, enhance the use of RI services and facilities, and encourage the uptake of research technologies, thus co-creating value.

The ENRIITC project (European Network of Research Infrastructures & Industry for Collaboration) aims to establish a permanent, pan-EU network of ILOs and ICOs in order to increase networking opportunities between RIs and industry, and to provide a platform where they can build stronger partnerships to jointly fuel innovation. ENRIITC is implemented during 2020-2022 by a consortium of 11 partners from seven countries. The project activities are also supported by over 60 Associate RIs.

As an important preparatory step towards the project's main goal of the ILO and ICO network, ENRIITC conducted two surveys during 2020 to map the level and scope of engagement between industry and RIs. The surveys were developed around two overarching topics: "Industry as an RI-supplier," and "Industry as an RI-user." The surveys focused, among other things, on investigating the nature of access routes used by industry, the characteristics of industry such as business sector or enterprise size, the effectiveness of current ILO and ICO performance indicators, as well as drivers of and barriers to closer collaborations between RI and industry.

This deliverable provides a thorough overview of the collected data and will be used by ENRIITC to develop an effective strategy and methodology to aid the establishment of an effective, pan-EU network of ILOs and ICOs, one that will be able to take the dialogue and cooperation between RI and industry to a new level.

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Methodology: Approach and Implementation

ENRIITC prepared two questionnaires to survey the ILOs and ICOs. The aim was to find out their views on RI-industry relations, focusing on two key themes: "Industry as an RI-supplier" (ILO survey) and "Industry as an RI-user" (ICO survey). The industry sector categorisation was based on an EU Commission classification[3] of the "Internal Market, Industry, Entrepreneurship, and SMEs," adapted to better reflect the existing and potential relations of the ESFRI RIs.

The content of the two surveys was prepared in Task 2.1 and Task 2.2. More specifically, the draft of the ILO survey was developed by WPT and EMSO, whilst the draft of the ICO survey was developed by DTI and EATRIS. All partners of the ENRIITC consortium had the opportunity to review the drafts and to provide feedback. Pilot versions of the surveys were tested with the help of an external audience in order to ensure the questionnaires were understandable, relevant, and that the important elements were all present. The final versions of the questionnaires were rolled out in the summer of 2020.

In parallel with the pilot activity, WPT in collaboration with their external supplier SURVIO started programming an online platform to collect responses. The questionnaires were promoted on the website of the ENRIITC project and the Big Science HUB portal, and also distributed through the communication channels of ENRIITC. ENRIITC partners together with external stakeholders, including the ERIC Forum and ESFRI, also helped with the distribution of the surveys to their respective networks. Invited participants had the opportunity to submit answers through SURVIO between 15 June and 30 July 2020. The ILO survey was answered by 47 respondents and the ILO survey was answered by 51 respondents.

Respondents took part in the survey on a voluntary basis. The questionnaire ensured the anonymity of survey participants and only general data was processed in a tabular form. Participants answered single and multiple-choice questions. Additionally, in some questions they scaled the significance of their answers. The respondents also had the possibility to add comments to selected questions.

The target respondents were identified among the European ILO networks and the partner and Associate RI ICOs. The threshold for validation of the survey results was set to 30% of the identified recipient-base of 100 actors. Participation in both surveys was higher than this threshold.

After the questionnaires were closed, the consortium started to analyse collected data with the support of SURVIO, which helped to extract collected answers into a readable document. Many meetings between WP2 Task Leaders, the WP2 Leader, and SURVIO took place over the summer and early autumn of 2020 in order to agree on how to frame the document and

[3] https://ec.europa.eu/growth/sectors_en

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analysis. The final data analysis resulted in a 450-page report. The consortium agreed to prepare a concise version of the report, i.e. the Deliverable you are reading. An editorial board composed of SZN, DTI, CDTI, WPT, EATRIS, and NWO was set up to finalise the work.

This Deliverable is the end result of the two surveys and presents the following details:

- "Industry as a Supplier," according to the ILOs' view: This section aims at characterising the ILO activity through the analysis of the results of the ILO survey and the further investigation of specific relations between key survey questions and differential criteria, such as: i) supplier-industry sectors; ii) ESFRI domain of ILO activity; ii) ILO geographic distribution; ILO-employer type;
- "Industry as a User," according to the ICOs' views: This section presents results of the ICO survey and additional analytical insight aimed at highlighting the differences in ICO activity, when segregated by: i) ESFRI domain of RI activity; ii) distributed and centralised RI organisation, iii) budget size, and iv) whether the RI employs an ICO and/or communications officer;
- "The RI-Industry engagement process" according to ICOs and ILOs, and the type of RI Research Domains and RI organisation as extracted from the two surveys.

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3.1. Results from the Survey of the Industry Liaison Officers (ILOs)

The ILO sample is well distributed over all of Europe, with 47 ILOs participating in the survey, representing 20 countries across Europe (Tab. 1).

Country	N. of respondent ILOs	Country	N. of respondent ILOs
Bulgaria	1	Norway	1
Czech Republic	1	Poland	2
Denmark	6	Portugal	1
Estonia	1	Romania	1
France	2	Spain	5
Germany	4	Sweden	5
Hungary	1	Switzerland	1
Ireland	1	Netherlands	6
Italy	2	Turkey	1
Lithuania	1	United Kingdom	4

Table 1: Geographical Distribution and number (N.) of Respondent ILOs.

ILOs are employed by a single institution (96% of respondents). Most of them belong either to Governmental Agencies (38%) or to Public Research Organisations (38%), followed by 19% who work for private non-profit associations. The remaining ILOs employed by Research Infrastructures and private commercial institutions constitute a small number. Overall, the ILO sample answering the survey provides a good representation of the ILOs geographical and organisational distribution across Europe, and represent a robust basis for this analysis.

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Answer Choices	Responses	Ratio
Governmental Agency	18	38.3%
Public Research Organisation	18	38.3%
Research Infrastructures	3	6.4%
Private Commercial Institution	2	4.3%
Private Not-for-profit Association	9	19.1%

Table 2: Type of ILO Employers.

The countries with more replies to the survey were countries from Western Europe that seem to have more developed and resourced ILO networks. Western European countries also have a longer membership history with, e.g., CERN and ESA, whereas Central and Eastern European countries only joined these organisations after 1990. Western European countries also identified a more diversified industry base, probably because ILOs deal with a broader portfolio of RIs, covering more research domains. In coordination with PERIIA, ENRIITC may further explore the way the national ILO networks are set up in the Western European countries, including their funding availability and the management strategy, and propose the best ways to set up this function.

ILOs were asked to estimate the working time they dedicate to ILO-related tasks for different RIs. The results show that 47% of respondents declare a working time between 1 and 6 person-months per year; 17% declare between 6 to 10 person-months per year, and 23% declare 10-12 person-months per year (data not shown). The smallest group are ILOs that declare between 0 to 1 person-month per year. The percentage of working time dedicated to ILO functions differs depending on the nature of the ILO employer. Full-time ILOs are more common in Governmental Agencies (33%) than in Public Research Organisations (17%) or Private Not-for-profit Associations (11%), as opposed to part-time ILOs with 1-6 months dedication per year (33% in Governmental Agencies compared to 56% in Public Research Organisations and 67% in Private not-for-profit Associations). According to the Big Science Business Forum 2021 (www.bsbf2021.org) ILO database, 67% of European ILOs cover one RI, 15% cover two, and the remaining 18% cover more than two.

As explained in the Executive Summary, ILOs are nationally employed officers with an official role in international Big Science RIs (CERN, ESO, F4E, ESRF, ESS, etc.). As visible in Fig. 1a, most ILOs (79%) responded “Support international RIs”. However, 40% of the respondents answered that they also support national RIs. Only 9% of ILOs indicated that they provide support to regional RIs (Fig. 1a). In addition (Fig. 1b), 58% of the respondents reported that

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they provide services to international RIs, while the rest of the respondents declared that they also provide services for national or regional RIs (21%), or they only work for national and/or regional RIs (23%). The results prove that a considerable number of ILOs are dedicated to RIs in their own countries.

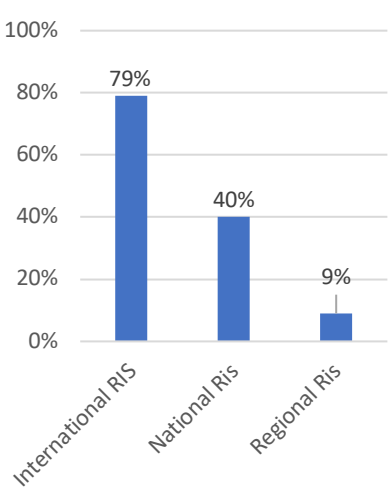

Fig. 1a - Main Types of RIs Supported by ILOs.

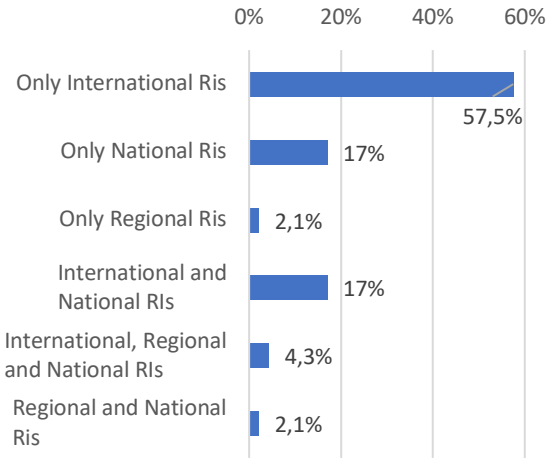

Fig. 1b - Distribution of RIs Supported by ILOs.

Research Domains of Industry as a Supplier

With regard to the research domains which the supplier industry relates to, ILOs were asked to assess the importance of the ESFRI Scientific Domains on a scale from 1 to 6, where 6 meant that a given Scientific Domain was the most important for the ILO-supported industry in terms of its perception as a market for products/services/technology. The results (Fig. 2) show that the main research domain supplied by industry is by far Physical Sciences & Engineering (83% rated relevance of 5 or 6), followed by Data Computing & Digital Research Infrastructure (56%), and to a lesser extent Energy (39%). These research domains correlate with the ILO clients' primary industry sectors and with Big Science technologies. On a geographic basis, the main industry research domains reported by ILOs are similar across Europe, although the rating of Social & Cultural Innovation is higher in Central and Eastern Europe than in the rest of the regions (data not shown).

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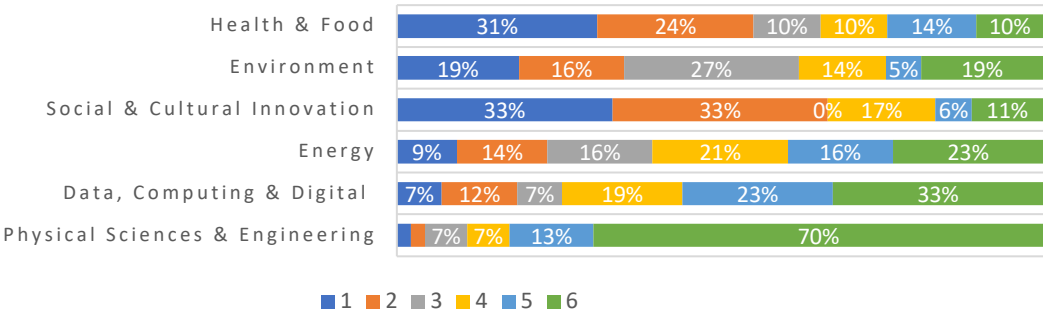

Fig. 2 - Relevance of Leading Research Domains Supplied by Industry According to ILOs - The Scale of Relevance Increases from 1 (less relevant) to 6 (most relevant).

Sectors and Products of RI-Supplier Industry

According to the ILOs responses, the main sectors of the RI-supplier industry supported by the ILOs (Fig.3) are: Electrical & Electronic Engineering (74%), Mechanical Engineering (74%), Energy (55%), and ICT/Data (53%). The next most important sectors in terms of number of ILO indications are Space (45%), Aeronautics (38%), Construction (40%), and Pressure Equipment & Gas Appliances (36%). The main sectors of the supplier industry supported by the ILOs correlate with the ESFRI domain of Physical Sciences & Engineering, into which most Big Science organisations with designated ILOs fall (Fig. 3).

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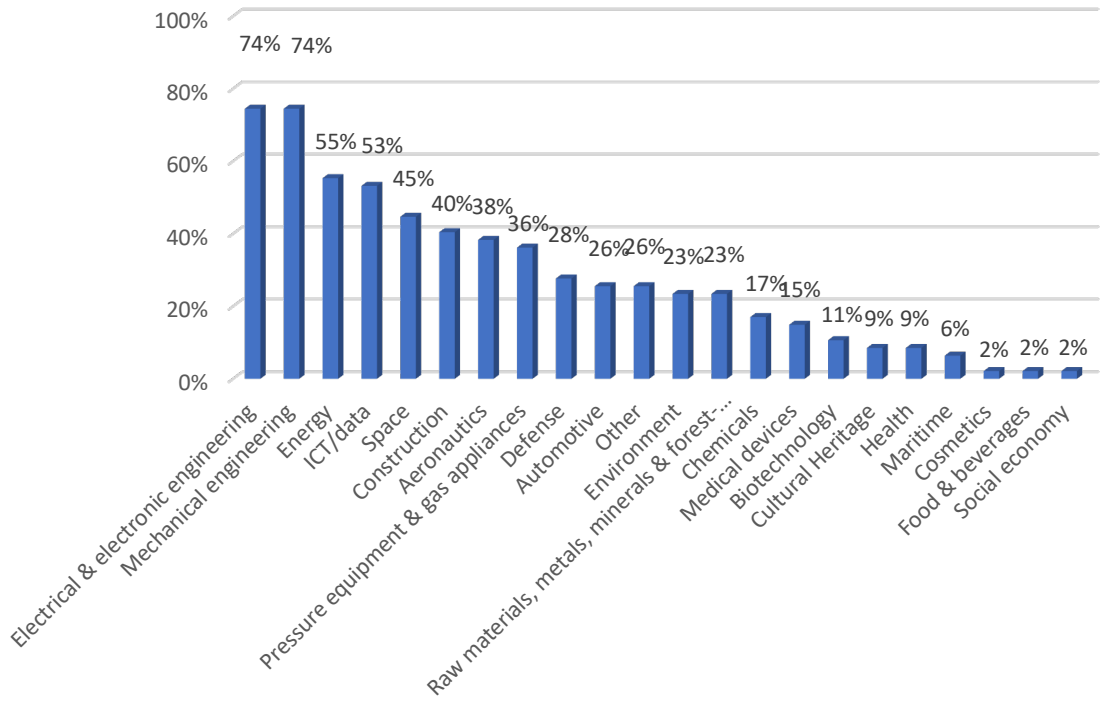

Fig. 3 - Industry Sectors to which Supplier Companies Primarily Belong, according to the ILOs experience.

Geographical differentiation of supplier industry sectors, by regions, in Europe, remark that Electrical and Electronic Engineering and Mechanical Engineering are primary industry sectors in practically all countries (data not shown). The next three sectors (Energy, ICT/Data, and Space) are identified by a smaller group of countries, in particular ICT/Data which some key countries (France, Germany, and Italy) do not identify. However, different industry sectors – such as Biotechnology, Cultural Heritage, Health, and Medical Devices, which relate to different ESFRI domains than Physical Sciences & Engineering, are referred to as significant in various countries. This may indicate that industry, which supplies the RIs, is quite diversified. The geographical breakdown of the companies with which ILOs work show that the greatest business sector diversity is in Denmark, Sweden, Spain, and Netherlands. Further investigation is required to clarify whether this is due to the greater number of ILOs from these countries answering the survey or to a more diversified industry base.

The graph in Fig. 4 depicts the different kind of supplies or collaborations that industries carry out with Research Infrastructures, according to the ILOs. Based on the answers provided, it may be noted that, on average, the most common types of supplies or collaboration for engaged companies are customised products (43%). This is a logical result as the RI-market typically requires special technological solutions that may even be beyond the state-of-the-art.

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In second place, standard or off-the-shelf supplies (22%) are found. ILOs also pointed out System Integration Contracts (13%) and Consultancy (almost 8%). The least common are strategic-alliance contracts (2%). This shows that industry typically (66%) acts as a pure supplier in the RI market, while collaboration – in the form of co-development, strategic alliance contracts, or consultancy, is only a marginal activity.

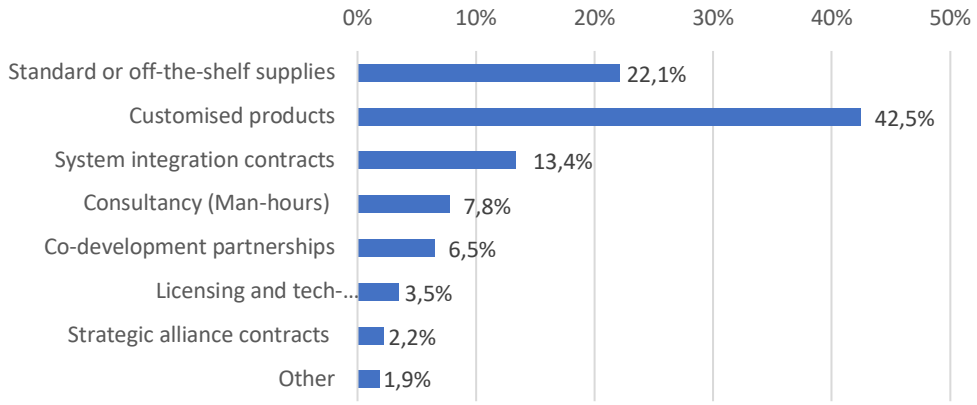

Fig. 4 - Most Common Types of Supplies or Collaboration for Engaged Companies.

Strategic Management – Georeturn Strategy

ILOs were consulted about the level at which the national georeturn strategy is formulated, yielding the following results shown on Fig. 5. Almost all (92%) of ILOs reported that the national georeturn strategy for their country is formulated by either Governmental agencies or Ministries. Only in 8.5% of the cases, decisions on strategy are made jointly by at least two types of organisations. Most often the national georeturn strategy is formulated by a single governmental agency (55%), possibly the one employing the ILOs. However, nearly a third of respondents (30%) report that, in their country, the georeturn strategy is formulated by a single institution at a ministerial level.

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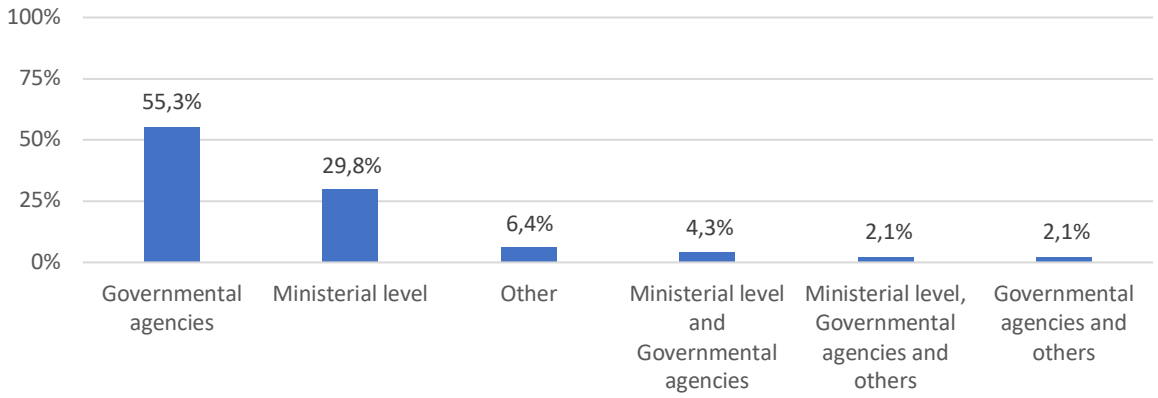

Fig. 5 - The Level at which the National Georeturn Strategy is Formulated.

ILOs were also requested to assess the level of information received from the RIs on three issues: georeturn, procurement strategy, and finance committee meetings. The results show that the overall assessment is rather positive (Fig. 6). Seventy-nine percent of ILOs declare they receive an appropriate level of information concerning the procurement strategy of RIs. Sixty-six percent declare an appropriate flow of information regarding finance committee meetings or similar. Information on georeturn scored the lowest, where only 60% declare that the level of information provided from RIs is appropriate.

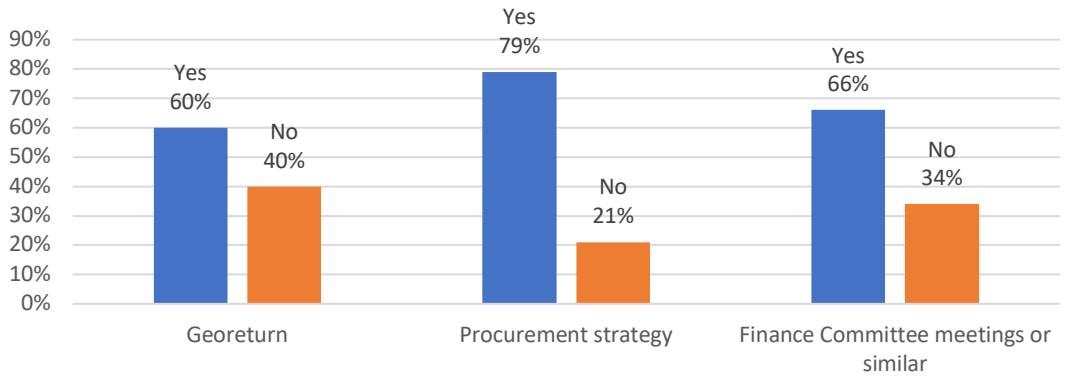

Fig. 6 - Assessment of the Level of Information Provided by RIs on Specific Subjects – Do ILOs Receive Appropriate Levels of Information from RIs

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While georeturn and finance committee meetings are inherent only to international RIs, an analysis of the RI procurement strategy parameters yields diverging results for the different geographical dimensions of Research Infrastructures: international, national and regional. There is a significant difference in the perceived level of information regarding the procurement strategy received by ILOs working for international RIs compared to ILOs working for national RIs (Fig. 7a-7c).

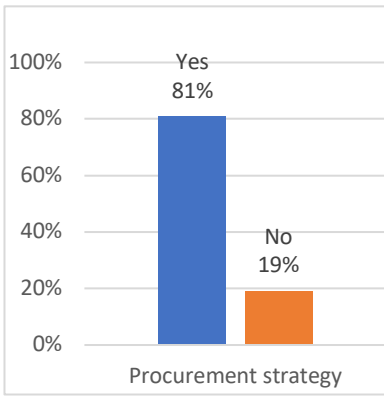

Fig. 7a - ILOs' satisfaction with the level of information regarding the procurement strategy from International RIs.

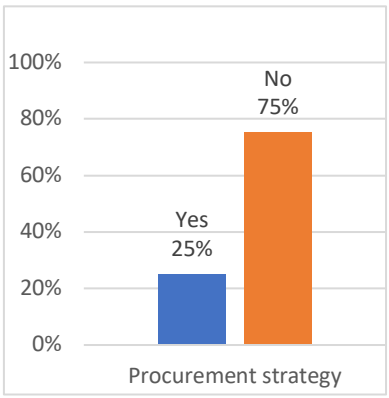

Fig. 7b - ILOs' satisfaction with the level of information regarding the procurement strategy from National RIs.

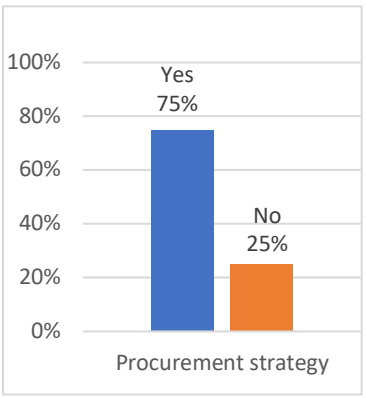

Fig. 7c - ILOs' satisfaction with the level of information regarding the procurement strategy from National RIs.

This may relate with the fact that the ILOs role and their responsibilities in international RIs are formalised, whereas for national RIs the role of ILO is not regulated. ILOs supporting regional RIs also receive an adequate level of information concerning the procurement strategy from these organisations.

The following graph (Fig. 8) provides further detail about the level of information which flows to ILOs depending on their place of employment:

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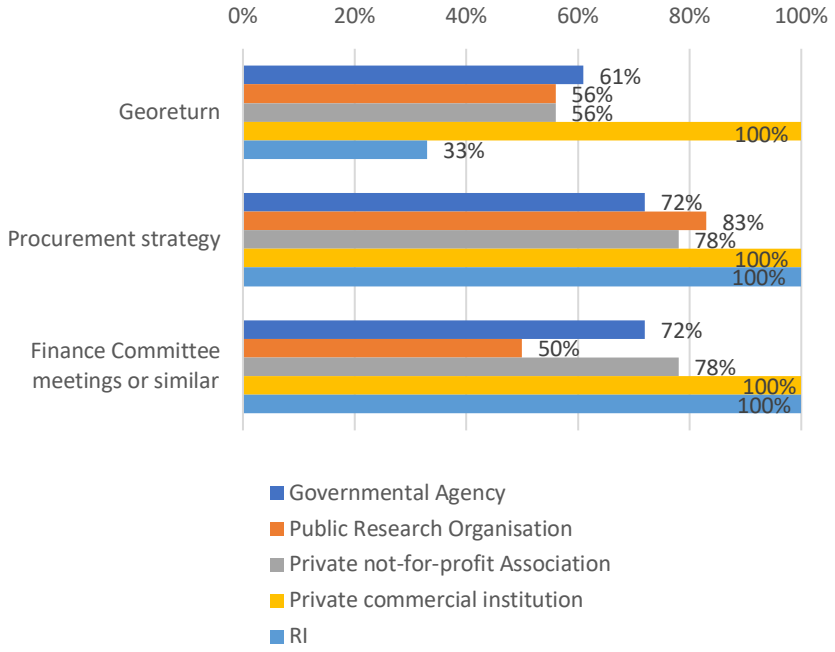

Fig. 8 - Do You Consider You Have an Appropriated Level of Information Coming from Your RI on Georeturn, Procurement Strategy, and Finance Committee Meetings or Similar – % of ILOs according to the Place of Employment.

The results seem to suggest that ILOs employed by Public Research Organisations are not as well connected to their counterparts in higher-level committees, such as finance committee (50%) as ILOs employed by Governmental Agencies (72%) or private non-profit associations (78%). The information concerning procurements strategy and georeturn is more evenly spread across the different ILO categories.

ILOs were asked to rate the relevance of other stakeholders they liaise with to promote industry – RI collaboration (Fig. 9). Almost every (98%) ILO indicated that other relevant stakeholders are involved in supporting industry-RI collaboration. Additionally, 96% of ILOs indicated more than one type of stakeholder engaged in supporting industry-RI collaboration. On average, each of them indicated four types of stakeholders. The three main types of ILO Networks are (indicated by 87% of ILOs): Industrial Associations (85% of ILOs), and National Agencies (83% of ILOs). More than half of respondents (66%) also indicated Technology Clusters as relevant stakeholders. Nineteen percent of ILOs also chose the answer "Other," and

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in optional comment section indicated stakeholders such as: national research centres, academic institutions, and national and regional agencies.

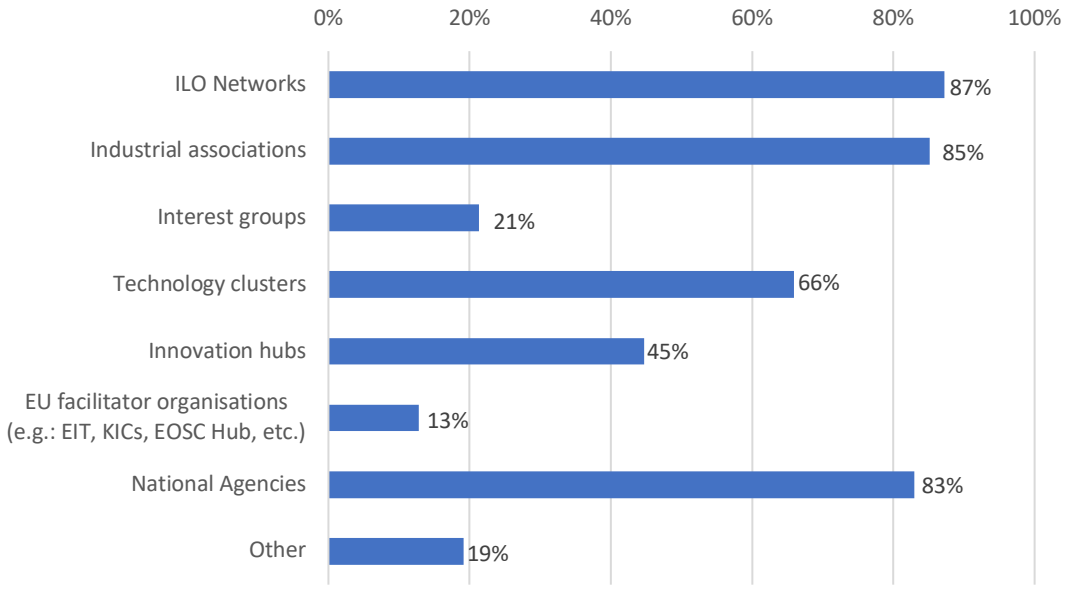

Fig. 9 - Most Common Types of Supplies or Collaboration for Engaged Companies (% of ILO Pointing to a Given Answer).

Results show the potential of ILO network and the opportunity for ENRIITC as a networking tool which also brings in the ICOs.

ILOs were asked about the existence of national technology roadmaps and/or a mapping of key technology strengths (Fig. 10): 77% of ILOs indicate the existence of national technology roadmaps and/or a mapping of relevant key technology strengths in their countries.

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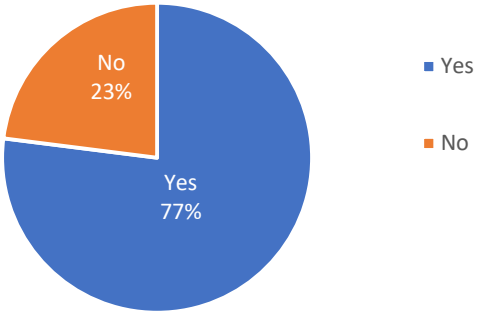

Fig. 10 - Existence of National Technology Roadmaps and/or a Mapping of Relevant Key Technology Strengths.

ILO Activities

Half of the respondents typically engage 101-1000 companies, however, a third of the respondent ILOs deal with a smaller set of companies, i.e. a portfolio of less than 50 companies (data not shown). There are significant differences in the number of companies engaged by the ILOs, depending on the nature of his employer. The majority (61%) of ILOs employed at Governmental Agencies engage with 101-1000 companies, the same as ILOs employed by Private Non-Profit Organisations (56%). However, ILOs employed by Public Research Organisations (50%) usually work with a smaller number of companies (1-50). The reason could be that ILOs working for governmental agencies have access to wider databases and usually cover more Research Infrastructures, therefore liaising with a greater number of companies and enabling cross-fertilisation.

Also, ILOs dealing with international RIs tend to engage with fewer companies (30% 1-50, 5% 51-100, and 54% 101-1000) than ILOs at a national level (26% 1-50, 64% 101-1000) or the regional level (25% 1-50, 75% 101-1000). This probably correlates with the fact that the requirements of tenders issued by international Big Science organisations (CERN, F4E, ESO, etc.) are technically and financially very demanding, hence their smaller industry base. There is certainly room here for ILOs to expand the international RIs supplier industry base.

In figure 11, the ILOs rated the relevance of their main activities to promote industry's involvement in RIs, from 1 (lowest relevance) to 5 (highest relevance). In the ILOs' opinion, activities focusing on tenders are the most important (87% gave this activity the highest ratings - 4 and 5). A lower ranking was assigned to matchmaking (66% of 4 and 5 ratings), and activities focusing on meetings, support/funding information (64% of 4 and 5 ratings). Marketing activities are rated as of moderate importance (30% of 4 and 5 ratings).

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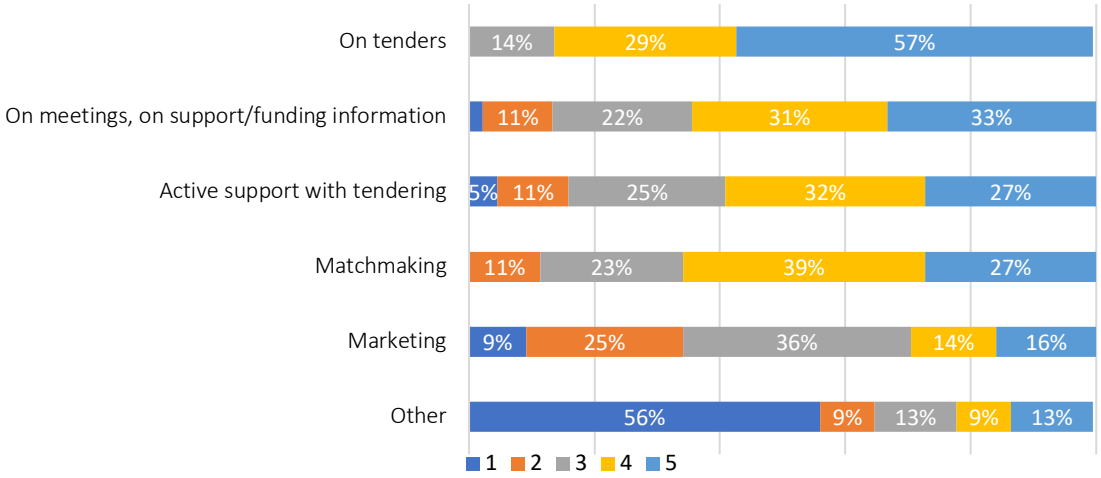

Fig. 11: Main Activities Carried Out by ILOs to Promote Industry's Involvement in RIs, Where ILOs Have Rated Their Level of Importance from 1 (lowest relevance) to 5 (highest relevance).

ILO Tools and Practices for Industry-RI Engagement

ILOs were requested to rank the relevance of the tools that they use to engage industry with RIs (Fig. 12). The respondents ranked the tools they use to achieve their goals on a scale from one to six, where one (1) is the least relevant, and six (6) is the most relevant. We can see that there is a correlation between the activities and the tools, where providing information on tendering opportunities, matchmaking, and active support to tendering are rated highest. In fact, the most important tool turned out to be the provision of information on tendering opportunities (average: 5.5). The second most important is matchmaking between representatives of RI and Industry (average: 4.4). In the ILOs' assessment, the least important tools are: providing funding tools for RI-Industry R&D project preparation and tendering (average: 2.1) and other tools, among which ILOs listed: an industrial capacities catalogue, a presentation of the RI to companies, professionalising the national ILO-net infrastructure, and B2B meetings between complementary companies.

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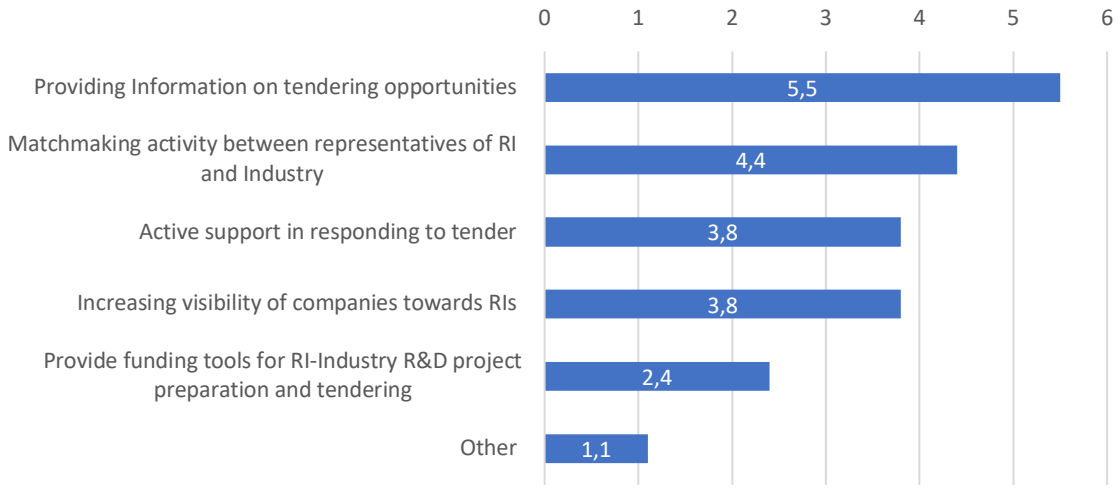

Fig. 12 - Relevance of Tools Used by ILO to Meet KPI (Average Grade For Given Answers on a Scale from 1 to 6, where 1 is the Least Relevant and 6 the Most Relevant).

When ILOs were asked about the tools and practices that they utilise to reach out to their national industry, the results show (Fig. 13) that more than 95% of the surveyed ILOs engage with the national industry through events (98%) and maintain a database of companies (96%), as well as through newsletters (70%). Usage of industry portals in order to connect with the industry is not so common (53% of ILOs declare that they do not use them).

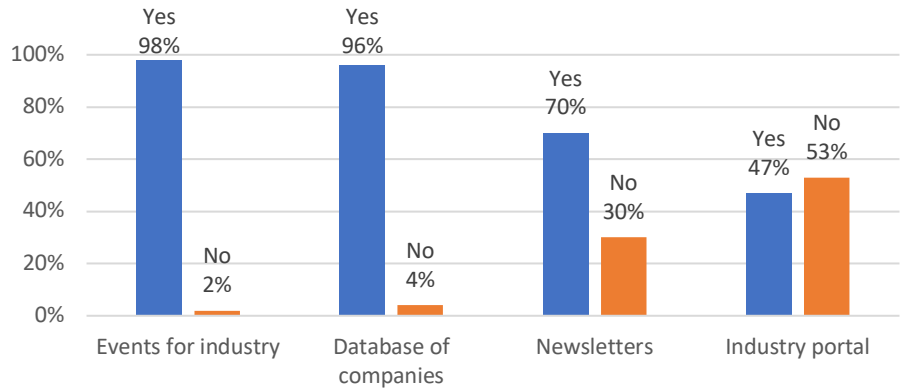

Fig. 13 - Engagement with National Industry – Tools Used by ILO.

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ILOs were asked to declare if they are members of ILO networks and what kind. Almost all ILOs (94%) declared membership to at least one type of ILO Network. Of the ILOs declaring association with some kind of ILO Network, the highest percentage (36%) of ILOs is associated with both the National ILO Network and the International ILO Network (PERIIA). Only 2% of ILOs declared no association with any kind of ILO Network. However, those who did not declare membership in any ILO Network (4% of ILOs) declared international cooperation within other structures (e.g. RIs) in their comments. Answers provided by respondents clearly indicate that international cooperation and international ILO networks (e.g. PERIIA) are a basic tool across all ILOs, and national ILO networks are used to a greater extent by ILOs employed by public research institutions (67%) than by Governmental Agency ILOs (50%) (data not shown). The following graph (Fig. 14) depicts the different types of networks in which ILOs are members.

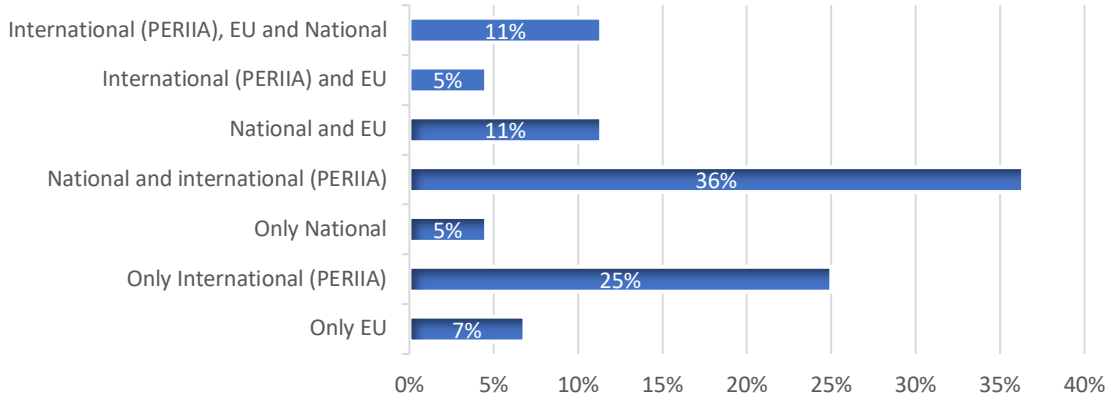

Fig. 14 - Membership of the ILOs to Various Types of ILO Network (Only Those Who Have Declared Cooperation within the ILO Network).

ILOs identified ILO networks as useful for sharing industrial databases, exchange of good practices, and organising joint industrial events. ILO networks also contribute to strengthen EU-scale supply chains for the Big Science market, are powerful tools to build consortia, and a more effective way to interact with RIs and international stakeholders.

Barriers and Drivers in Industry-RI Engagement

ILOs were also asked to add the main drivers and barriers in the engagement with the supplier industry. The main obstacles identified could be grouped into five thematic areas: the market, communication with RIs and formal issues, technical issues, tenders, and awareness.

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- Market barriers deal with the complexity and requirements of the Big Science market in comparison to its rather small size. Other identified issues are technical and financial barriers, the high risk of the market in comparison with its low profit, geographical distance, and strong international competition;
- Communication and formal issues barriers: most common drivers and barriers are the administrative complexity, different mind-sets and objectives in RIs and industry, communication difficulties, and perceived impenetrability and inflexibility of RIs by industry;
- Technical barriers: ILOs pointed out towards large tenders' complexity and requirements, which lead to hesitancy in industry. Perception of non-transparency of tender-awarding is identified as a barrier, as well as the perception that RIs tend to prefer working with local suppliers;
- Issues regarding the tenders are the complicated public procurement procedures, the lack of a common RI procurement approach across Europe, the low success rate, the focus on cost rather than value for money, and the overall complexity of the tenders;
- Awareness barriers which were identified are the lack of industrial awareness of and interest in RI projects, the non-involvement of industry in early R&D phases, and the need for more information on industrial opportunities, in the medium and long term.

The effects of RIs having or lacking a central hub/headquarters communications officer were explored in several questions of the ICO questionnaire and reported here. The employment of a central RI communication officer and a central RI procurement officer appears to be beneficial in supporting communication with industry and profiling of RI capabilities. RIs that have a central hub/headquarters communications officer with commercial promotion experience more often conduct regular communication with industry and announce upcoming tenders on their websites. A larger percentage of RIs, which have a centralised procurement office, see the advantages of setting up a common procurement portal for all RIs. The RIs that have such an office are also more likely to maintain a supplier database. Generally, 71% of RIs/ICOs were unable to provide the approximate annual expense for industrial supplier contracts; of those who did provide data, 27% reported an annual expense for supplier contracts of 0 EUR, 40% < EUR 10 M, 30% in the range EUR 10-99 M, and 13% > EUR 100 M (data from the ICO survey, not shown).

ILO Key Performance Indicators

ILOs were asked to rate the relevance (1=least relevant, 5=most relevant) of the Key Performance Indicators, by which their employer measures their activity (Fig. 15):

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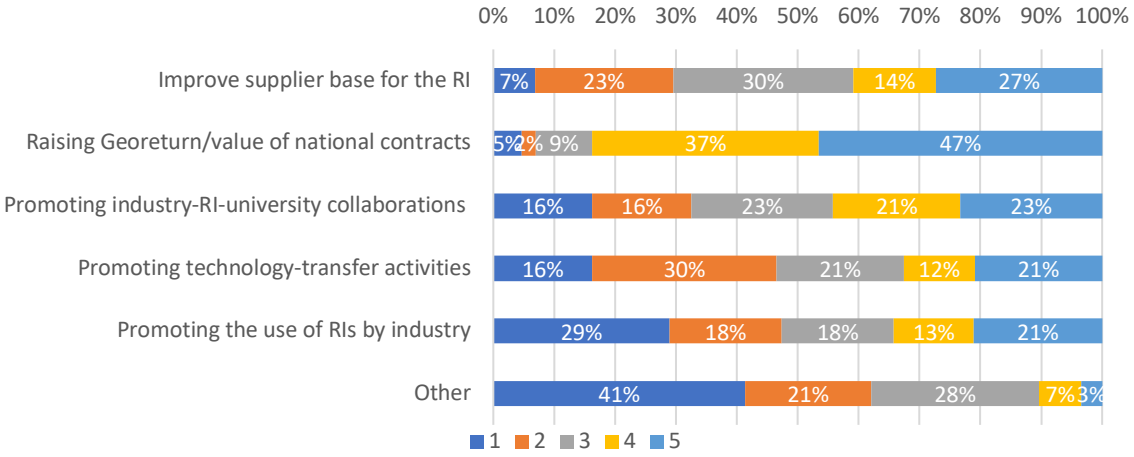

Fig. 15 - Evaluation of ILOs' Performance – KPI Relevance – Employer.

The following percentage grades only considers ILOs who indicated that a given KPI is applicable to the evaluation of their work (more than 90% in all cases except for 81% "Promoting the Use of RIs by Industry"). The most important KPI indicated by ILOs is "Raising Georeturn/Value of National Contracts" (84% of ILOs gave this factor the highest impact ratings - 4 and 5). The promotion of industry-RI-university collaborations is also of some importance (44% of ILOs gave the highest impact ratings for this factor - 4 and 5), as well as improving the supplier base for the RI (41% with impact rating 4 and 5).

The results were broken down by the different places of employment of the ILO. The results (Fig. 16a-16c) suggest that ILOs employed by governmental agencies are pushed to a greater extent towards improving georeturn (94% of 4 and 5 rating) than ILOs employed by public research organisations (76% of 4 and 5 rating), which focus more on promoting collaborations and technology transfer. ILOs employed by private non-for-profit associations are somewhat in the middle (86% of 4 and 5 rating). The opposite occurs with technology transfer, where 13% Governmental Agency employed ILOs rate it 4 or 5, 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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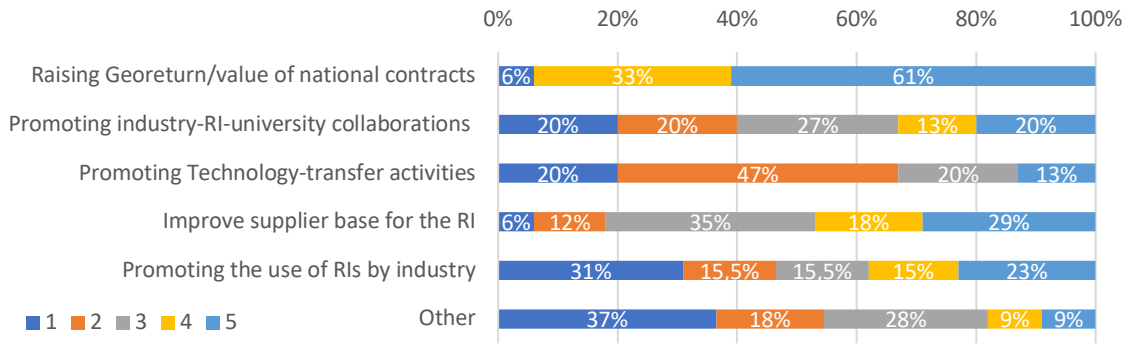

Fig. 16a - Employer's Evaluation of ILOs' Performance according to Employer Governmental Agencies" - KPI Relevance from 1 (Lowest) to 5 (Highest).

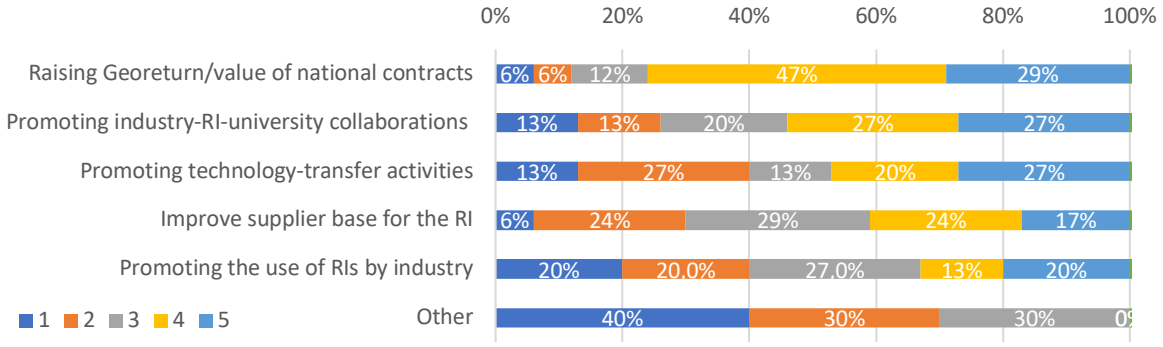

Fig. 16b - Employer's Evaluation of ILOs' Performance according to Employer "Public Research Organisation" - KPI Relevance from 1 (Lowest) to 5 (Highest).

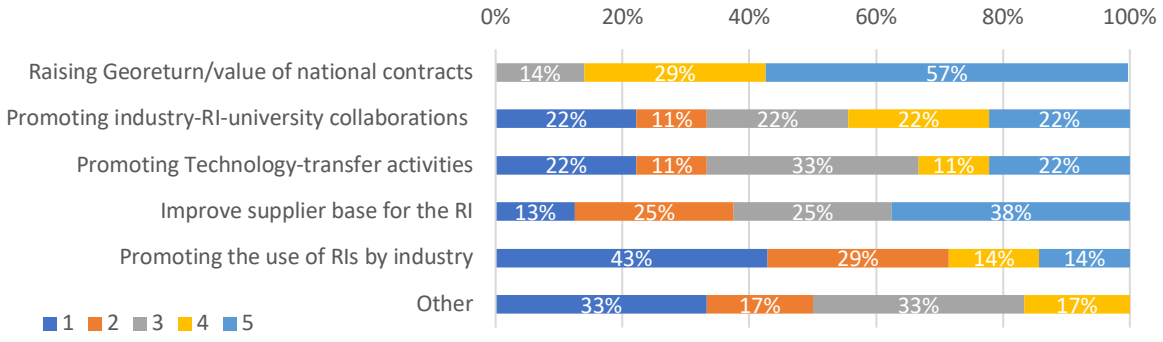

Fig. 16c - Evaluation of ILOs' Performance according to the Employer "Private Not-for-profit Association" - KPI Relevance from 1 (Lowest) to 5 (Highest).

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In Fig. 17, the different KPIs are ranked according to the importance given by the employer vs. the opinion of the ILO sample. 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 (57% of 4 and 5 ratings). 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.

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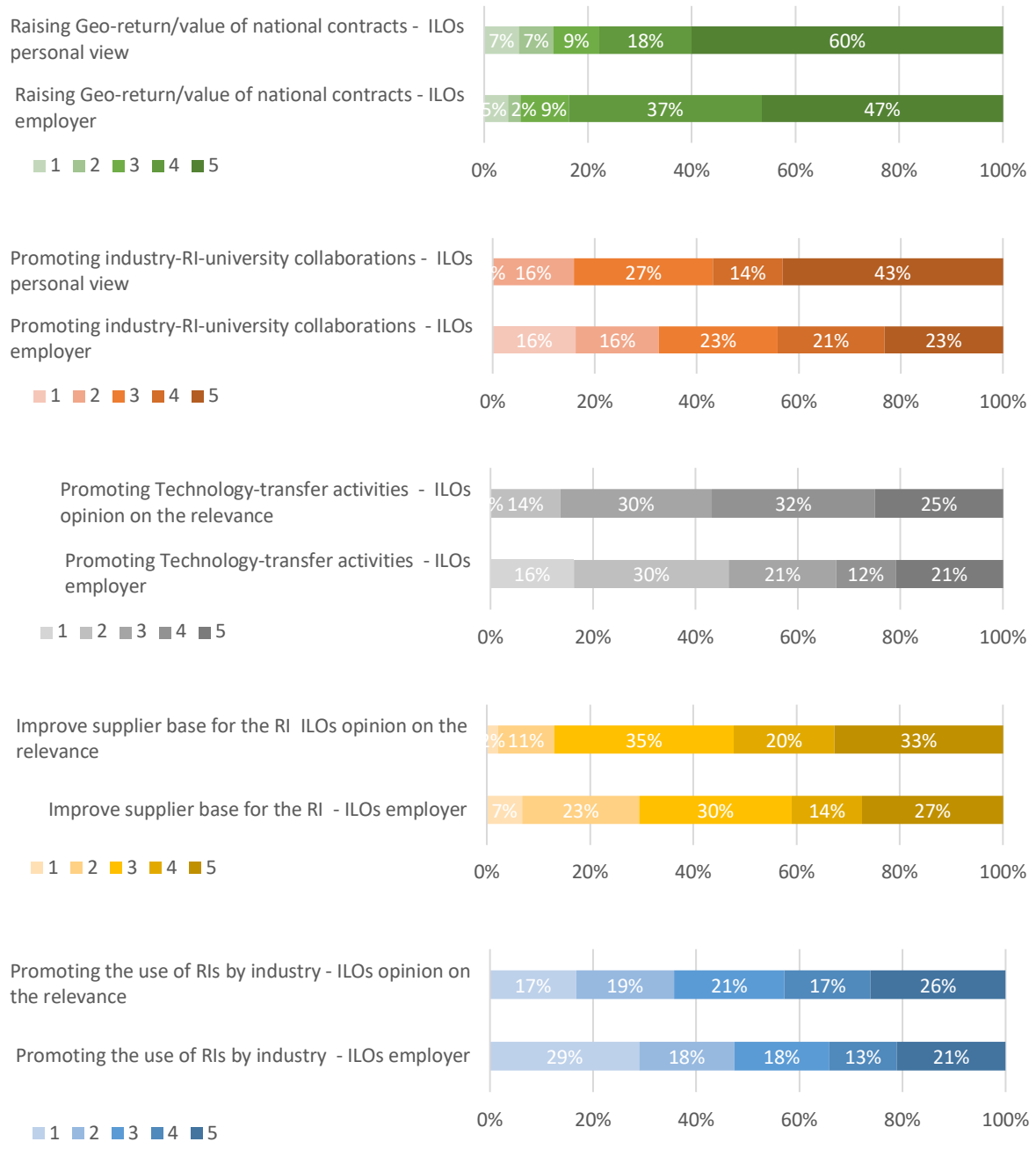

Fig. 17 - Assessment of the Work of ILO – Employer and ILO's Perspectives on Relevance of KPIs from 1 (less relevant) to 5 (more relevant).

Finally, ILOs were asked for their suggestions for KPIs that could help evaluate the impact of their services (Fig. 18). In their opinion, the most important KPIs are: number and type of organised brokerage events, and the number and budget of preparatory R&D projects for RIs.

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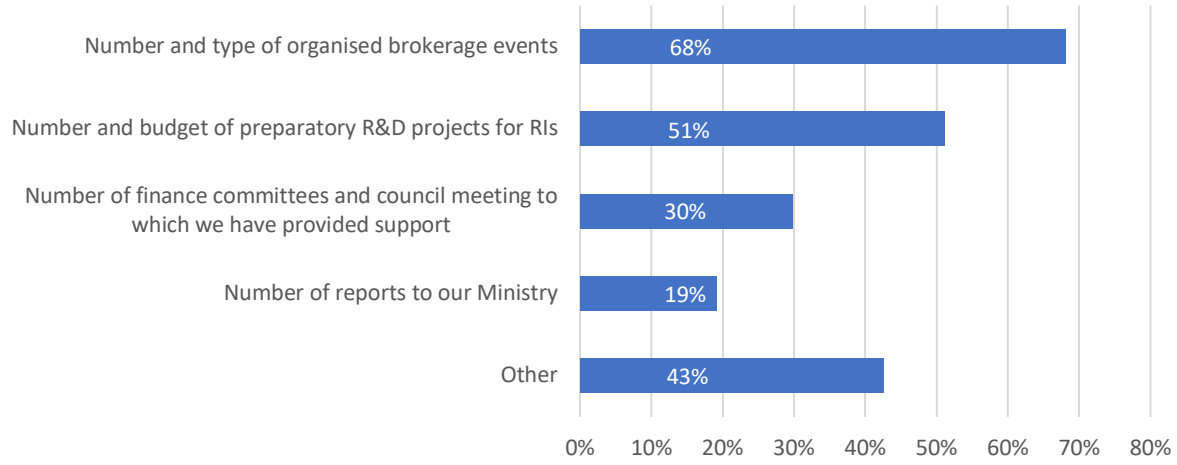

Fig. 18 - ILOs Suggestions for KPIs That Could Help Evaluate the Impact of ILO Services (multiple choice).

More than 40% of ILOs have also provided other ideas for KPIs, including: jobs created by the volume of business activity; satisfaction of the industry supplier base; number of participants at events; reviews of ILOs' performance; the number and value of contracts won by companies from the ILO's country; the number of submitted tender offers from companies; and the number of industrial visits to the RI.

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3.2 Results from the Survey of the Industry Contact Officers (ICOs)

The RIs Represented in the Survey

This section presents the general information about the characteristics of the Research Infrastructures as described by the ICOs or equivalent staff - including procurement officers and industry liaison officers, who answered the survey.

The survey was answered by 51 RIs – either by ICOs or persons responsible for industry collaboration, representing at least 44 institutions from a range of different disciplines and ESFRI domains (Fig. 19).

Some 55% of the institutions surveyed are in the fully operational phase of development, which means they have been operating for more than three years. This compares to 16% for the operation spin-up phase, and 14% for the preparatory phase. Seventy-six percent of the RIs indicated their status on the ESFRI Roadmap with 56% as landmark and 36% project status. Physical Sciences & Engineering was the highest represented scientific domain (33%), while 27% identified Health & Food. The surveyed RIs are mostly distributed facilities (65%), as opposed to single-site facilities (35%).

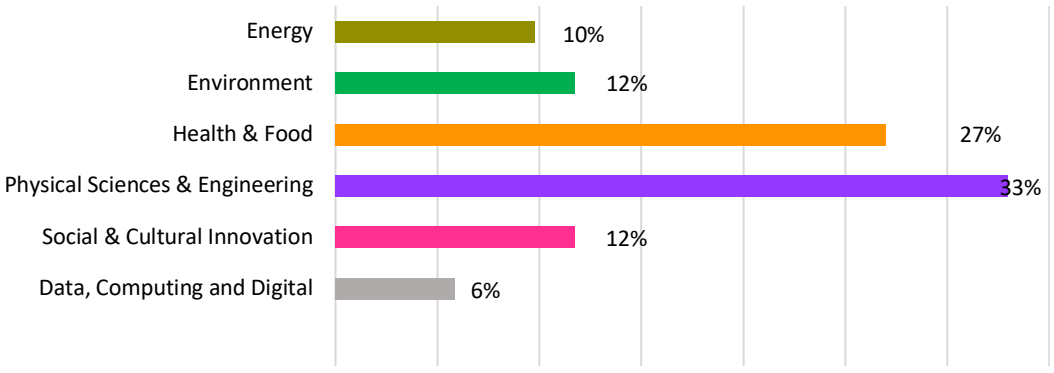

Fig. 19 - Chart showing to which ESFRI Research Domain the Responding RIs Belong.

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The survey probed the central (hub or headquarters) for distributed RIs or the single-sited RIs human resource capacity of the RIs as measured in full time equivalents (FTEs). The results show that 40% of RIs employed between 1 and 10 FTEs, 30% between 11 and 100 (no RI indicated numbers between 51 and 99 FTEs), and 30% above 100 FTEs.

Annual centrally-managed budgets of EUR 1 to 5 M apply to 43% of the institutions surveyed; because 33% the budgets exceed EUR 10 M. Member contributions (58%) are the major component, followed by funding from EU projects (25%), other sources including national funding, private funding, national or regional calls, non-EU projects, In-kind contributions, university contributions, and host contributions (9%). Finally, 8% of the budget comes from income related to services for industry.

Some 47% of the surveyed RIs employ dedicated ICOs or equivalent staff in charge of engagement with industry (29% employ full-time staff, 18% part-time). This relatively low percentage is an important finding, although RIs lacking a central ICO may work through equivalent positions located in the decentralised structures.

A total of 53% of the surveyed RIs have a centralised procurement office. Of these, 59% involve up to five FTEs, 15% have between five and 10 FTEs, and 11% more than 10 FTEs. Fifty-seven percent of RIs employ a central hub/headquarters communications officer with commercial promotion experience and skills, and 29% of the surveyed RIs declared that they have an active programme of joint technology innovation pilots involving industry.

With regard to collaboration with industry, the majority of RIs provide or could provide support services for feasibility studies (80%), pre-competitive research (73%), and proof of concept/demonstration (69%). Most RIs offer (or could offer) services and support at more than one stage of an industry's research. Assistance with commercialisation is much less prominent (22%). So far, 16% of all RIs do not have a relationship with industry, but 6% of this particular group have indicated potential areas of support to industry.

The majority (65%) of RIs provide information to industry through a portal/website. Note that this must be assumed to include both contacts with industry as supplier and user. Sixty-one percent of RIs have a strategy of collaboration with companies, while 20% altogether lack such a strategy (Fig. 20a). Only 20% of the RIs have an active industry advisory committee, while an additional 16% have it as part of their general advisory committee (Fig. 20b).

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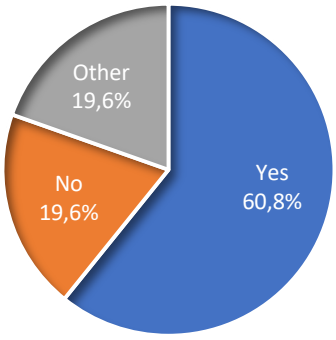

Fig. 20a - Does the RI Have a Strategy for Collaboration with Companies?

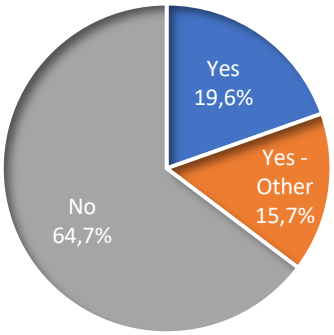

Fig. 20b - Does the RI Have an Active Industry Advisory Committee?

Other means of communication include: RIs publishing information and tools to encourage/facilitate collaboration with industry (41%), communicating RI procurement information (41%), and upgrading and maintenance plans/programmes with industry. Fifty-three percent of RIs publish information about upcoming tenders on their websites, 78% of this group publish the information on their website, whilst 22% use other websites. Forty-seven percent of the surveyed RIs maintain a database of supplier companies. Of RIs maintaining a database of suppliers, 38% indicated it contained between one and 50 companies, 21% had between 100 and 1000 companies in their database, and the same percentage of RIs had over 1000 companies in the database. Also, 47% of RIs do not have a label certifying quality and compliance of instruments and processes with international reference standards – noting that this may not be a requirement for service provision in any case.

Seventy-one percent of RIs keep a database of current and prospective industry clients. Most RIs have more than one database, and 18% of the RIs have databases of both supplier companies, user companies, and collaboration partners.

Regarding the ICO's characterisation of RIs in terms of statements regarding industry outreach activities, 41% provide brochures or informational material specifically addressing industry clients. About one third of all RIs also maintain an online catalogue of RI services, have a standard overview presentation for industry audiences, organise various forms of events for industry, or maintain a calendar of key events dedicated to industry (respectively 33%, 33%, 33%, and 31%). Twenty-five percent of the surveyed ICOs state the majority of RI activities related to industry outreach are run autonomously by distributed branches of the organisation. These are all distributed RIs, amounting to 39% of the distributed RIs responding. In addition, 14% of RIs ticked the "other" answer, often explaining that those kinds of activities are planned for the future or are already in place but are still informal in character.

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Seventy-three percent of all surveyed RIs regularly cooperate with various entities to engage industry (Fig. 21), and 84% of them do so with more than one entity. As seen in Fig. 21, most often RIs partner with national technology clusters, science parks, and innovation hubs (53%). Local/Regional business organisations (49%) are equally important. National ILOs and ILO networks also play a role – 39% of RIs indicate regular cooperation with them. A total of 27% indicate no cooperation with the clusters/hubs.

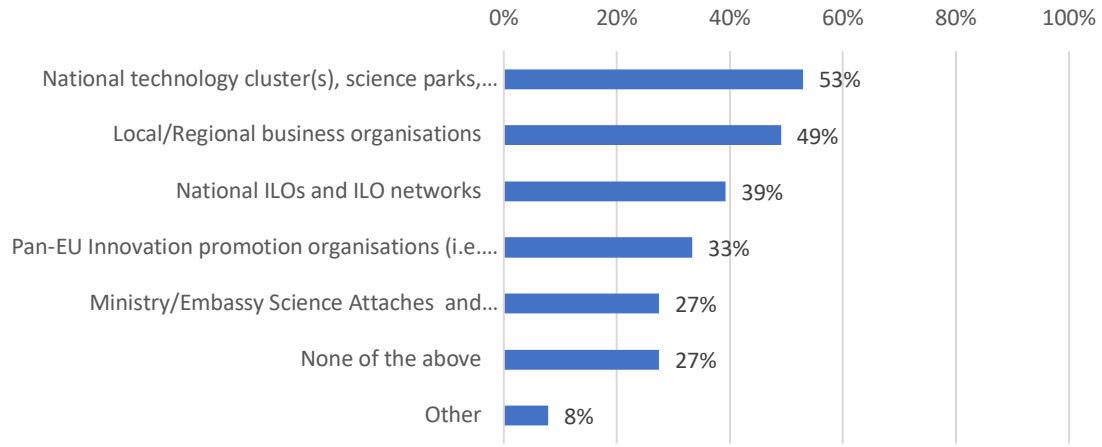

Fig. 21 - To Engage with Industry, the RI Cooperates Regularly with the Following Type of Organisations.

In the general opinion of ICOs, the factor that could most strongly support the development of cooperation between industry is EU/Public-funding Projects - 82% of the ICOs indicated this. However, industry partnerships and pilot programmes are also evident enablers of RI-Industry collaboration (Fig. 28). For RIs who employ an ICO among their staff, technology transfer actions are also a means to engage with industry.

Fig. 22 compares the services offered by the RI and requested by the companies. As shown in the figure, 84% of the ICOs have identified which services the RI offers to industry. Also, 91% of them indicated more than one service provided by the RIs. Among the most popular are: access to facilities, instruments and testing (67% of RIs), access to data, modelling via e.g. an RI data portal (49% of RIs), and access to specialised training (49% of RIs). The least frequently provided services include space and/or other logistics for own research or development trials (16% of RIs) and space and logistics support for custom development and trials (14% of RIs).

Sixty-seven percent of ICOs identified the services that are of interest to RIs' industrial users. For 53% of RIs, access to facilities, instruments, and testing are among the most required services by customers. Testing and quality/standards compliance validation of instruments and processes was indicated by 31% of RIs.

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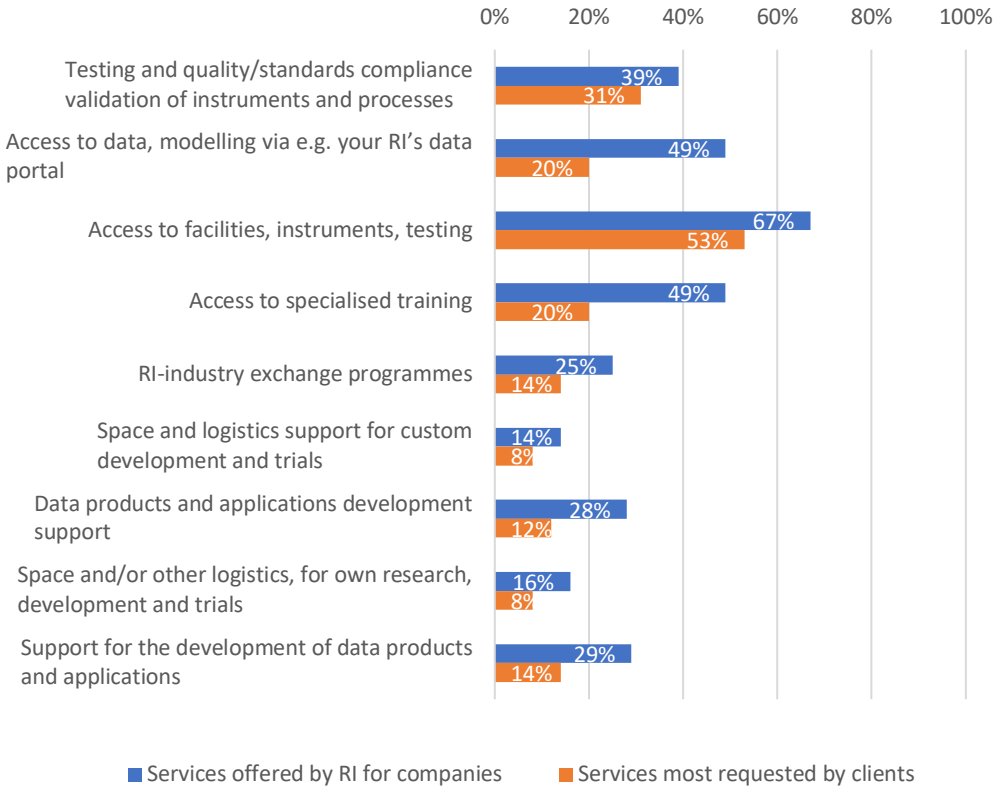

Fig. 22 - RI Service Offer vs. Services Most Requested by Industry Clients.

Eighty-two percent of the surveyed ICOs gave a characterisation of the nature of collaboration between RI and industry clients; 37% of all answers indicated the character of collaboration to be a mix of "one-off impromptu" and "mainly part of systematic long-term relationship." Also, 51% of all surveyed ICOs declared an approximate number of industry contracts established annually. Of these, 46% report a range of 1-10 annual industry contacts, 27% indicate having 11-99, and 27% >100 or more.

Seventy-three percent of the surveyed ICOs have given estimates of RIs income from contracts with industry. However, 37% of all answers indicated that the income is not measured or is equal to zero, and a further 27% either did not know or were unable to answer. This lack of awareness of income from industry emerges from the whole study as an area for further investigation of what the metrics for performance evaluation are, in this respect, for ICOs.

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Business Sectors of Industry-as-a-User of RIs

ICOs were asked to identify the primary industry sector of the RIs' actual or potential industrial clients/consumers. They responded (Fig. 23) that 92% of ICOs provided such identification, and 88% of them indicated more than one industry sector. The main industry sectors identified by ICOs are: Biotechnology (49%), Healthcare Industries (43%), Energy (37%), and Chemical (35%). The next most important sectors in terms of number of ICO's indications are Medical Devices (33%), ICT/data (31%), Aeronautics (29%), and the Automotive Industry (29%). The data gathered suggest that in general RIs respond well to the needs of their industrial customers, although in a few areas there may be scope for optimisation.

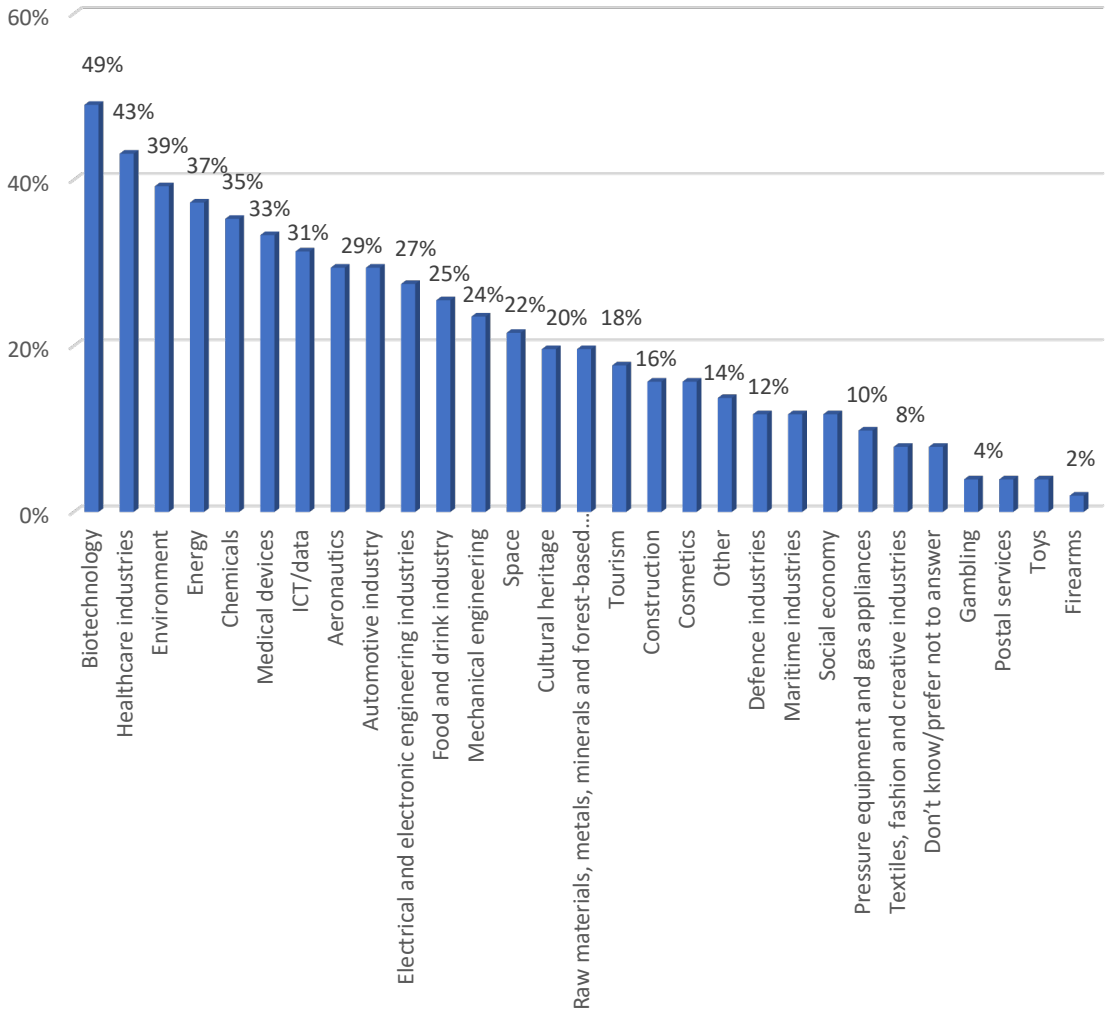

Fig. 23 - The Business Areas of the RIs' Actual or Potential Industrial Clients/Customers.

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Size and Geographical Distribution of Industry-as-a-User of RIs

As detailed in Fig. 24, small and medium-sized Enterprises (SMEs), are the largest group of industry users of RI services across all ESFRI domains; large enterprises (LEs) figure strongly in all domains except Environment (33%) and Social & Cultural Innovation (33%); start-ups and micro enterprises are represented in all domains, with only a relatively low number in Physical Sciences & Engineering (41%).

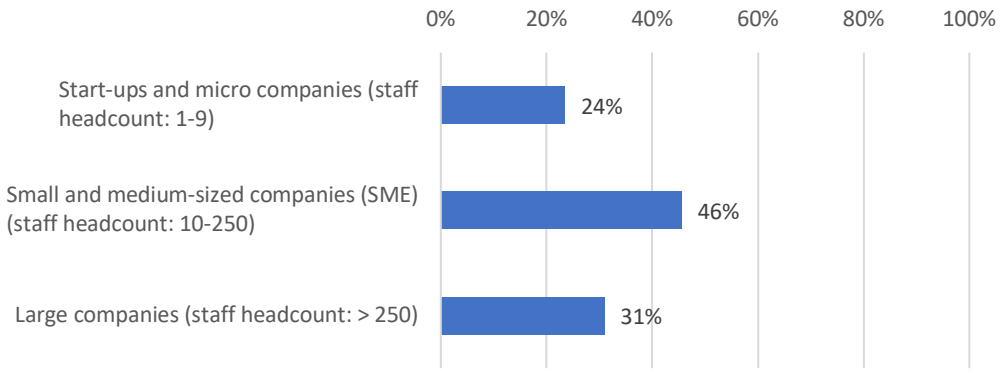

Fig. 24 - Average Size of the Enterprises Using the RI.

In addition (data not shown), 59% of the ICOs have indicated the geographical distribution of the companies using the RIs, and 43% of RIs from this group indicated they are most often used by companies that are from the same country as the RI, although not local. A third (33%) of RIs from this group stated their clients most often come from foreign countries.

The Role of the ICO

The survey shows that 47% of the surveyed RIs employ an industry contact officer (ICO) or equivalent staff (29% employ full-time staff, 18% part-time), while 39% do not employ an ICO. Among the respondents who answered “other” (14%), most often the function is placed in structures other than the central office or is connected to implementation of EU projects. This section presents an analysis of the RI’s activities according to whether they employ or do not employ an ICO.

The employment of an ICO correlates with the number of employees in the RI and the budget of the RI. Additionally, the employment of an ICO correlates with the income from services

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offered by the RI. The RIs that employ an ICO more often offer pre-competitive research (92% vs. 50%).

In comparison to RIs without an ICO, RIs that employ an ICO more often:

- provide information specifically for industry in its online portal/website (83% vs 35%);
- have a strategy for collaboration with companies (79% vs. 45%);
- RI have an active industry advisory committee (50% vs. 15%) (Fig. 25); and
- keep a database of current and prospective industry users/clients (71% vs. 25%) and collaboration partners (63% vs. 40%).

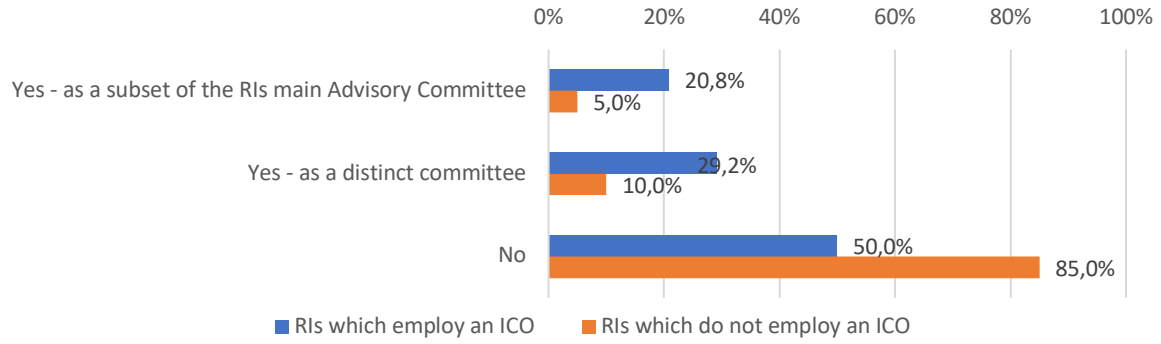

Fig. 25 - Does the RI Have an Active Industry Advisory Committee?

The RIs that have an ICO function also (Fig. 26):

- maintain an online catalogue of RI services and technologies targeting industry (38% vs. 15%) and have brochures or other information material targeting industry (58% vs. 15%);
- have a "corporate" presentation targeting industry (50% vs. 10%) and publish user cases (33% vs. 15%); and
- maintain a calendar of events for industry (46% vs. 10%) and organise/participate in brokerage events (50% vs. 5%).

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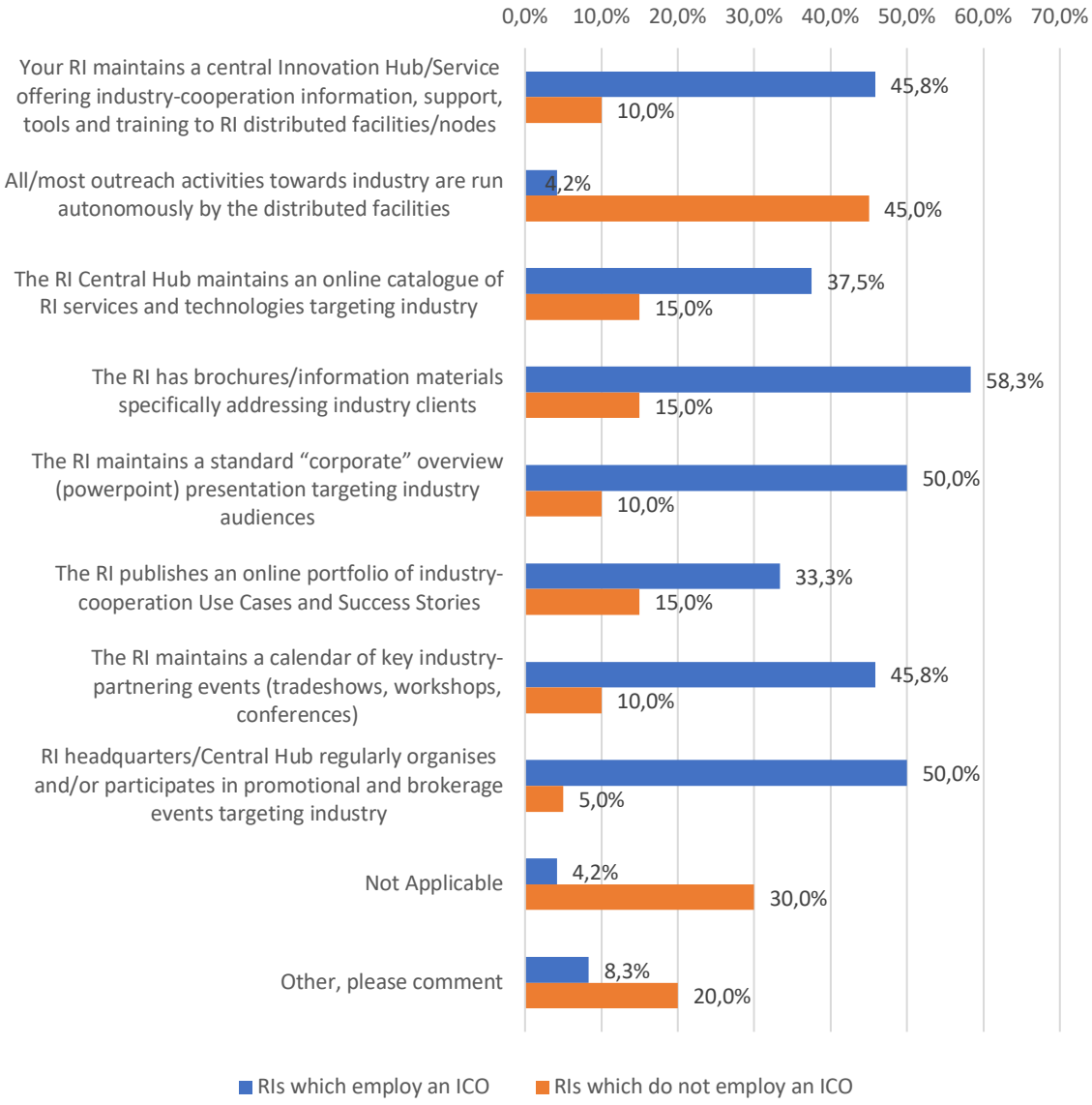

Fig. 26 - Which of the Following Statements Apply to Your RI? - RIs which Employ an ICO vs. RIs which Do Not Employ an ICO.

The RIs with an ICO employed are more likely to cooperate with technology clusters, science parks and innovation hubs (75% vs. 25%), pan-EU innovation promotion organisations (46% vs. 20%), and local or regional business organisations (67% vs. 25%) (Fig.27).

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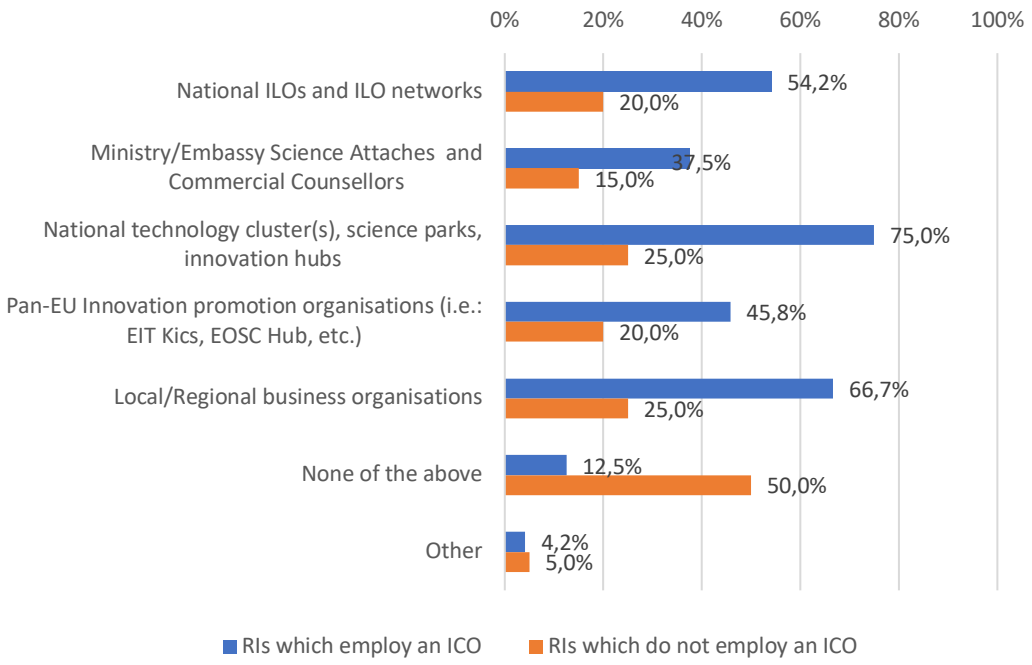

Fig. 27 - RI Intermediaries of Relations with Industry - Differential Analysis for RIs with an ICO and RIs without an ICO.

Regarding the measures which would be most helpful in developing collaboration between the RI and industry, the answers from RIs who employ or not employ an ICO are similar, the most notable difference being that RIs employing an ICO favour "direct company visits/meeting" (67% vs. 40%). RIs that employ an ICO are more likely to engage industry for joint research, development, and innovation (R&D&I) through: industrial partnerships/long-term agreements (54% vs. 40%), transfer of technology/licensing (46% vs. 15%), and industry sponsored/co-sponsored projects (50% vs. 25%).

The level of use of different industry collaboration methods by RIs with/without an ICO are similar for industrial partnerships (54% vs. 40%), publicly-funded projects (75% vs. 70%) and pilots (46% vs. 40%); however, RIs with an ICO engage industry with technology-transfer (46% vs. 15%) and industrially-sponsored projects (50% vs. 25%) more than RIs without an ICO.

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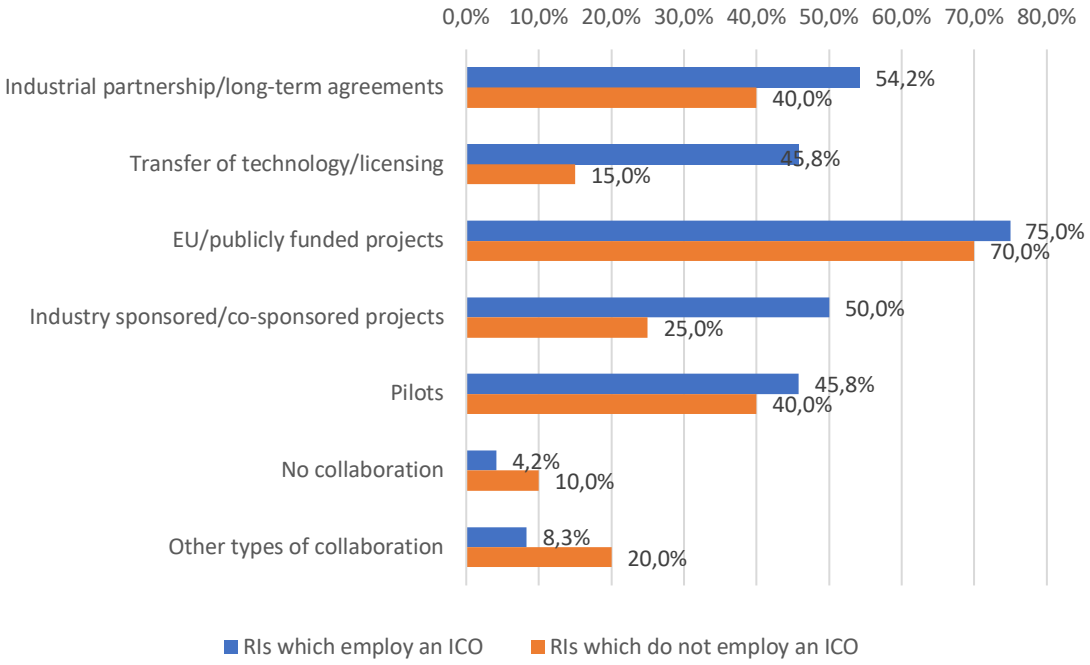

Fig. 28 - How Does the RI Engage Industry for Joint Research, Development, and Innovation (R&D&I)?

RIs that employ an ICO more often offer: access to facilities, instruments, testing (75% vs. 55%), access to specialised training (58% vs. 30%), RI – industry exchange programmes (37% vs. 5%), space and logistic for own research, development, and trials. Whereas the majority of RIs with and without ICOs do not use intermediaries (companies that are not themselves the end-user of the RI product/service), those that employ an ICO do work with intermediaries more (33% vs. 10%) (data not shown).

As seen in Fig. 29, for RIs with an ICO, fewer RIs report that the income from collaborative industry projects is “zero” or “not measured,” as compared to RIs without an ICO (29% vs. 50%). Also, please note that 25% of RIs respond “do not know/prefer not to answer” to this question, and 13% of the RIs with an ICO report above EUR 1 M in income.

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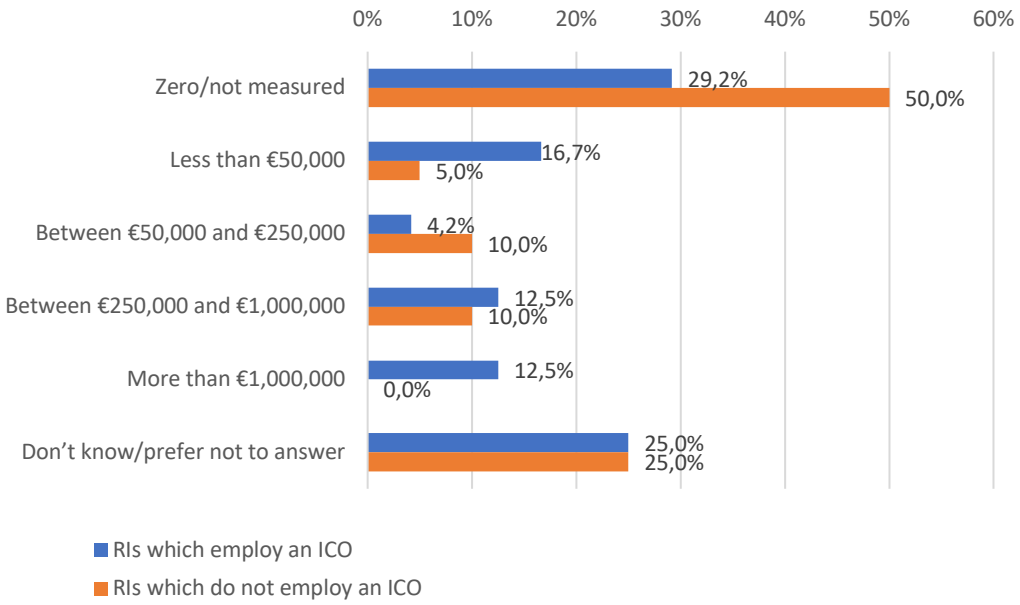

Fig. 29 - What is the estimated income to the RI from contracts with industry (excluding public funding) via, e.g., collaborative projects?

Remarkably, the number of industry user/client contracts per year are similar between RIs having an ICO function and not. RIs having an ICO do, however, report larger income from contracts with industry and are more prone to find their company users from countries other than where the RI is located (29% vs. 15%; data not shown) and engage more with large enterprises (92% vs. 40%; Fig. 30).

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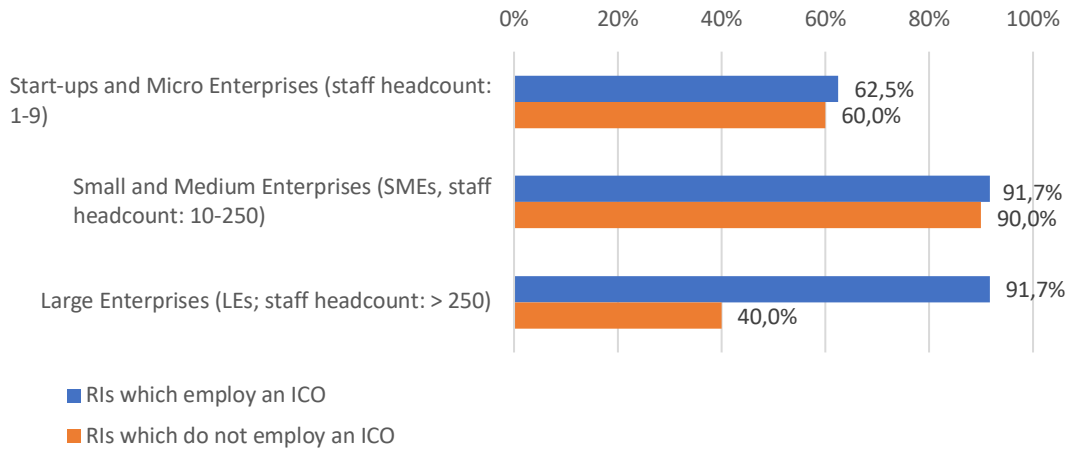

Fig. 30 - What is the Size of the Enterprises Using the RI? - RIs which Employ an ICO vs. RIs which Do Not Employ an ICO -

The Characteristics of the RI Research Domain Represented in the Survey

With reference to the categorisation presented in the ESFRI Roadmap 2018, the RIs were asked to which research domain they belonged. This criterion was used to segregate answers to the survey questions and investigate domain-specific characteristics. The results indicate the number of respondents per each sector.

It should be noted that the entities responding to the questionnaire comprised a majority of the distributed RIs, with or without ERIC status, all of relatively recent origins and representing most of the domains, together with a smaller number of entities with facilities in a single country, established much longer ago and representing mainly Physical Sciences & Engineering. The responses reflect this breakdown. See also the clarification on pages 54 and 55.

Energy (5 respondents)

The majority of RIs for which the ESFRI domain is energy were established between 2000 and 2010 (60%). Twenty percent are yet to be established. For 80% of RIs, a specific date of establishment is indicated in the range up to 2020. Of these, 75% were established between 2000 and 2010, and 25% between 2011 and 2020 (present). Other characteristics include:

- 60% of RIs pointing to energy as their scientific domain operate as distributed facilities;
- 40% declare annual budgets between EUR 1 M and EUR 5 M. The remaining budget ranges have been indicated by 20% of RIs each;
- 60% of RIs in this scientific domain declare the human resources capacity of headquarters/central management office above 100 FTEs;

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- A majority of RIs declares to be in the fully operational phase of development (80%), with the remaining 20% pointing to the preparatory/implementation phase.

All RIs from this group provide or could provide services and support regarding feasibility studies, proof of concept/demonstration, and pre-competitive research. Also, 60% could provide support for commercialisation. They cooperate mostly with companies from the energy sector.

Environment (6 respondents)

Fifty percent of RIs for which the ESFRI domain is environment were established between 2011 and 2020. For the remaining RIs, the date of the onset operational phase has either not been indicated or is set for the future.

- All of the RIs indicating environment as their scientific domain operate as distributed facilities;
- 50% declare an annual budget between EUR 5 M and EUR 10 M, and 33% report their annual budget to be above EUR 10 M;
- 83% of RIs declare human resources capacity of headquarters/central management office between 1 and 10 FTEs;
- A majority of RIs declare being in the preparatory or implementation phase of development (67%).

All RIs from this group provide or could provide services and support regarding feasibility studies, and proof of concept/demonstration. Half of those surveyed report the ability to provide a pre-competitive research support, and only 17% the ability to provide support for commercialisation. It is worth adding that 17% of RIs in this group have no relation with industry thus far. They cooperate mostly with companies from business areas such as environment and ICT/data.

Health & Food (12 respondents)

Exactly 71.4% of RIs declaring Health & Food as their ESFRI domain have been established between 2011 and 2020. For the remaining RIs, the date of onset of the operational phase has either not been indicated or is set for the future.

- 93% of RIs pointing to Health & Food as their scientific domain operate as distributed facilities;
- 64% declare an annual budget between EUR 5 M and EUR 10 M, and 29% report an annual budget that does not exceed EUR 1M;
- 57% of RIs declare human resources capacity of headquarters/central management office between 1 and 10 FTEs, and 36% between 11 and 100 FTEs;
- A majority of RIs declare to be in the fully operational phase of development (80%), with the remaining 20% indicating the preparatory/implementation phase.

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A majority of RIs from this group provide or could provide services and support regarding pre-competitive research (93%), feasibility studies (86%), and proof of concept/demonstration (86%). Twenty-nine percent of RIs could provide support for commercialisation. They mostly cooperate with companies from business areas such as the biotechnology and the healthcare industries.

Physical Sciences & Engineering (15 respondents)

Thirty-five percent of RIs with Physical Sciences & Engineering as their ESFRI domain were established no later than 1999, and 53% between 2000 and 2020. For the remaining RIs, the date of the onset of the operational phase has either not been indicated or is set for the future. For 88% of the RIs, a specific date of establishment/onset operational phase is indicated. In addition, 40% of RIs from this group were established before or in 1999.

- 82% of RIs pointing to Physical Sciences & Engineering as their scientific domain operate as single-sited facility. This is the largest concentration of single-sited facilities across the different domains;
- 65% declare an annual budget above EUR 10 M, and 24% report their annual budget between EUR 5 M and EUR 10 M. Again, this is the highest average among the ESFRI domains;
- 56% of RIs declare human resources capacity of headquarters/central management office above 100 FTEs, and 31% between 11 and 100 FTEs;
- 65% of RIs report being in the fully operational phase of development, with the remaining RIs divided equally between the operation spin-up and preparatory/implementation phases.

A majority of RIs from this group provide or could provide services and support for feasibility studies (82%), while 59% indicate support for pre-competitive research, and 41% point to support for proof of concept/demonstration. Also, 18% of RIs could provide support for commercialisation. They cooperate mostly with companies from business areas such as energy, aeronautics, and electrical and electronics engineering.

Social & Cultural Innovation (6 responses)

Eighty-three percent of RIs declaring Social & Cultural Innovation as their ESFRI domain were established between 2000 and 2020, with 50% indicating establishment dates after 2011. For 17% of RIs, the date of the onset of the operational phase was not indicated.

- All RIs pointing to Social & Cultural Innovation as their scientific domain operate as distributed facilities;
- 67% report an annual budget between EUR 1 M and EUR 5 M;
- 17% of RIs report that their annual budget does not exceed EUR 1 M and the same percentage point to an annual budget above EUR 10 M;
- 67% of RIs declare human resources capacity of headquarters/central management office between 11 and 100 FTEs, and 33% between 1 and 10 FTEs;

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- 67% of RIs declare the fully operational phase of development, with the remaining RIs divided equally between the operation spin-up and preparatory/implementation phases.

Fifty percent of RIs from this group provide or could provide services and support for Pre-competitive research, while 33% indicate support in feasibility studies and proof of concept/demonstration. No RIs from this group declare the ability to provide support for commercialisation, and 50% have no relation with industry thus far. They mostly cooperate with companies from the cultural heritage business area.

Data, Computing, and Digital Research Infrastructures (DIGIT) (3 respondents)

All RIs declaring DIGIT as their ESFRI domain, were established between 2000 and 2020, with 50% indicating an establishment date after 2011. All RIs declaring DIGIT as their ESFRI domain, were established between 2000 and present day, with 50% indicating an establishment date after 2011.

- 67% of RIs pointing to DIGIT as their scientific domain operate as distributed facilities;
- 67% declare an annual budget between above EUR 10M. 33% of RIs report their annual budget between EUR 1M and EUR 5M;
- 67% of RIs declare a human resources capacity of their headquarters/central management office between 1 and 10 FTEs, and 33% above 100 FTEs;
- All RIs declare to be in the fully operational phase of development.

All RIs from this group provide or could provide services and support regarding pre-competitive research and proof of concept/demonstration, while 33% declare support in feasibility studies. No RIs from this group declare the ability to provide support for commercialisation. However, all RIs declare having already established relations with industry. They mostly cooperate with companies from business areas such as automotive, the healthcare industries. and ITC/data.

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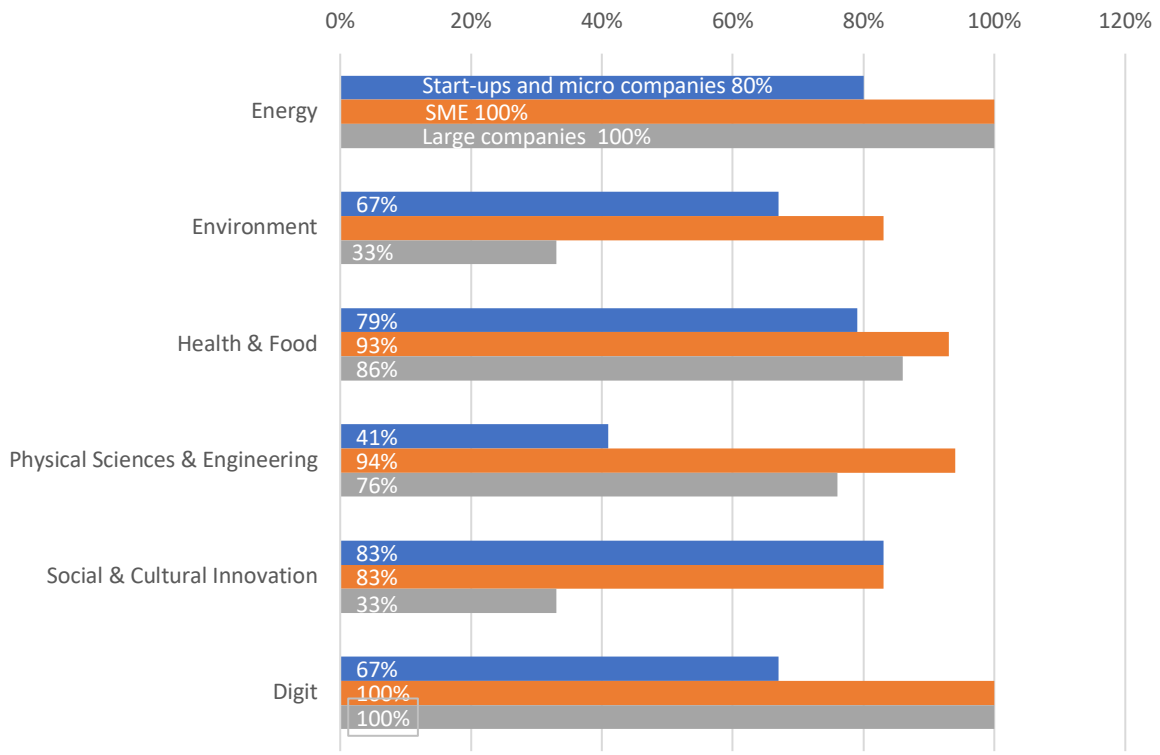

Fig. 31 - ESFRI Domain of the RI vs. Size of the Enterprises Using the RI.

Across the scientific domains, SMEs are typical industry clients for RIs (Fig. 30): between 83% of ENV and SCI RIs report having SME users/clients; and; 100% of ENE and DIGIT RIs. Micro enterprises use RIs in the Physical Sciences & Engineering domain less frequently than RIs of other domains. Thirty-three percent of RIs from ENV and SCI report to have users from large companies, which is much less than the 76-100% of RIs from the other domains who engage with large companies.

The Influence of the Research Domain of the RI on Industry-RI Engagement Practices

We looked at the survey data through the differential lenses of the RI research domain. Broadly speaking, it emerged that the RIs belonging to Physical Sciences & Engineering domain share many characteristics that are different from the other five domains. This makes sense, since these RIs are typically older and more expensive to construct and operate than RIs from other domains.

A similar percentage of RIs from all domains have a central hub/headquarters communications officer with commercial promotion experience and skills (41% vs. 44%); and both groups show

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a high involvement in joint technology pilots with industry (100% for Physical Sciences, 89% for other RIs). However, a significant series of differences emerges between the two groups, which are summarised below (Fig. 32-34).

For Physical Sciences & Engineering, the RIs (more often):

- have a centralised procurement office (82% vs. 38%);
- regularly communicate/share procurement, upgrade and maintenance plans/programmes with industry (59% vs. 32%);
- announce upcoming tenders for suppliers on a website (70% vs. 44%);
- maintain a database of supplier companies (82% vs. 24%) ;
- employ an industry contact officer (or equivalent staff), who is based in the central management office, and is responsible for strengthening and coordinating cooperation strategies and activities with Industry (76% vs. 53%) (Fig. 33);
- provide information specifically for industry in their online portal/website (94% vs. 50%);
- have a strategy for collaboration with companies (76% vs. 53%);
- keep in addition to a database supplier companies, databases of industry users and collaboration partners;
- of RIs which maintain databases the number of companies listed is higher for Physical Sciences & Engineering;
- have brochures/information materials specifically addressing industry clients (47% vs. 38%);
- maintain a standard "corporate" overview presentation targeting industry audiences (47% vs. 26%);
- maintain a calendar of key industry-partnering events (tradeshows, workshops, conferences) (53% vs. 21%);
- regularly organise and/or participates in promotional and brokerage events targeting industry (53% vs. 23%);
- cooperate with national ILOs and ILO networks (76% vs. 21%), national technology clusters, science parks, innovation hubs (65% vs. 47%), ministry/embassy science attachés and commercial counsellors (30% vs. 26%), and local/regional business organisations (59% vs. 44%);
- cooperate with companies operating in sectors such as: aeronautics (53% vs. 18%), automotive industry (42% vs 24%), chemicals (41% vs. 32%), construction (29% vs. 9%), electrical and electronic engineering (47% vs. 18%), energy (65% vs. 24%), mechanical engineering (41% vs. 15%), medical devices (41% vs. 29%), pressure equipment and gas appliances (18% vs. 6%), raw material, metals, minerals, and forest-based industries (24% vs. 18%), space (41% vs. 12%) and textiles, fashion, and creative industries (18% vs. 3%);
- employ more FTEs;
- have higher numbers of industry contacts.

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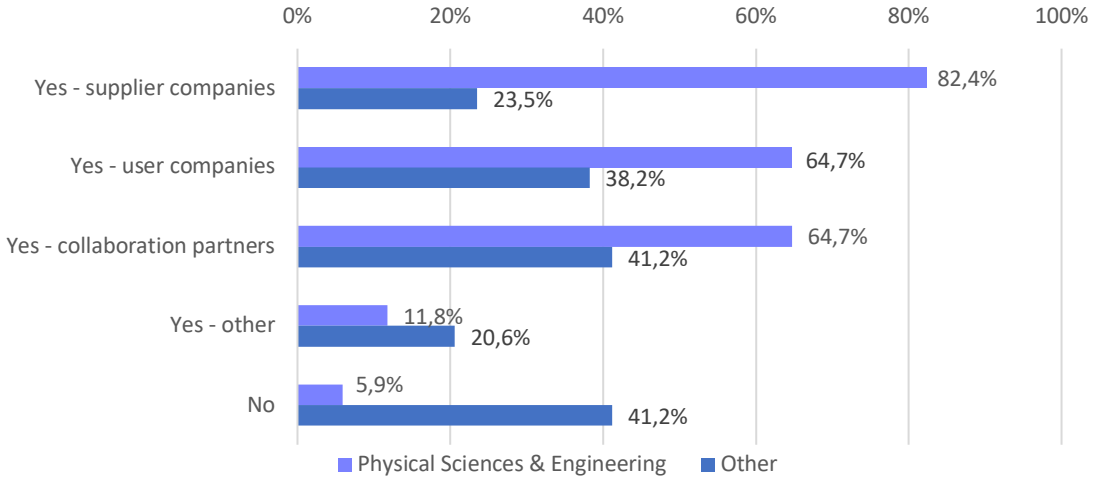

Fig. 32 - Does the RI Keep a Database of Current and Prospective Industry Clients (Suppliers, Users, Partners)? Multiple Choice Results Are Shown for RIs in the PSE domain and for Aggregated RIs from All the Other Domains.

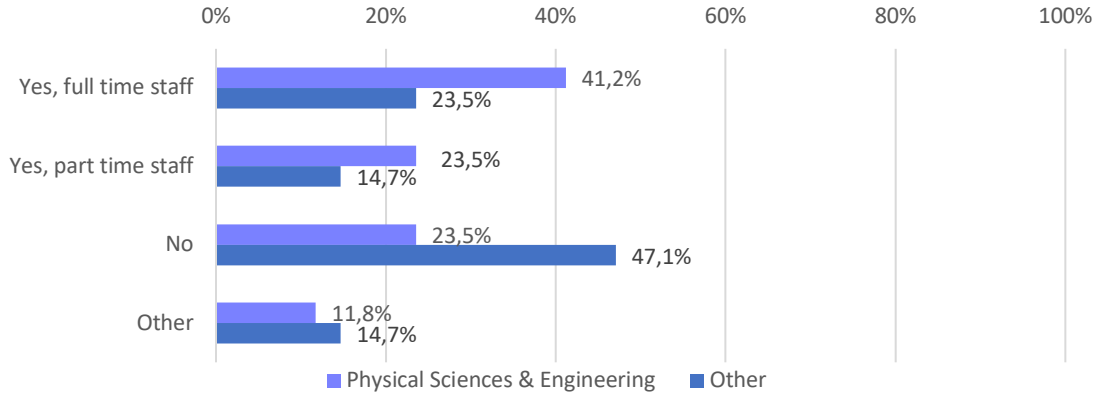

Fig. 33 - Does the RI Employ an ICO (or equivalent staff), based in the Central Management Office, Responsible for Strengthening and Coordinating Cooperation Strategies and Activities with Industry? Results are Shown for RIs in the PSE Domain and for Aggregated RIs from All the Other Domains.

RIs which in the Physical Sciences & Engineering scientific domain do the following less often than the other RIs:

- have an active industry advisory committee (18% vs. 44%);
- maintain an online catalogue of RI services and technologies targeting industry (12% vs. 44%);
- see an advantage if all RIs announced their upcoming tenders for suppliers on a single common "RI procurement" website (59% vs. 68%);
- cater for needs in data access, modelling, and data applications (24% vs. 12%);

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- cater to specialised training needs (29% vs. 0%).

The Influence of the Budget of the RI on Industry-RI Engagement Practices

On average, income from member contributions is the largest source of RI budget income, while EU projects is the second largest (Fig. 33). Income from services is on average slightly less than 10%; however, looking at the differences across the RI research domains, the energy domain features a very large 34% and is the only sector where income from services is even higher than member contributions. At the other end of the spectrum, the social sciences and cultural innovation sector shows zero income from service provision; low percentages, below 4% are in all other sectors (Environment, DIGIT, Physical Sciences & Engineering), with the exception of the Health & Food sector that shows a relevant 11% of income budget from the service provision (Fig. 33).

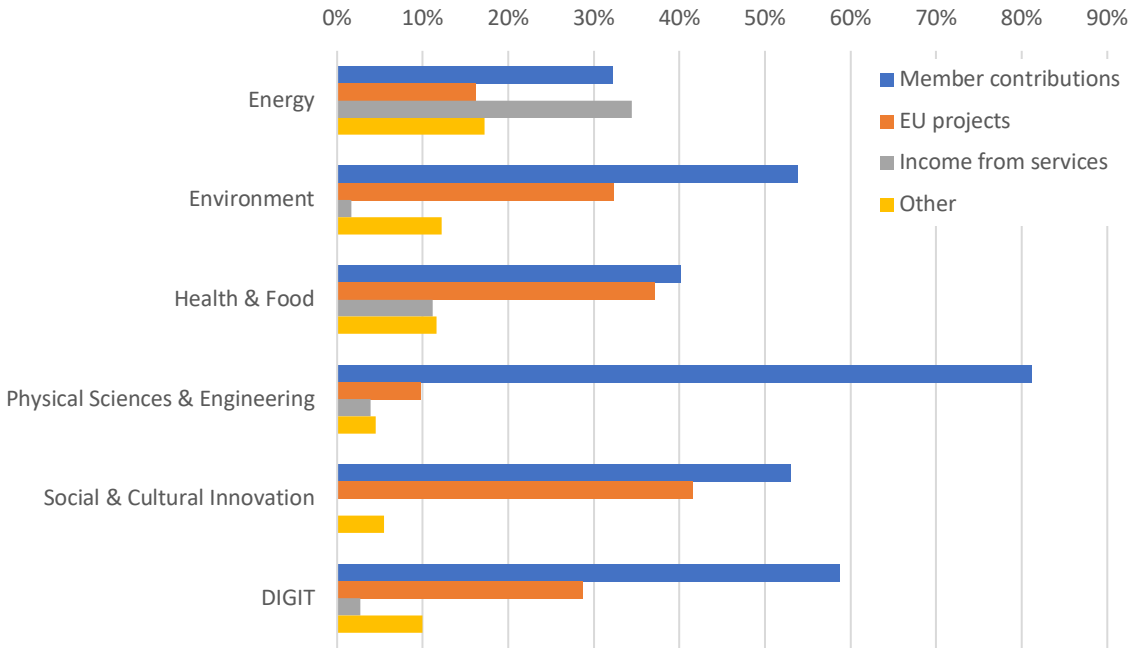

Fig. 34 - Approximate Percentages of the RI Annual Budget Composition vs. RI ESFRI Domains.

In the detailed analysis of the relation between the RI budget on the interaction with industry, three budget groups are used:

- Up to EUR 1 M (14% of RIs);
- Between EUR 1 and 5 M (43% of RIs);
- Above EUR 5 M (43% of RIs).

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A clear relation does not emerge when comparing income from contracts with industry with annual budget ranges for the RIs. In the first place, only 35% of respondents provided answers. Of the responses, the categories "zero income/no measures" and "don't know/prefer not to answer" were predominant. As noted elsewhere, this in itself constitutes an important conclusion from the study for further attention.

Other important insights from the analysis follow below:

- RIs that declare Physical Sciences & Engineering as their ESFRI scientific domain also report operating with larger budgets;
- RIs with higher budgets more often have a database of current and prospective industry clients (suppliers, users, partners), an active programme of joint technology innovation pilots involving industry, a centralised procurement office, a central-hub/headquarters communications officer with commercial promotion experience and skills;
- RIs with higher budgets indicate higher activity regarding the use of industry portals, or "green" technology promotion/advocacy. Among RIs, with a budget between EUR 1 and 5 M, only 9% report that they participate in "green" technology promotion/advocacy;
- Among RIs with budgets above EUR 5 M per year, only 50% employ a full-time ICO;
- Only 50% of RIs with a budget between EUR 1 and 5 M have a strategy for collaboration with companies as compared to c. 70% for RIs with smaller or larger budgets; RIs that report ERIC as their legal status, most often declare their annual budget between EUR 1 and 5 M;
- 68% of RIs with budgets above EUR 5 M per year participate in "green" technology promotion/advocacy. In contrast, only 9% of RIs with budgets between EUR 1 and 5 M are so engaged, and 29% of RIs with a budget below EUR 1 M.

As seen in Fig. 35, a majority of RIs with a budget above EUR 5 M maintain a database of both suppliers (64%) and users (64%). For RIs in the medium budget range of 1 to 5 M Euro, less focus is on keeping a database of supplier companies (32%) and user companies (37%), but more focus is on collaboration partners, where 55% keep a database of companies.

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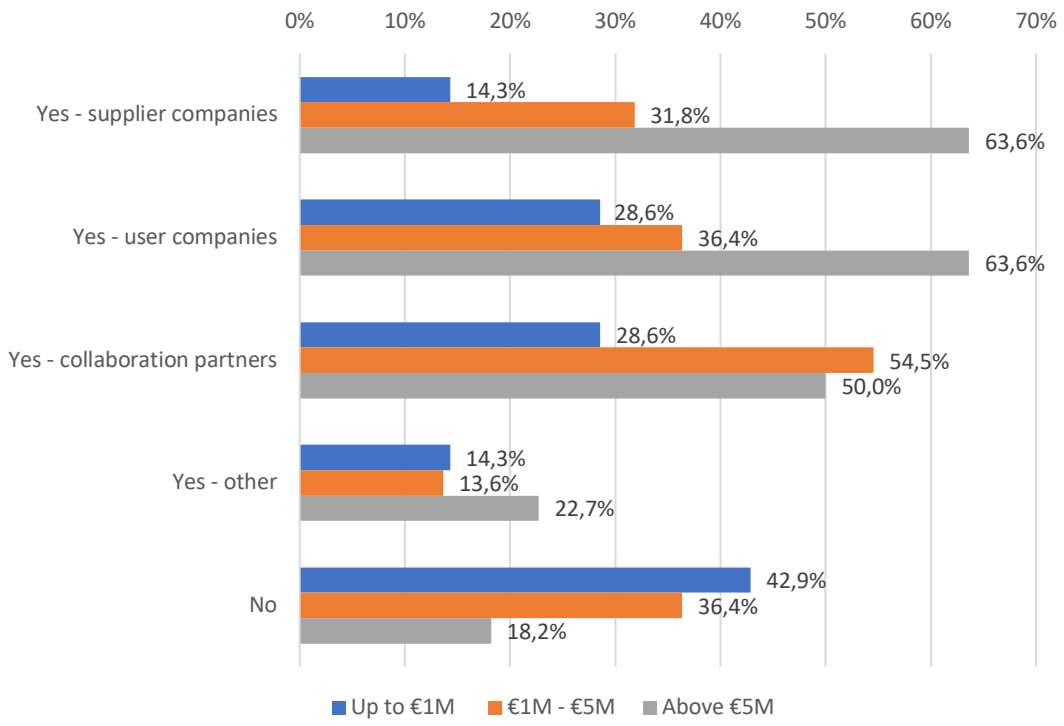

Fig. 35 - Does the RI Keep a Database of Current and Prospective Industry Clients (Suppliers, Users, Partners)? – RIs according to Annual Budget.

The Influence of the Type of RI Organisation on the Industry-RI Engagement Practices

RI activities were analysed according to a differentiation into distributed facilities (65%) and single-sited facilities (35%).

Single-sited RIs (SSRIs) are more strongly represented in the fully operational state of development (72%) than distributed RIs (DSRIs) (46%). There are also more distributed RIs in the preparatory/implementation phase (39%) than for single-sited RIs (11%). Physical Sciences & Engineering is the prominent ESFRI scientific domain (77.8%), among single-sited entities. Single-sited RIs have usually been in operation longer than distributed RIs: 55% of the SSRIs were established before 2010, while 49% of distributed RIs were established between 2011 and the present day. A third (33%) of the single-sited RIs indicated national not-for-profit Association (data not shown) as their legal entity form, while 39% of distributed RIs indicated ERIC (international public body) as their legal status.

Annual budgets are in different ranges for the two categories. Most of the distributed RIs (70%) declare a budget range of EUR 0-5 M. Only 33% of single-sited RI have a budget as low, while it is greater than EUR 10 M, in 50% of the observed cases. Only 24% of distributed RIs report

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budgets as elevated. However, the distribution of income contributions is broadly similar for single-sited and distributed RIs: single-sited show about 15% more from member contributions and 15% less from EU projects.

The number of industry contacts in databases is greater for single-sited facilities (Fig. 36). Illustrative is that for single-sited 62% have over 100 contacts versus 18% for distributed.

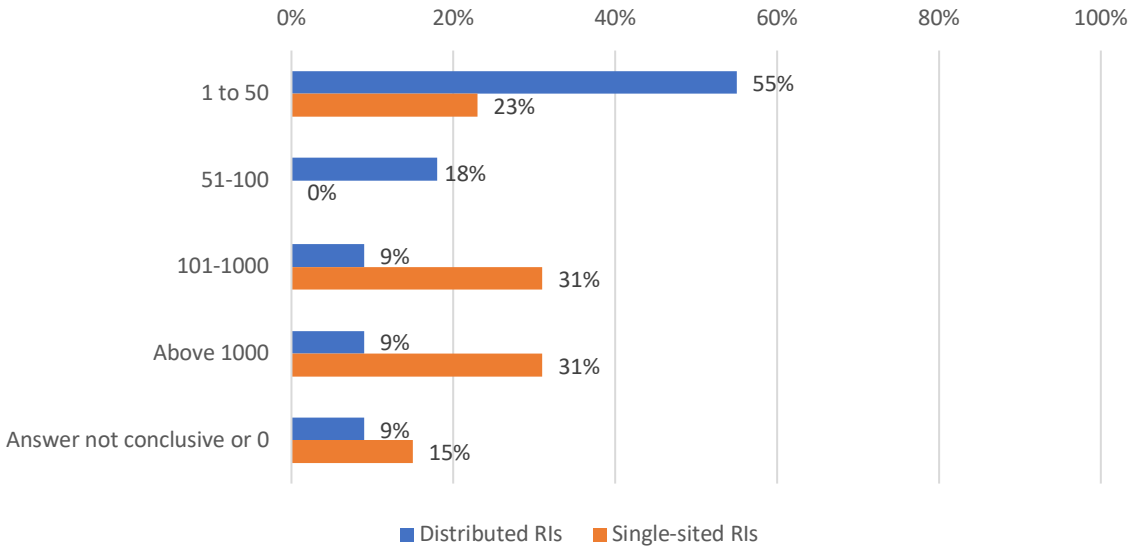

Fig. 36 - How Many Companies are On Your Database? - Distributed vs. Single-sited RIs - % of RIs which Declared Maintaining a Database of Companies.

As expected, single-sited facilities (which do more often have centralised procurement) engage ILOs and ILO networks more often than distributed facilities (72% vs. 21%). Other interactions with industry organisations are also stronger for single-sited facilities, e.g. technology clusters/science parks (78% vs. 39%) and to local business organisations (72% vs. 36%).

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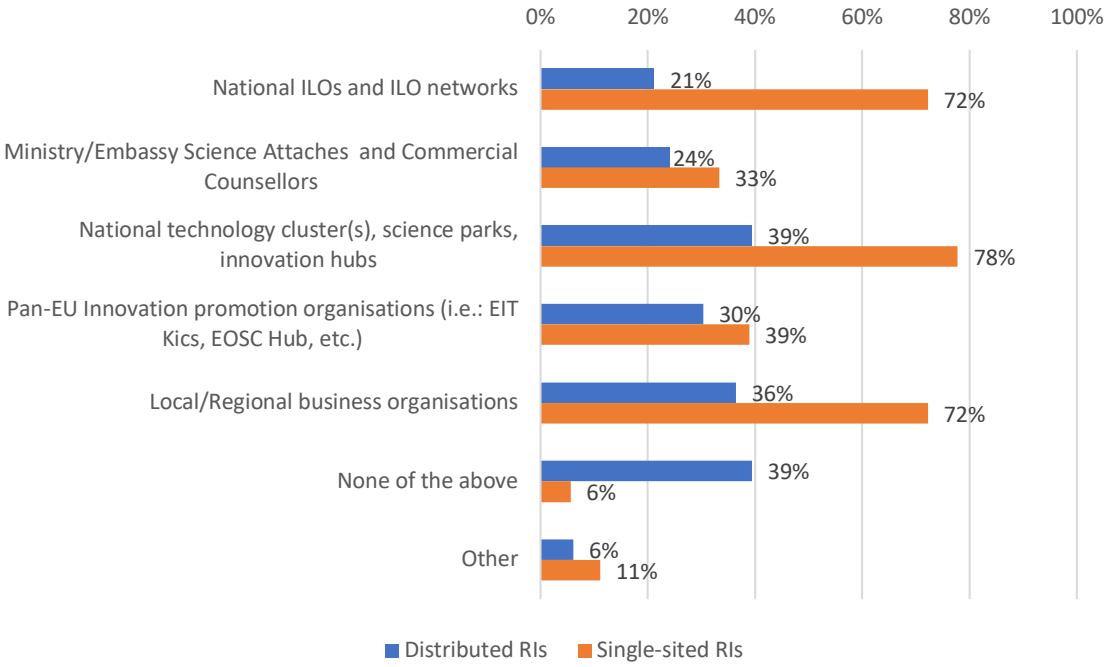

Fig. 37 - Entities with which RIs Cooperate to Engage with Industry - Distributed vs. Single-sited RIs.

The types of services available to industry are broadly similar for the two categories (Fig. 38), the only significant difference being that single-sited score higher for help with commercialisation (28% vs. 18%).

Significantly, 21% of distributed RIs have no relation with industry thus far, whilst for single-sited RIs the figure is 6%. This is most likely an effect of several distributed facilities only being in the preparation phase and the single-sited facilities being mostly in the Physical Sciences & Engineering domain, which represents the RIs established since longer time.

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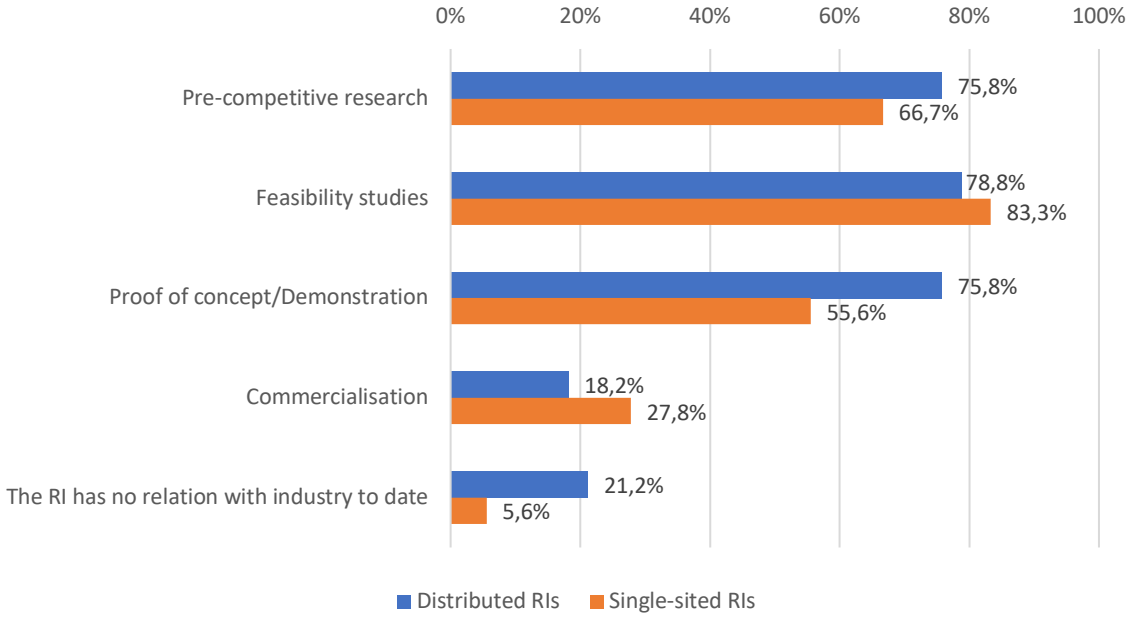

Fig. 38 - At which Stages of the Industry's Research, Development and Innovation Process Does Your RI Provide (or could provide) Support and Services? – Distributed vs. Single-sited RIs.

In analysing a number of answers to the questionnaire, some observations can be drawn with respect to aspects more prevalent with single-sited than distributed RIs.

Single-sited are more inclined/likely to:

- employ an Industry Contact Officer (74% vs. 33%);
- provide information specifically for industry in its online portal/website (100% vs. 45%);
- have a strategy for collaboration with companies (83% vs. 48%);
- have an active industry advisory committee (42% vs. 22%);
- participate in a "green" technology promotion/advocacy (i.e., Green Deal, Climate Partnership, etc.) together with industry partners (33% vs. 15%);
- have a label certifying quality and compliance of instruments and processes with international reference standards (28% vs. 24%);
- keep a database of current and prospective industry clients (suppliers, users, partners) (94% vs. 58%);
- have brochures/information materials specifically addressing industry clients, maintain a standard corporate overview (55% vs. 33%);
- maintain a standard "corporate" overview presentation targeting industry audiences (44% vs. 27%);
- publish an online portfolio of industry-cooperation use cases and success stories (39% vs. 21%);

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- maintain a calendar of key industry-partnering events (tradeshows, workshops, conferences) (56% vs. 18%);
- regularly organise and/or participate in promotional and brokerage events targeting industry (56% vs.21%);
- publicise information and tools to encourage/facilitate collaboration with industry, such as policies on pricing, IP protection, procurement, data handling (44% vs. 33%);
- have intermediaries as users, i.e. companies that are not themselves the end-user of the RI product/service (33% vs. 21%).

Specifically, regarding industry as a supplier, single-sited are more inclined/likely to:

- have a centralised procurement office (78% vs. 39%);
- regularly communicate/share procurement, upgrade, and maintenance plans/programmes with industry (61% vs. 30%);
- announce upcoming tenders for suppliers on a website (72% vs. 42%);
- maintain a database of supplier companies (72% vs. 33%).

Single-sited RIs also feature in general:

- higher employment (FTE);
- more companies in their database;
- higher approximate annual expense in terms of industrial supplier contracts;
- higher income to the RI from contracts with industry.

Single-sited RIs also identify more entities they work with to engage with industry and establish more industry contracts. ICOs representing distributed RIs more often see an advantage if all RIs announced their upcoming tenders for suppliers on a single common "RI procurement" website (70% vs. 30%).

Some similarities are also evident. Both categories:

- have a central hub/headquarters communications officer with commercial promotion experience and skills (44% vs. 42%);
- have an active programme of joint technology innovation pilots involving industry (33% vs. 27%);
- maintain a central Innovation Hub/Service offering industry-cooperation information, support, tools, and training to RI distributed facilities/nodes (33% vs. 27%);
- have an online catalogue of RI services and technologies targeting industry (33% vs. 33%).

The ICOs assessment of measures which can help the most to develop collaboration between the RI and industry is generally similar in both groups. The difference might be observed in case of EU/publicly-funded projects – 91% of ICOs from distributed RIs find this practice important, whilst only 67% of ICOs from single-sited RIs have similar opinion.

Both distributed and single-sited RIs most often engage industry for joint research, development, and innovation through EU/publicly funded projects. However, single-sited RIs

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show a more diverse portfolio of activities to engage industry in this kind of collaboration. It is worth noting that distributed RIs more often engage industry through pilots (51% vs. 44%) than single-sited RIs.

Regarding services offered by RIs for companies, the survey shows that distributed RIs more often than single-sited offer access to data, modelling via e.g. the RI's data portal (67% vs. 17%). This huge difference may, however, relate to the question being understood differently among the respondents. Other services that are offered more by distributed RIs include:

- Testing and quality/standards compliance validation of instruments and processes (42% vs. 33%);
- Access to specialised training (54% vs. 39%);
- Data products and applications development support (21% vs. 11%);
- Support for the development of data products and applications (36% vs. 17%).

Single-sited RIs more often than distributed RIs offer:

- Access to facilities, instruments, testing (72% vs. 64%);
- RI-industry exchange programmes (39% vs. 18%);
- Space and logistics support for custom development and trials (22% vs. 9%).

Similar percentages of distributed and single-sited RIs offer space and/or other logistics, for own research, development, and trials (17% vs. 15%). Sixty-seven percent of single-sited RIs and 45% of distributed RIs declare access to facilities, instruments, and testing among the most required services.

It is worth adding that clients of distributed RIs more often request access to specialised trainings (24%), than clients of single-sited RIs (11%).

Both single-sited and distributed RIs most often describe the nature of collaboration with industry clients as a mix of one-off impromptu and systematic long-term plan/relationship. But, as seen in Fig. 39, single-sited facilities more often work in long-term relationships with industry (33%) and distributed more often in one-off/impromptu fashion (33%).

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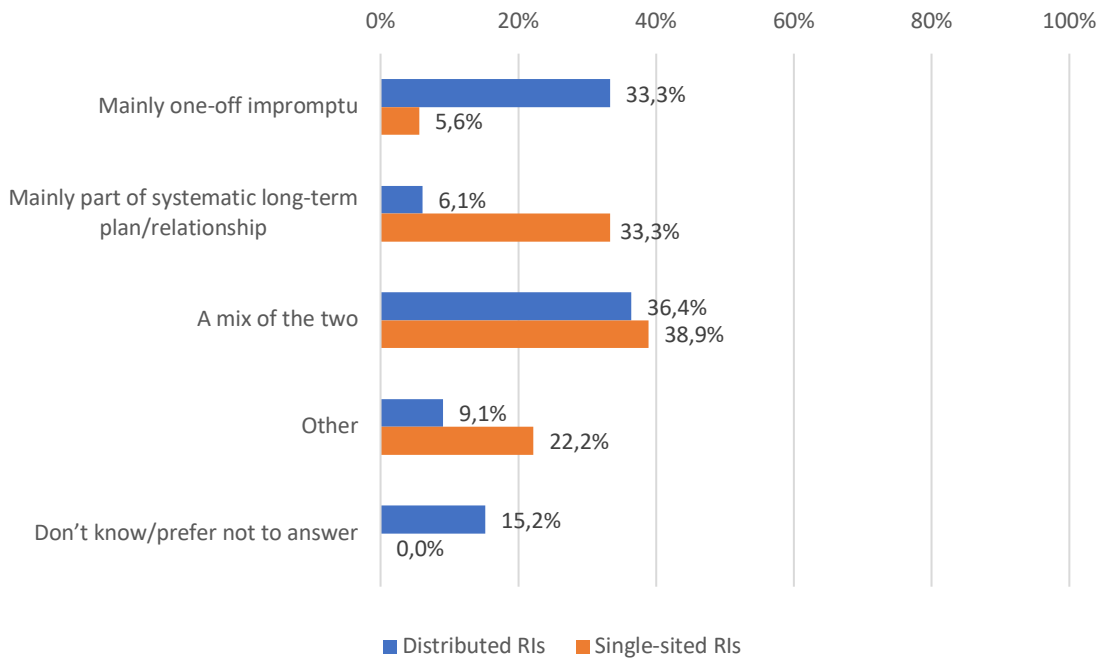

Fig. 39 - What is the Nature of the Collaboration between the RI and Current Industry Clients? - Distributed vs. Single-sited RIs.

A final point concerns income generated from industry contracts. As shown in Fig. 40, single-sited RIs score higher in all income categories. However, what is possibly more significant is that in the category "zero/not measured" the percentages are 6% for single-sited and 55% for distributed. This is clearly an area for future attention.

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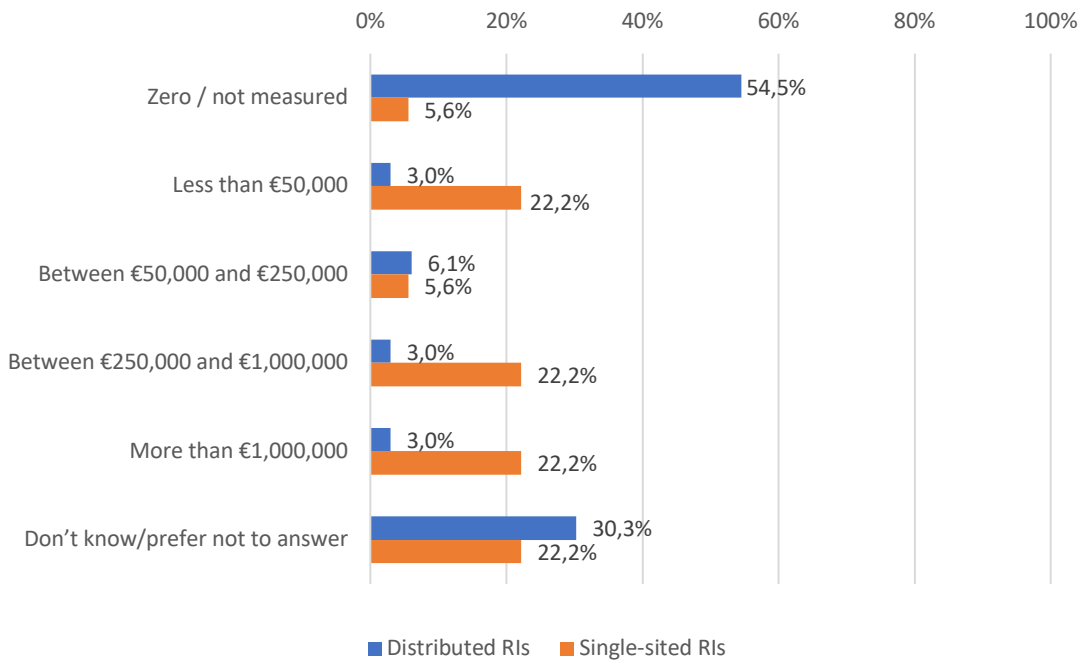

Fig. 40 - What is the Estimated Income to the RI from Contracts with Industry (Excluding Public Funding via, e.g. Collaborative projects)? - Distributed vs. Single-sited RIs.

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4.1 Industry as a RI-Supplier

The Sector and Research Domain of Industry as a Supplier of RIs

"Engineering dominance but a field open to many players"

The primary industry sectors working as suppliers to RIs are (in order of relevance): Electrical and Electronic Engineering, Mechanical Engineering, Energy, ICT/Data, Space, Construction, Aeronautics, Pressure equipment and gas appliances, Defence, and Automotive. Other industry sectors (e.g. Biotechnology, Cultural Heritage, Health, and Medical Devices) are also involved, indicating that, in general, the companies working in the RI market space are quite diversified.

The main research domain supplied by industry is by far Physical Sciences & Engineering, followed by Data Computing & Digital Research Infrastructure and, to a lesser extent, Energy, and Environment.

Necessary Competences of the "Industry as a Supplier"

"Broad ILO supplier networks, customised advanced technology products"

As far as can be assessed from the questionnaire, there seems to be a wide industry base that is in regular contact with ILOs to engage with RIs as a supplier. The number of companies who are in contact with ILOs varies depending on the nature of the ILO employer: ILOs employed at governmental agencies and private not-for-profit associations collaborate on average with a broader industry base (100-1000) than ILOs working for research organisations (1-50).

ILOs, in general, point out that the most frequent form of industrial supply for or collaboration with Research Infrastructures is in customised products, which agrees with the fact that RIs request supplies from industry with high-added value competences and specific expertise in advanced technologies. Off-the-shelf supplies rank in second place, followed, then, by system integration contracts.

The development of the necessary supplier competence benefit from the existence of national technology roadmaps. More than 75% of the ILOs point to the existence of national technology roadmaps in their countries. These documents cover the key strategic technologies for their countries covering different areas of interest.

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Institutional Support to "Industry as a Supplier" - The INDUSTRY LIAISON OFFICER (ILO)

"ILOs bring to the table different backgrounds and emphases"

ILOs are usually employed by a single institution. Most of them belong either to a public body – either a Governmental Agency (38%) or a Public Research Organisation (38%) the third group are ILOs employed by Private Not-for-profit Associations (19%). On average, most ILOs cover only one Research Infrastructure, with 33% of the ILOs serving more than one. ILOs also differ in their percentage of dedication to their functions, with ILOs belonging to Governmental Agencies closer to full-time dedication than ILOs employed by Public Research Organisations and private non-for-profit associations.

The main activities carried out by ILOs in support of industry as a supplier of RIs are providing information on tendering opportunities, matchmaking between RIs and industry, active support in tenders response, and company marketing toward RIs. ILOs rate these activities as having high impact in their results, except for marketing activities which in their opinions have moderate impact.

The main tools used in cooperation with industry are events followed by databases, newsletters, and industry portals. The funding tools for RI-Industry R&D projects are, in ILOs' opinions, not so relevant to achieve their goals. According to the survey, international ILO networks are a basic tool for all ILOs. National ILO networks are also used, but more by ILOs employed by public research institutions than by Governmental Agency employed ILOs. The respondent ILOs also report liaisons with industrial associations, national agencies, technology clusters, and innovation hubs.

Regarding the information coming from the RIs, ILOs employed by Public Research Organisations are not as well connected to the RI's high-level committees (such as the finance committees) as ILOs employed by Governmental Agencies or private non-profit associations.

The Performance Metrics against which ILOs are Measured.

"Different perspectives offer scope to enhance and enrich ILO performance and objectives"

With regard to how ILOs' performance is measured, the results show that by far the most important indicator is national georeturn, followed by improving the supplier base and promoting industry-RI-university collaborations. The results also 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.

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The survey showcases some differences between ILOs' KPIs and their own personal view of their role. Technology transfer is perceived as much more important by the ILOs than by their employers, as well as the promotion of industry-RI-university collaborations. These discrepancies between the evaluation from the ILO and their employers should be explored further by ENRIITC, as there may be an overlooked innovation potential in supporting supplier industry to become technology user or co-creator.

There can be a great diversity between ILOs, where synergies between georeturn, co-development, and technology transfer may often not be sufficiently recognised. This division between responsibilities and the place of employment of the ILOs have an influence on their strategy and objectives. ENRIITC can explore this matter in further detail.

ILO Perspectives on the Barriers to and Drivers for the Engagement of Industry-as-a-RI-Supplier

"Learnings from what works or falls short according to the ILO perspective"

The main obstacles in achieving stronger relations between RIs and industry can be grouped into five thematic areas: market approach and entry, communication with RIs and formal issues, technical issues, responding to tenders, and awareness of the RI needs.

The employment of a central RI communication officer and a central RI procurement officer appears to be beneficial in supporting communication with industry and profiling of RI capabilities. The existence of a central procurement office appears to be related to a higher income generation for the RI from industry contracts, but responses here were blurred by a large number of "zero income/not measured" and "not known" answers. Uncertainty surrounding the income from industry contracts is featured in several places in this study and is an area for attention. A larger percentage of ICOs working in RIs which have a centralised procurement office see the advantages of setting up a common procurement portal for all RIs.

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4.2 Industry as a RI-User

The User-Industry Sector, Size, and Research Domain

"One size does not fit all."

The sectors of the RIs' primary (>34%) industrial users are: biotechnology (49%), healthcare industries (43%), energy (37%), and chemical (35%). On the second tier (<34%) are: medical devices (33%), ICT/data (31%), aeronautics (29%), and the automotive industry (29%). The data gathered suggest that in general RIs respond well to the needs of their industrial customers, although in a few areas there may be scope for optimisation.

As far as it can be inferred from the survey responses, RIs in all ESFRI domains have an industry-user base, which includes various size-types of industrial enterprises: SMEs appear to be the category more involved in RI service use, in all domains, representing nearly half (46%) of the RIs' industry as a user base; large enterprises represent 31% overall and are almost completely absent in the RIs from the domains of Environment and Social & Cultural Innovation; 41% of the RIs from the Physical & Engineering Sciences domain report interactions with start-ups and micro enterprises which is below the average for RIs.

RI Service Offer to Industry and Industry Demand and Uptake

"*Supply and demand of products and services for industry are in good balance overall, but some opportunities for improvement can still be identified.*"

Broadly speaking, there is correspondence between RI service offer and industrial interests, suggesting good awareness and communication between RI and industrial users. Among the most popular services requested 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). However, there appear to be types of services offered, which are not being taken up optimally by industry, such as data and training, while the least frequently provided services include space and/or other logistics for own research (16% of RIs) and support for custom development and trials (14% of RIs). These may represent important opportunities, upon which the ENRIITC network can make visible and act. Also, while half of the responding RIs have a strategy for their approach to industry, many relations are established on an impromptu basis

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RI Support to "Industry as a User" - The INDUSTRY CONTACT OFFICER (ICO)

"*ICOs are good for business, but not all RIs realise this yet.*"

There is much evidence from the survey that RIs with an ICO function are more active across the board in engaging with industry. This includes having a strategy for working with industry, using an industry advisory board, and providing information on homepage in brochures or via presentations targeting industry. Some of these characteristics, however, are only found in less than half of the RIs that employ an ICO, which demonstrates that the role of ICO is not fully developed or harmonised. Thus, there appears to be basis for ENRIITC to facilitate a discussion among RIs/ICOs with the purpose of defining this role by, e.g., producing a list of ICO activities to consider.

RIs with ICOs also 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 that where the RI is located; although the number of clients is similar to RIs without ICO, these organisations generate a higher income from industry.

Over the sampled population, approximately half of the RIs employ an ICO. It is positive that 61% have a strategy for working with industry, but only 35% have an industry advisory board. 64% of the RIs do not track their income from industry (or report zero income).

ICO perspectives on the Barriers to and Drivers for the Engagement of Industry-as-a-User

"*Various instruments to improve engagement with industry, but funding is key*."

Regarding measures that would help the most to develop collaboration between the RI and industry, RIs with an annual budget up to EUR 1 M point to financial subsidies for RI-industry collaboration and EU/publicly-funded projects as the most important factors. The importance of these factors decreases for RIs with larger budgets. For RIs with larger budgets the key factors are direct company visits/meetings, EU/publicly-funded projects, and industry training programmes.

RIs with budgets lower than EUR 5 M, most often describe the nature of collaboration with industry clients as mainly one-off impromptu, whilst RIs with an annual budget above EUR 5 M most often describe it as a mix of a one-off impromptu and a systematic long-term plan/relationship. RIs with larger budgets also are more likely to be able to support an ICO among their staff. This is turn increases the performances of the RI through the surveyed engagement indicators, such as income from industry use of the RI facilities and systematic long-term relationships with industry. Financial means appear to be a crucial driver of this

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process. It seems important to consider providing support to the establishment of the ICO function in RIs, through public co-financing.

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4.3 The Industry-engagement Process and the Types of RI Research Domains and RI Organisations

"ILOs and ICOs; different worlds, synergy under-exploited."

The survey has highlighted significant differences in the mission, practices, and performance indicators of the key intermediary figures – i.e. the ILOs and ICOs, for the reciprocal engagement of industry and RIs. The survey results seem to reflect that the worlds of ILOs and ICOs are distinct; ILOs are employed at national research institutes and government agencies, and have a predominant focus on georeturn. They mainly consider industry as an RI supplier for instrumentation and services. ICOs, on the other hand, are looking at industry predominantly as a user of RI services. Their perspective is European, rather than just national.

Synergy can be created between georeturn, co-development, and technology transfer in the domain of RIs, but the opportunities of collaboration between ICOs and ILOs are under-exploited, likely due to different missions and responsibilities, as well as different interests of the stakeholders, and between the national and European levels. Exploiting the full potential of collaboration would require a more strategic approach in contrast to the opportunity-driven character (focused either on tendering or obtaining new users) that seems to be predominant now. ENRIITC shall pose the basis for this enhanced collaboration.

The survey has also highlighted that significant differences in the engagement of industry can be observed among RIs according to their research domain (ESFRI categories), their administrative organisation (Distributed vs. Single-Sited), and their budget size. Overall, the clear pattern that emerges from these comparisons is that Single-sited and Distributed RIs are very different organisations.

The single-sited institutions have a centre of gravity in Big Science initiatives and typically feature larger budgets and a higher intensity of the interaction with industry, both as supplier and user; they are mostly established since a longer time than the distributed RIs, have better developed instruments for industry outreach and deploy more resources for this; they are better connected with ILO networks and other national and international initiatives such as science parks, than distributed RIs; They typically benefit from a government-appointed ILO, while the distributed RIs can only count on a directly employed ICO.

In fact, this distinction underpins perhaps a more fundamental pattern. In particular, RIs belonging to the Physical Sciences & Engineering (Big Science) are almost exclusively single-sited and with larger budgets than the average distributed RI. A significant amount of single-

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sited RIs are also in the Energy and DIGIT domains, while Health & Food, Social & Cultural Innovation, and Environment are almost entirely distributed organisations, with annual budget below EUR 5 M. The distributed facilities cater on average to a wider spectrum of industry sectors than single-sited facilities; they appear to be active in reaching out to industry through catalogues of services, information provision and training, and through an industry advisory committee. Their function mainly entails raising awareness about what the RIs can offer. However, they seem to be unaware of the RI potential to generate income through industry contracts.

These observations suggest a number of areas to explore best practice sharing and networking interaction. Analysing the experience of ILOs and of ICOs in large and long-established institutions can be useful for distributed RIs, who often lack the assistance of an ILO; and for RIs in early stage of development, who will benefit from the longer-established-RIs' proficiencies. It is also possible that distributed organisations provide inspiration to the ENRIITC-driven community of ILOs and ICOs to expand the portfolio of activities with clever small-scale initiatives to reach out to industry, as well as for a more diversified portfolio of industry sectors for this community to engage with.

Areas of activity regarding the support to co-creation processes could be strengthened across the various initiatives to better support the EU Innovation Union policy goals. In fact, while ILOs and ICOs may share industry engagement practices such as the use of meetings, newsletters, brokerage events, and databases, the survey confirms that they have entirely different missions. ILOs are tasked with increasing the volume of national industry supply contracts with RIs; the ICO mandate is typically to establish new relations with industry as a user of the RI services and facilities. Neither ILOs or ICOs are primarily tasked to foster innovation – this is an area of attention for policy if we mean to overcome the European Innovation Paradox, which determines insufficient innovation products and processes despite the relevant European scientific production and entrepreneurship capacity.[4]

[4] *Fragkandreas, Thanos (2017-10-02). "Innovation Paradoxes: A Review and Typology of Explanations." Prometheus.* ***35*** *(4): 267–290. doi:10.1080/08109028.2018.1506620.*
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5. Figures

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6. Tables

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