



Report on the Consultation on Long Term Sustainability of Research Infrastructures

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**Report on the
Consultation on
Long Term Sustainability of
Research Infrastructures**

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FOREWORD

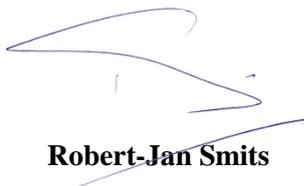
Europe has a long tradition of scientific excellence and ensuring access to world-class research infrastructure facilities is crucial to staying at the forefront of science and technology and remaining competitive in a global knowledge-based economy.

But some science facilities are just too big or complex for a single country to build and manage alone. The European Strategy Forum for Research Infrastructures (ESFRI) was set up in 2002 to help coordinate the development of large-scale research facilities in the European Research Area. The successive ESFRI roadmaps including the recent update published in March 2016, together with the European Research Infrastructures Consortium (ERIC) Regulation, have been important milestones in this process.

Many of the facilities in the 2016 ESFRI Roadmap have now reached the implementation phase and require substantial funding and support in the coming years to reach full operation and ensure long-term sustainability. But, besides ensuring funding, those facilities also have challenges as regards: curation and storage of data, these challenges were the main focus of a European Commission consultation launched in December 2015.

The results of the consultation are presented in this report and highlight the need to strengthen the involvement of industry to develop credible business models as well as efficient governance models to develop research infrastructures. It is also necessary to look into the different existing funding schemes both to ensure appropriate synergies and to explore possible new solutions.

The Member States participating in the Competitiveness Council on 27 May 2016 recognised the importance of ensuring the long-term sustainability of research infrastructures and invited the Commission to prepare, together with ESFRI and other relevant stakeholders, a dedicated action plan. I am confident that this report sets a sound basis for the development of this action plan.



Robert-Jan Smits
Director-General

Directorate-General for Research and Innovation

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EXECUTIVE SUMMARY

Research infrastructures (RI) are one of the key elements for the development and improvement of knowledge and technology. Long term sustainability has been repeatedly highlighted as the main challenge for European RI.

Given these premises, in December 2015, the European Commission launched an online consultation targeting RI stakeholders with the aim of collecting their views on the interrelated pre-conditions that could ensure the long term sustainability of RI and the potential actions/measures to tackle the challenges posed by their implementation.

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

Data were collected through an online semi-standardised questionnaire, i.e. with a mix of close-ended and open-ended questions. The questionnaire was structured in two parts, the first aimed at characterising the profile of the respondent and the second at capturing the respondents' views on the following pre-conditions:

- Ensuring Scientific excellence;
- Managing tomorrow's RI - Skills of managers, operators and users;
- Unlocking Innovation potential of RI;
- Measuring socio-economic impact of RI;
- Exploiting better the data generated by the RI;
- RI Life cycle – Upgrading of RI;
- RI Life cycle – Decommissioning of RI;
- Ensuring sustainable governance of RI;
- Funding the construction and operation of RI;
- Structuring the international dimension of RI.

"Scientific Excellence" is widely acknowledged as the most important of the identified pre-conditions to Long-term Sustainability, which is then followed in relevance by the "Funding the construction and operation of RI". Other pre-conditions tend to rank closely one to the other. Only the "RI Life cycle decommissioning" ranks significantly lower than the rest.

Main findings

Ensuring scientific excellence

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

Managing tomorrow's RI

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

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

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

Unlocking the innovation potential of RI

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

Measuring the socio-economic impact of RI

The findings demonstrate the perceived relevance of direct and indirect, tangible and intangible benefits deriving from the use of RI services and instruments.

However, the importance of assessing socio-economic impact of RI varies according to the profile of the respondents. As such, funding organisations rank this dimension much higher than the RI operators and the Research Performing Organisations.

Moreover, the acknowledgment of the need to measure impact has not yet resulted in a systematic assessment and evaluation of such impacts throughout the life cycle of RI.

Exploiting better the data generated by the RI

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

RI Life cycle – Upgrading

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

RI Life cycle – Decommissioning

The majority of the organisations do not include decommissioning in their lifecycle management and business plan.

Among the RI that do plan the decommissioning phase, it appears that channelling the know-how and transferring data are the dimensions that require closer attention.

Ensuring sustainable governance of RI

The outcomes of the consultation highlight a requirement to establish better synergies among national roadmaps and to have these synchronised with the funding planning processes in the Member States.

National processes would need to be inserted into a European strategy, reason for which the European Commission should take a greater role in monitoring, supporting and facilitating the whole exercise.

On the ERICs' further development, as it is still a relatively new legal instrument, there appears to be a general view not to propose immediate changes as much as to continue overseeing its implementation. Simultaneously, the respondents identified a number of areas for further development of the instrument such as VAT exemption, extension of the ERIC applicability to EURATOM, to international consortia and to research networks.

Funding the construction and operation of RI

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

Structuring the international dimension of RI

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

1. INTRODUCTION

European RI represent a success story of EU research policy, and yet, RI face a considerable challenge of long term sustainability.

Commissioner Moedas stressed in his Mission Statement that: “Improving research infrastructure and making better use of research results is essential to strengthen innovation further, develop new activities and boost the productivity and competitiveness of our economy”.

The Informal Competitiveness Council of July 2014 highlighted the importance of long term sustainability of RI, stressing that open access to RI and data, better links with industry and prioritisation based on a multi-level approach (national, European and international level) were key to ensure sustainability. Furthermore, RI need a long term perspective for their construction and operation.

Building on the achievements of the European Research Area and the Innovation Union flagship initiative, there is now a need to identify the next steps for a more comprehensive approach and vision on the long term sustainability of RI, fully using their potential to deliver on the Commission priorities on open innovation, open science and open to the world.

Given these premises, from 2 December 2015 to 1 February 2016, the European Commission launched an online consultation on long term sustainability of Research Infrastructures with RI stakeholders, receiving ca 200 answers.

The aim of this targeted consultation was to collect key stakeholders’ views on the interrelated pre-conditions that could ensure the long term sustainability of RI and the potential actions/measures to tackle the challenges posed by their implementation. The pre-conditions are: Ensuring Scientific excellence, Managing tomorrow's RI - Skills of managers, operators and users, Unlocking Innovation potential of RI, Measuring socio-economic impact of RI, Exploiting better the data generated by the RI, RI Life cycle – Upgrading of RI, RI Life cycle – Decommissioning of RI, Ensuring sustainable governance of RI, Funding the construction and operation of RI and Structuring the international dimension of RI. For every pre-condition, the consultation provided a short explanation and a brief description of the issues at stake and possible actions.

The communities targeted by the consultation were the ERA stakeholders, the ESFRI projects and ERICs, the ESFRI delegates, the members of the Programme Committee of the RI part of Horizon 2020, the e-Infrastructures Reflection Group (e-IRG) delegates, the EIROforum members, International Organisations, RI associations (e.g. ERF), National Contact Points (dissemination within key stakeholders), and science attachés from strategic third country partners.

Data were collected with an online semi-standardised questionnaire, i.e. with a mix of close-ended and open-ended questions. The qualitative open-ended questions addressed the most relevant topics in the survey, i.e. the measures to tackle the challenges posed by the pre-conditions for sustainability; this type of questions allowed interviewees to freely express their considerations in their own words allowing therefore for the possibility to deepen their answers with personal opinions and experiences.

The response rate to the consultation was high as was also the level of detail provided by the respondents in the open questions. This has positively impacted both the quality and the reliability of the consultation results.

The responses have been analysed with the support of an external expert. An overview of the initial findings of the consultation was already presented on the occasion of the ESFRI Roadmap 2016 Update Launch event that took place on 10 March 2016 in Amsterdam.

The purpose of this consultation is to derive the main trends on RI sustainability, as perceived by the targeted communities, on which basis elements of an action plan can be developed in concertation with the main stakeholders.

This report presents the main outcomes extracted from the responses received by the Commission services during the consultation. The responses were categorised and grouped in order to extract core trends and potential measures to tackle the identified challenges. It provides also an overview of the profile of the respondents and a summary of the survey results.

2. THE CONSULTATION PROCESS

The consultation was designed in a manner to best address three main dimensions:

- Evaluate the relevance of the pre-conditions for Research Infrastructures sustainability;
- Identify the potential actions/measures which stakeholders suggest;
- Create a basis for discussion for designing an action plan to tackle these challenges.

The organisations targeted by the survey were:

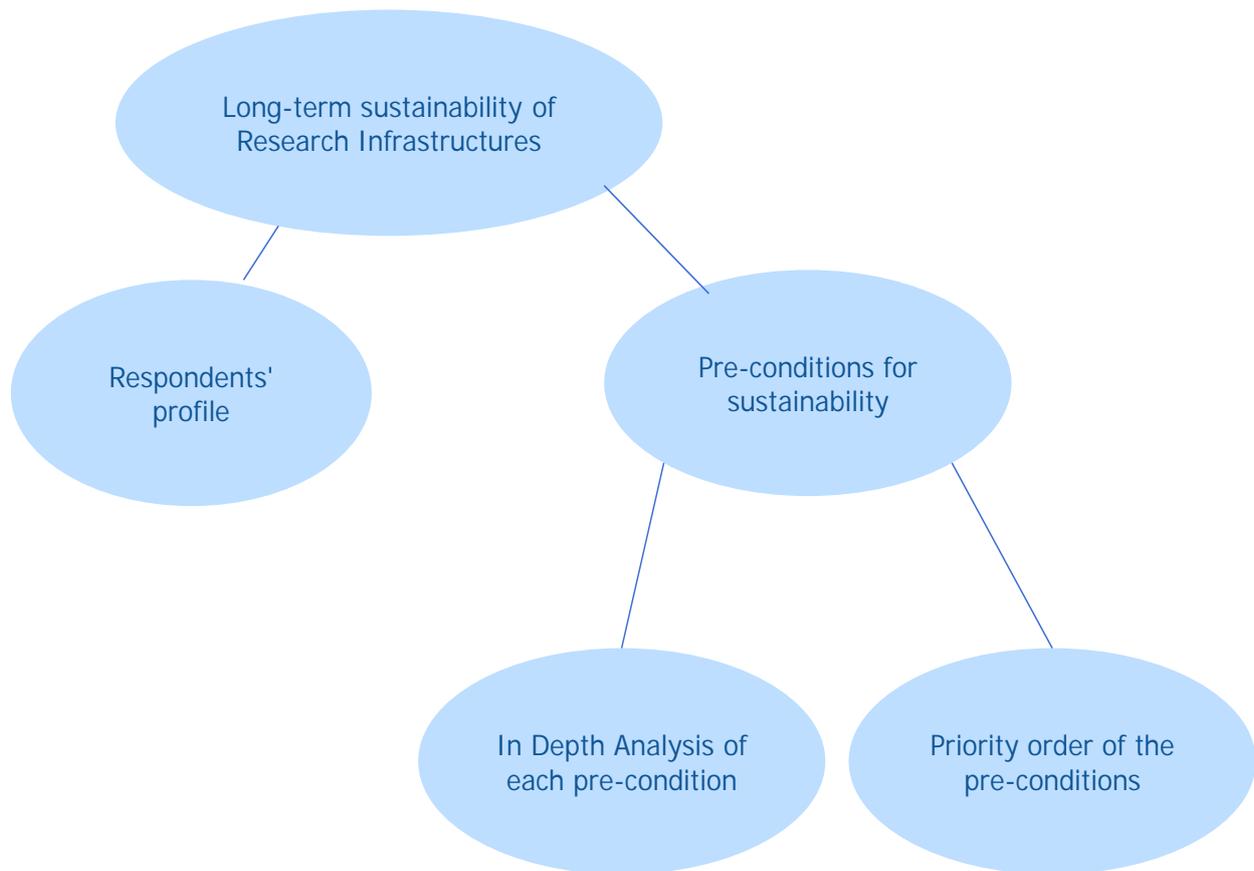
- ERA stakeholders;
- ESFRI projects
- ERICs;
- ESFRI delegations;
- e-Infrastructures Reflection Group delegates;
- Members of the Programme Committee for the Research Infrastructures part of Horizon 2020k;
- EIROforum members;
- RI associations;
- RI National Contacts Points (for further dissemination within key stakeholders);
- Science attachés from strategic third country partners.

The questions were developed taking into account two main dimensions (as shown in the concept map, Fig. 1): the profile of the respondents and the pre-conditions. Specifically:

- Respondents' profile: type of organisation, scientific field, country, etc.;
- Ensuring Scientific excellence: the role of RI in the advancement of knowledge and technology and the importance of their full exploitation;
- Managing tomorrow's RI: Skills of managers, operators and users;
- Unlocking Innovation potential of RI: interaction with industry, development of key technologies and provision of innovative services;
- Measuring socio-economic impact of RI: consolidated socio-economic impact modelling, direct and indirect impact;
- Exploiting better the data generated by the RI: research data management policies, data reuse and interoperability;
- RI Life cycle – Upgrading of RI: upgrades planning, benchmarking and scientific landscaping, international evaluation standards;
- RI Life cycle – Decommissioning of RI: integration in life cycle management, business plan and international evaluation accounting standards;
- Ensuring sustainable governance of RI: governance mechanisms, synchronisation of decision-making and planning processes;
- Funding the construction and operation of RI: synergies between funding mechanisms and business models development;
- Structuring the international dimension of RI: global approach to RI development and international outreach of RI.

A final section of the questionnaire aimed at identifying a hierarchy of relevance of the pre-conditions for long term sustainability according to the views of the respondents.

Fig. 1 – Concept map of the Survey on RI LTS



The online consultation was open from 2 December 2015 to 1 February 2016; ca 200 respondents replied to the survey.

Some of the questions submitted to the respondents were targeted exclusively to Research Infrastructure operators, as they were related to issues directly pertaining to the daily management of Research Infrastructures.

Data quality control and data screening procedures were then applied to check for the reliability of the dataset. The resulting research sample was a 189 records dataset which can be considered as a positive result given the fact the majority of the questions were qualitative open-ended requiring more work to be answered than closed-ended ones.

The identity of the respondents has been safeguarded as indicated in the questionnaire which specified that only "*A synthesis of the contributions received via this online questionnaire, as well as any individual contribution, may be made public, safeguarding the identity of the respondents*".

3. SURVEY RESULTS

Survey results are presented in line with the structure of the questionnaire:

3.0. Respondents' profile

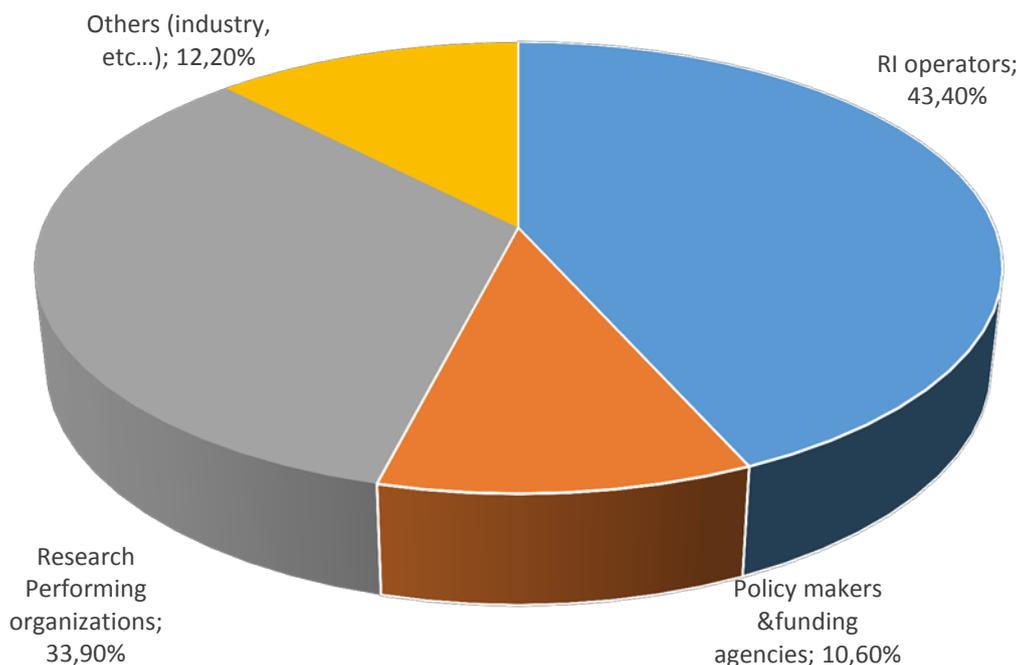
As shown in Tab. 1, the majority of the respondents belong to public research organisations (31.2%) or to public RI operators (30.2%); other types of organisations then follow with lower percentages.

Tab. 1 – Replying as/on behalf of:

	Frequency	%
National government	8	4.2
Regional/local government	1	.5
Research funding organisation	11	5.8
Public research organisation	59	31.2
RI operator – public	57	30.2
RI operator – private	12	6.3
RI user	5	2.6
Private organisation - Industry (less than 250 employees)	1	.5
International organisation	13	6.9
Other	22	11.6
Total	189	100.0

In order to aggregate the data, and be able to derive significant trends, the respondents were grouped in four categories according to their type of organisation (Fig. 2). The majority of respondents resulted being grouped under RI operators (43.4%), followed by representatives from Research Performing Organisations (33.9%).

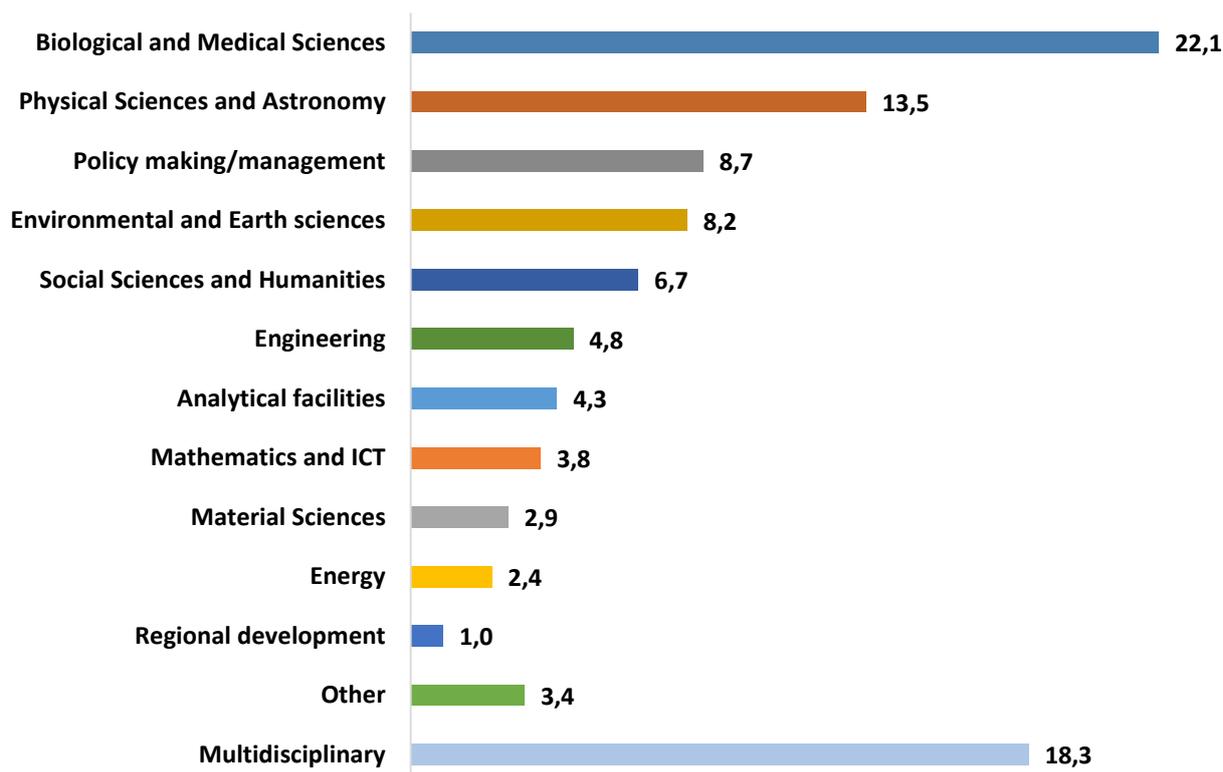
Fig. 2 – Type of organisation – recoded in four categories (%)



Respondents were then asked to specify the scientific field(s) of work of their organisations. In aggregating data, a “multidisciplinary” category was introduced to highlight organisations operating in three or more fields.

The results show that the relative majority of respondents belong to “Biological and Medical Sciences” (21.9%), while a slightly lower percentage belongs to multidisciplinary environments (18.1%); other scientific fields are represented at lower percentages (Fig. 3).

Fig. 3 – Fields of work (%)



The table below shows the distribution of the organisations by country: the majority of respondents come from Spain (12.2%), Italy (10.2%), Germany (10.1%), France (9.5%), and the Netherlands (8.5%).

Tab. 2 – Distribution by Country

Country	Frequency	%
Spain	23	12.2
Italy	20	10.6
Germany	19	10.1
France	18	9.5
the Netherlands	16	8.5
United Kingdom	11	5.8
Portugal	10	5.3
Czech Republic	9	4.8
Belgium	8	4.2
Austria	4	2.1

Finland	4	2.1
Ireland	4	2.1
Greece	3	1.6
Sweden	3	1.6
Denmark	2	1.1
Latvia	2	1.1
Lithuania	2	1.1
Bulgaria	1	.5
Luxembourg	1	.5
Malta	1	.5
Poland	1	.5
Romania	1	.5
Slovakia	1	.5
Other	15	7.9
International Organisations	10	5.3
Total	189	100.0

3.1. Ensuring scientific excellence

This section of the questionnaire focused on the identification and analysis of the elements needed to ensure the scientific excellence of RI. Such elements included setting-up independent international external scientific and technical evaluation committees and peer-review systems for selecting user projects and attributing access.

The responses indicate that the majority of RI (78.9%) have established international scientific advisory committees. At the same time, less than half of the respondents use an international peer-review system for selecting user projects (47.1%).

Fig. 4 – Do you have an international Scientific Advisory Committee with representatives of the main scientific research fields addressed by the RI? (%)

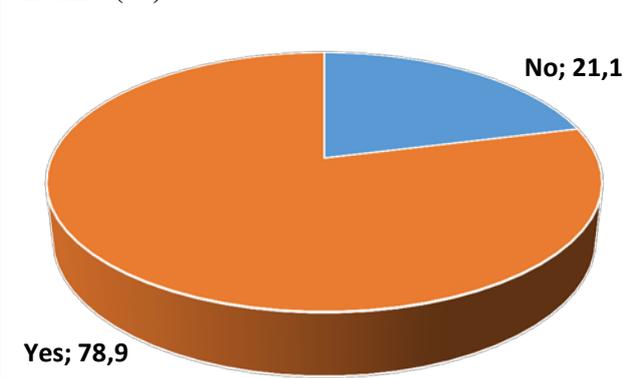
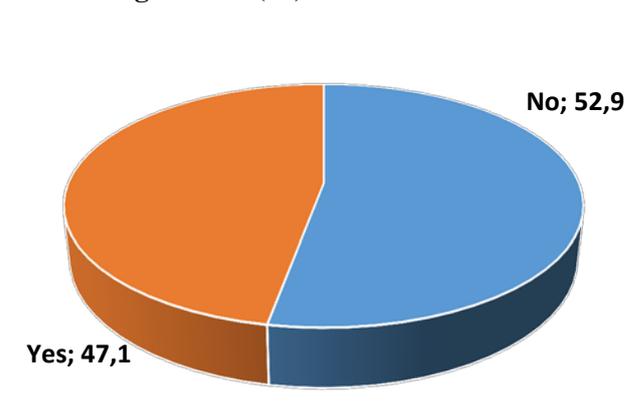


Fig. 5 – Do you have an international peer-review system for selecting user projects and attributing access? (%)



When asked to indicate the main measures that could be taken to support the scientific excellence of RI, respondents put as their first priority (19.4%) the setting of an international peer-review system.

Stable and adequate funding and commitments (14.2%) is also mentioned to keep the RI at the forefront of scientific excellence (Fig. 6). This is considered important for maintaining EU leadership and competitiveness in research as expressed hereunder:

“Provide a long time financing at the European/international level, avoiding fluctuations of national science policies. Use international evaluation, with important role of non-European evaluators. European/international coordination/supervision of the projects from the very beginning”

[Research Performing Organisation]

Other elements such as attractiveness of the RI which were mentioned by respondents will be further described under the following sections of this Report.

Networking of RI is recognised as another driver for excellence allowing to overcome scientific ‘silos’ in an interdisciplinary manner and providing the opportunity to address complex problems and societal challenges, as illustrated in the following excerpt:

“RI should build a strategic plan, how they collaborate with other RI for future benefits. They are at the forefront to find new societal ways to deal with societal challenges”

[Public research organisation]

Fig. 6 – Measures to support the scientific excellence of European RI (%)¹

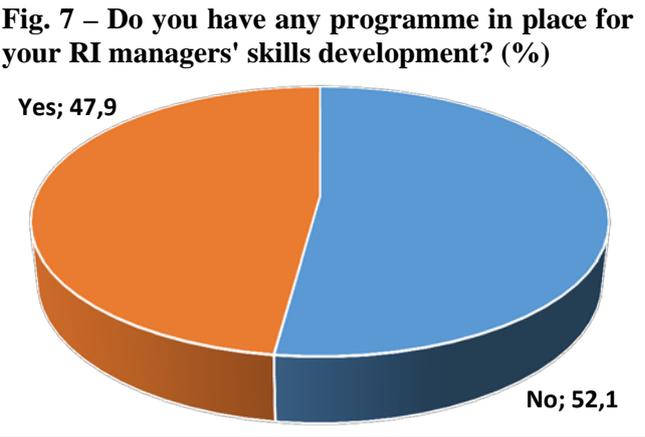


¹ The graphs in this report list only the items extracted as trends from the responses.

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

3.2. Managing tomorrow's RI

This section focuses on the respondents' perception of the need for the development of RI managers and users' skills and the relative measures and programmes in place to strengthen the human capital of RI, to stimulate their efficient management and to promote their development and competitiveness at national, European and international level.



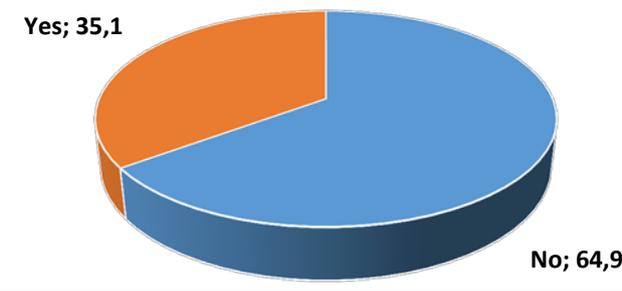
Although it is recognised that the successful management and leadership of RI requires a complex collection of competencies, less than half of the RI operators have a programme in place for managers' skills development (47.9%). Almost half of the RI operators having such a programme operate in the Biological and Medical sciences.

Fig. 8 – Measures to support skills development of European RI managers (%)



Staff mobility and exchange programmes to promote knowledge and experience sharing (12.2%), a dedicated professional training to acquire the required managerial and leadership skills (10.0%), dissemination and lesson learned initiatives (7.5%) are recognised as the main measures that could be taken to support skills development of European RI managers. Respondents also raise the issue of continuous funding of European RI managers' training programmes, such as the "Realising And Managing International Research Infrastructures" (RAMIRI) and "Research Infrastructure Training Programme" (RITrain) projects supported by EU Framework Programme grants (Fig. 8).

Fig. 9 – Is there a need for a harmonised accredited curriculum? (%)

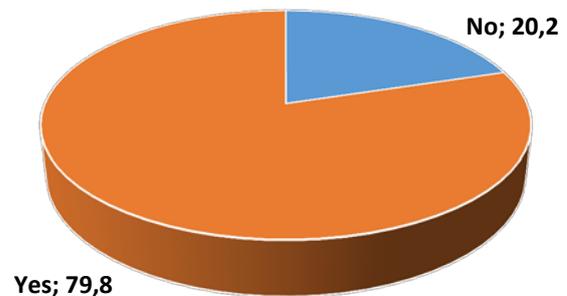


It should be noted that an harmonised and accredited curriculum is not seen as crucial by the majority of respondents (64.9%), regardless of their profile (Fig. 9). Apart from creating accredited careers paths, such a measure would also contribute to make RI appealing for top-skilled candidates and to improve the attractiveness of RI.

In line with the results showed in Fig. 10, the vast majority of respondents (79.8%) also recognised that a staff exchange programme targeting managers and operators of RI would most probably boost the attractiveness of working for of RI (Fig. 10).

Indeed, when asked to indicate the main measures that would increase the attractiveness of RI as employers, respondents identified these as mainly being related to improving working conditions (Fig. 11). These conditions vary from working contracts based on a long-term perspective (13.0%), to higher salaries (12.7%), promoting skills development and ensuring recognised career progression paths (8.4%).

Fig. 10 – Is there a need for a staff exchange programme targeting managers and operators of RI?



“The most important would be to have a viable career path for RI managers and employees, i.e. some type of tenure structure and possibility for advancement and long term perspectives. There is currently no such path, with RI employees often “falling in between the cracks” since they do not fit into the traditional basic research pathway”

[RI operator]

Fig. 11 – Measures which would increase the attractiveness of RI as employers (%)

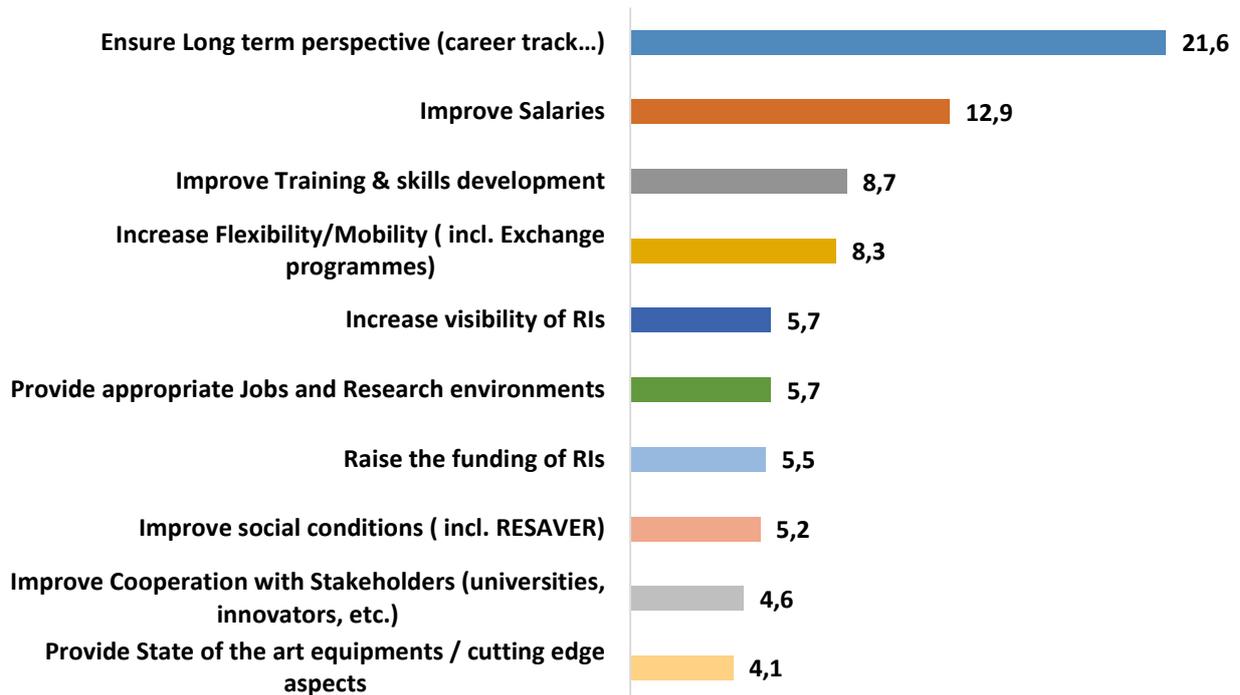
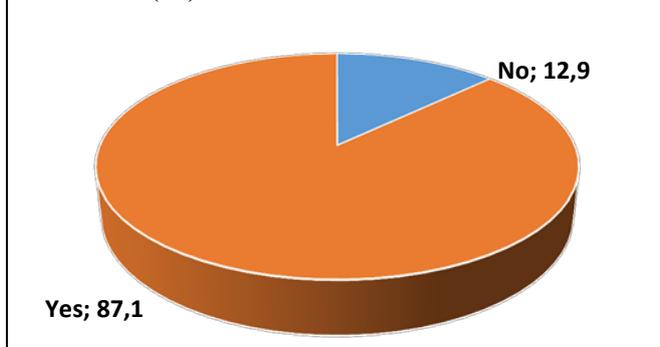


Fig. 12 – Do you offer specific training to your RI users? (%)



While training programmes for RI managers still appear not to be widely in place, a large majority of interviewed organisations declared to already offer specific training for RI users (87.1%), as shown in figure 12.

At the same time, the responses appeared to indicate that relations with potential industrial users can be further improved since more than half of them expressed the needs for a dedicated training programme for industry users (56.9%).

Fig. 13 – Is there a need for a dedicated training programme for industry users? (%)

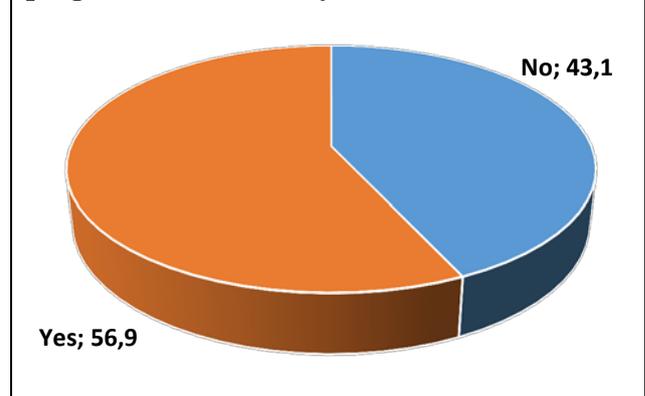
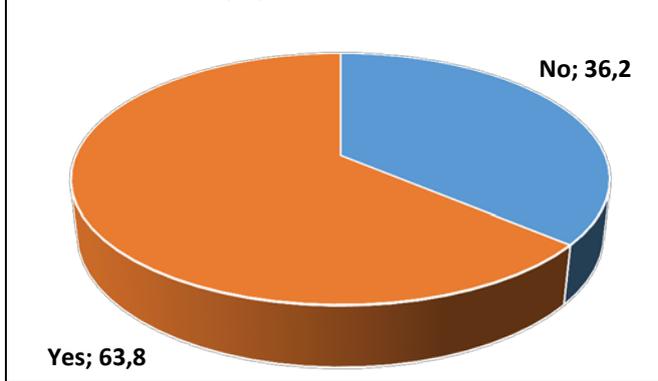


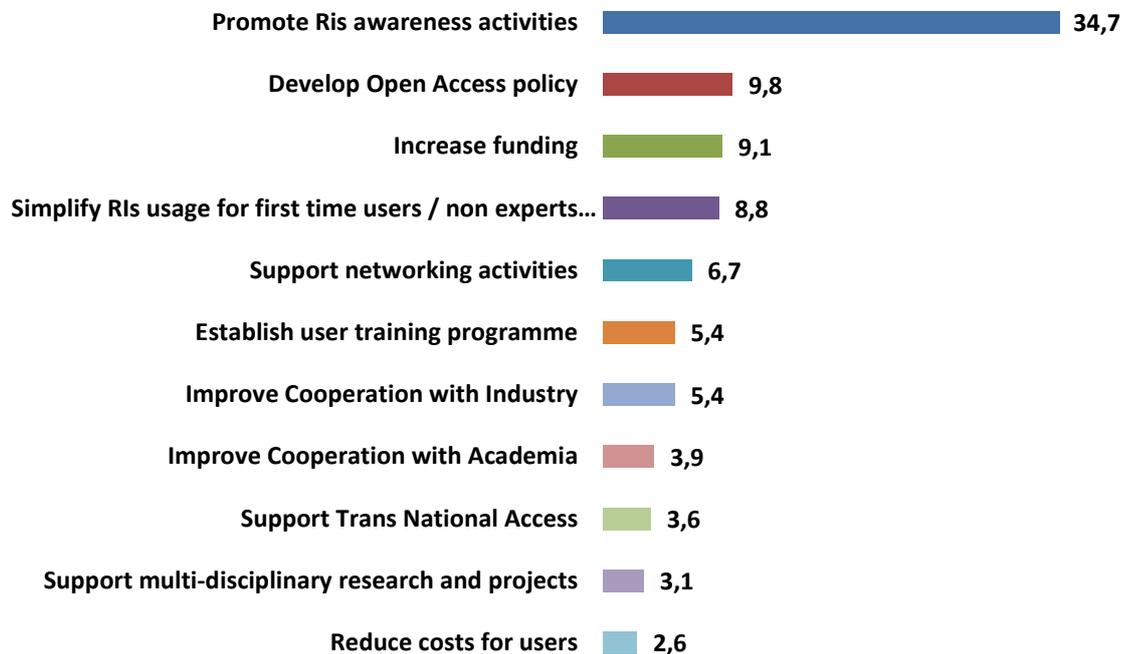
Fig. 14 – When applicable, should there be specific measures for promoting the use of RI for citizen science? (%)



Apart from recognizing the critical role of training for RI users, respondents also acknowledged the importance of specific measures for promoting the use of RI for citizen science (63.8% of respondents declare that such measures should be implemented).

In the context of the identified measures that could broaden the range of potential users of Research infrastructures, raising awareness of RI services and tools was identified as the most important action (34.7%) to be possibly implemented (Fig. 15). Other potentially effective measures which were put forward were the development of an open access policy (9.8%), the increase of funding (9.1%) and the implementation of measures to simplify RI usage for new users (8.8%).

Fig. 15 – Measures to broaden the range of RI users (%)



Summarising, the respondents acknowledged the need for developing managerial skills but did not associate this with the requirement for an harmonised accredited curricula. However, respondents highlighted the benefits of exchange programmes for managers between RIs. The development of RI user skills & outreach was acknowledged as a relevant measure and associated to the presence of specific training for RI users, including industry users.

A wide range of different measures for increasing RI attractiveness as employer were put forward - most of them linked to working conditions improvements.

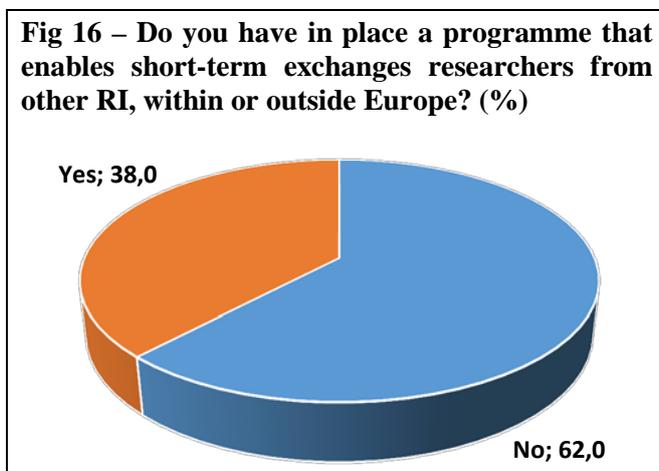
The most mentioned measure to make RI a feasible career option for high-qualified researchers was to ensure a long term perspective of work within RI.

3.3. Unlocking the innovation potential of RI

Section 3.3 of the questionnaire addressed the innovation potential of RI by investigating how cooperation between RIs and between RI and industry could be further fostered and by identifying the main barriers in this context.

A number of possible measures were identified as being potential leverages to increase innovative services. Among these a recurring theme was the need to ensure cross-disciplinary cooperation among RI.

Fig 16 – Do you have in place a programme that enables short-term exchanges researchers from other RI, within or outside Europe? (%)



When specifically asked, the respondents highlighted that for the time being exchange programmes of young researchers among RI are not necessarily widely conducted. Only 38% of them declare to have in place such programmes (Fig. 16).

When dealing with RI and industry relations, the industrial dimension is characterised as being either:

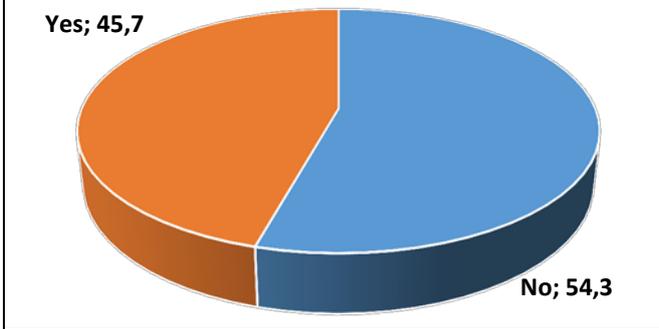
- Provider of equipment to the RI;
- RI User.

Whatever the relation, the level of interaction between RI and Industry currently appears to remain low. On average, findings show that 20.4% of the budget of RI is dedicated to industrial high tech components procurement and that 10.7% of the Access to RI is represented by industrial users (see tab. 3). These figures need however to be taken with a high degree of caution since standard deviations are higher than mean implying a strong variability among respondents' answers.

Tab. 3 – Industrial cooperation (descriptive statistics)

	Mean
Percentage of annual budget spent on procurement for the supply of high-tech components	20,4
Percentage of Industry users	10,7

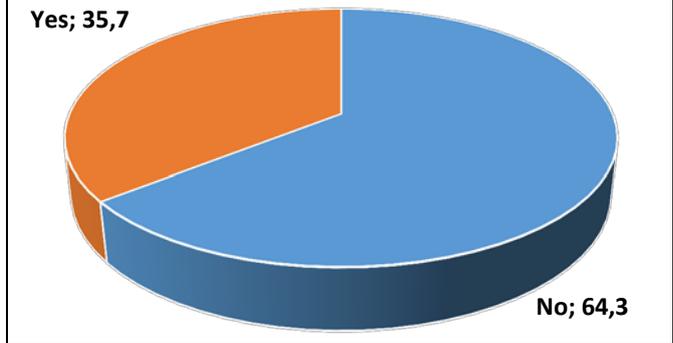
Fig. 17 – Do you have a business model that includes the development of commercial applications of RI services and tools? (%)



At the same time, only around half the RI (45%) declare having developed a business model that would specifically address the development of commercial applications of services and tools potentially deriving from the research activities conducted within the RI (Fig. 17).

The majority of respondents (64.3%) also declared not having in place an Innovation Advisory Committee meaning a dedicated organisational element that would allow to better reach out to industry and to the public sector needs (Fig. 18).

Fig. 18 – Do you have an Innovation Advisory Committee with representatives from industry and public sector? (%)



Respondents were asked to indicate the three main barriers that in their view prevented effective cooperation between RI and industry (Fig. 19). The majority (24.4%) identified a perceived disconnection between Research and market needs as the main barrier.

According to some respondents, cooperation is also hampered in function of different goals and expectations between industrial users and Research Infrastructures' (9.4%) and of administrative, legal and fiscal burdens connected to working with Research infrastructures (6.4%). Significant differences between the research community and industry are highlighted in the words of the following respondents:

"(...) industry has the Focus to make Profit."

[Public research organisation]

"We speak completely different languages (e.g. the meaning of concepts like "short term" are dramatically different"

[RI operator – private]

"(...) science gains by opening, innovation by industry can only be closed, for obvious survival reasons. This contradiction cannot be resolved in a standard collaboration"

[International organisation]

The lack of an appropriate information flow between the two dimensions is also clear in the following statements:

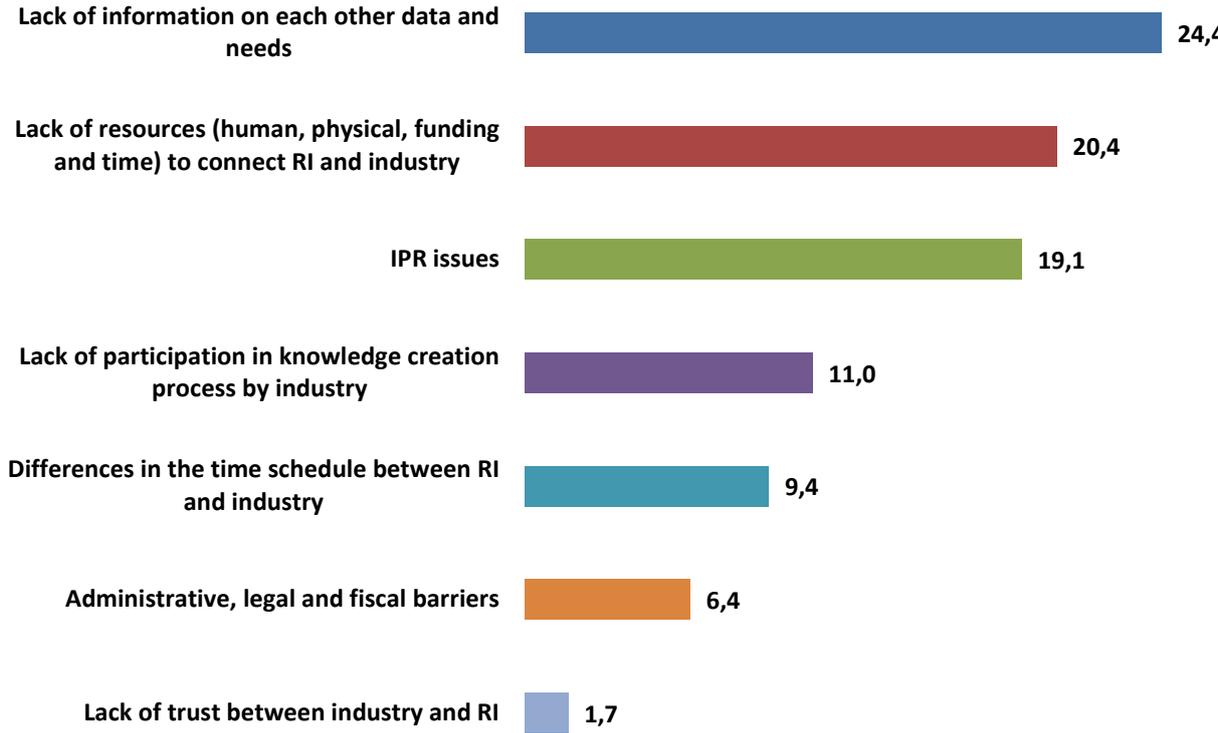
“Compartmentalization between industry and academic careers leads to a different language and objectives. This causes on one hand difficulties from academy to perceive industry needs, and difficulties for industry to understand the relevance of research not oriented to immediate commercial development”

[RI operator – private]

Other responses indicate that the Industrial dimension might not have yet sufficiently understood the potential benefits and the impact especially in terms of innovative solutions and products that could derive from appropriate collaboration with research infrastructures.

Many respondents (20.4%) also mention the lack of resources (human, financial and time) to liaise with industry. Also the lack of dedicated access regimes and rules is identified as a possible barrier to cooperation. RI operators also criticise the product oriented approach that industry has when interacting with them. Very few instances can demonstrate a true willingness to participate in a collaborative long term research effort based on a shared innovation strategy.

Fig. 19 – Barriers preventing effective cooperation between RI and industry (%)



Respondents were also asked to identify possible measures to be adopted to encourage the cooperation between RI, academia and industry in the context of open innovation (see Fig. 20). The trends that can be derived from such suggestions include new funding mechanisms, mediation schemes, dedicated access rules and human capacity building.

In the frame of possible new funding schemes to be adopted research performance organisations tended to identify public-private co-investment in a open-innovation process as the most interesting solution.

Other measures emerging from the consultation include:

“Subsidy incentive schemes that really favour the innovative industry”

[Public research organisation]

“Funded calls for open innovation”

[RI operator – public]

“Public Private Partnerships Vouchers”

[Multiple respondents]

“Additional resources/programmes for financing joint technology development between RI and industry”

[RI operator – public]

“Support funding of new start-up companies based on inventions”

[RI operator – public]

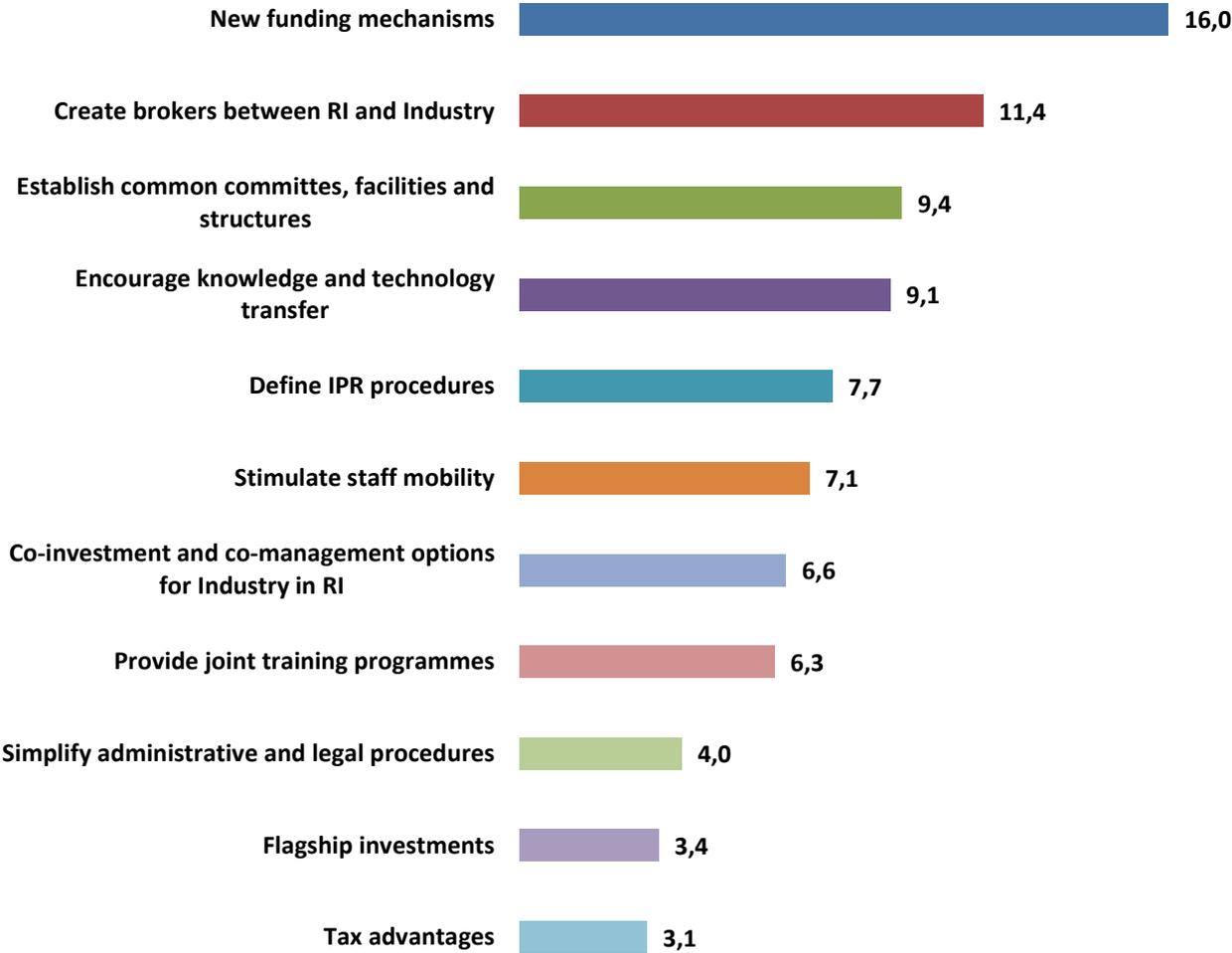
“Special funds addressed to industry in order to reduce the Risk of its participation in projects or joint research with RI and academia”

[Public research organisation]

The respondents suggested the need for dedicated mediation schemes which would refer mainly to measures to encourage knowledge and technology transfer though specific brokers or "relations with industry" organisational elements within the RI.

In terms of Access conditions that prevent ties with industry, these appear to mainly concern IPR regimes and procedures for accessing RI. Staff mobility and exchange programmes between RI and industry are identified as measures that could overcome the cultural barriers preventing cooperation.

Fig. 20 – Initiatives to encourage the cooperation of RI, academia and industry in the context of open innovation (%)

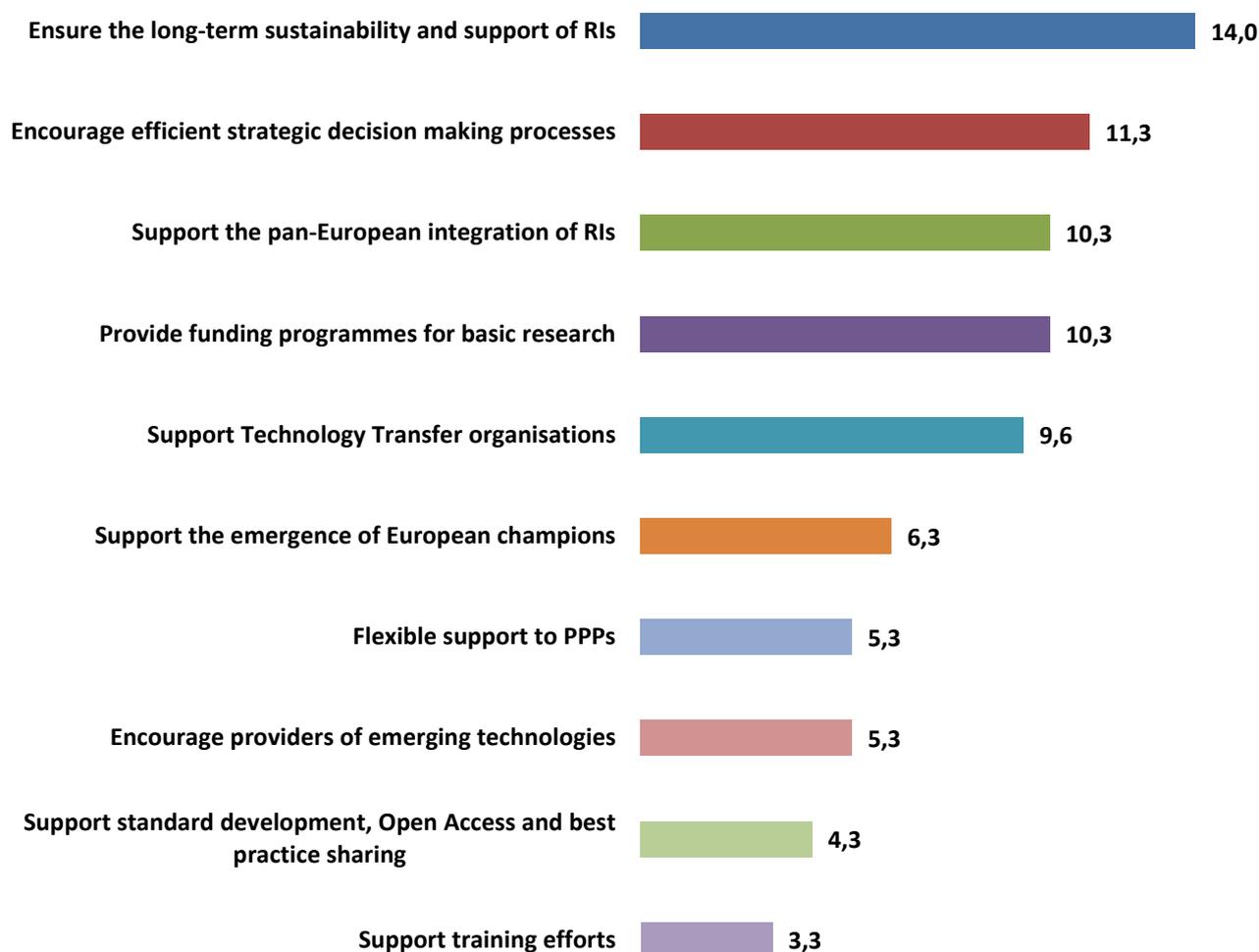


When asked to indicate the main measures that should be taken to ensure that Europe preserves a competitive advantage for the development of key technologies required for the RI, respondents attribute a clear role to the European Commission (Fig. 21) in this domain. In addition to providing funding, the European Commission should further promote the clustering of RI belonging to different domains and different countries, therefore avoiding unnecessary duplication of R&D efforts and develop fruitful collaboration among RI:

“Provision of R&D funds for new or extended technologies are required. Where possible the joint action of several RI should be enforced, but the specific needs and requirements have to be respected”

[International organisation]

Fig. 21 – Measures to ensure that Europe preserves a competitive advantage for the development of the key technologies required for the RI of tomorrow (%)



To summarise, the innovation potential of RI seems to be still widely untapped since both RI and Industry still do not fully perceive the benefits of collaboration. In general terms, this would require a change in the mind-set of all the communities involved in the innovation cycle (RI, Academia and Industry). Such cultural change should lead to increased cooperation among RI and between RI and industry. The responses highlighted a need to attract industry both as supplier and as a user of RI through more effective processes such as the open-innovation approach which would enable to maximise synergies between science and industry, address new markets, promote commercial application of science and facilitate commercial exploitation of research findings.

3.4. Measuring the socio-economic impact of RI

This section of the questionnaire focused on assessing the need of evaluating and monitoring the socio-economic impact of investments in Research Infrastructures.

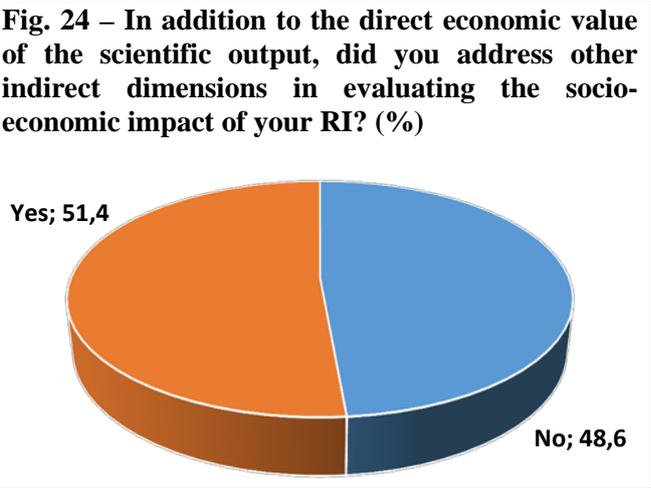
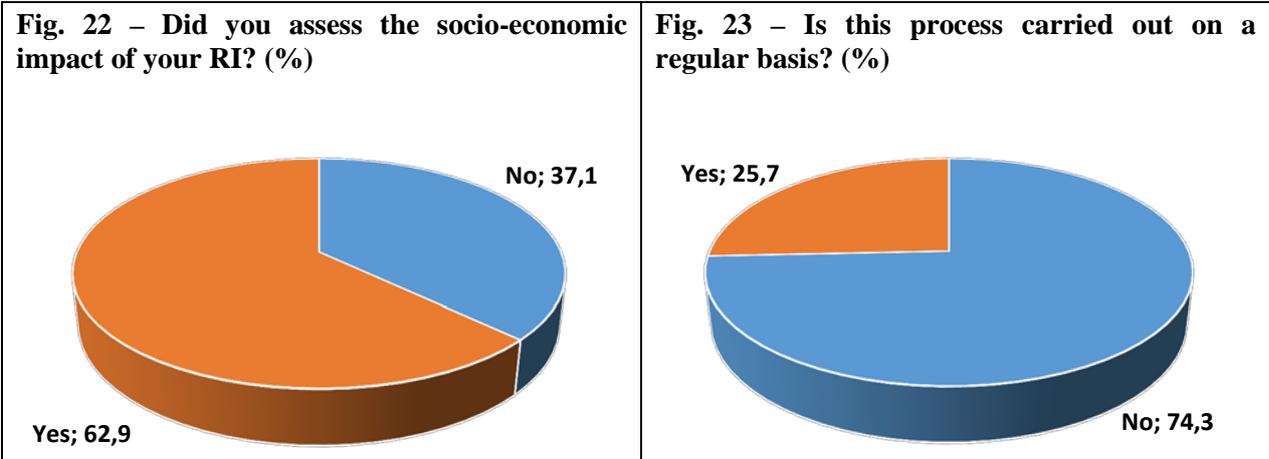
Since the construction and operation of RI is primarily funded from public sources, it is interesting to note how the socio-economic impact assessment is perceived as a relevant

dimension when the respondent is a funding organisation and a less critical issue when the response comes from a Research Infrastructure.

It is widely recognised that the possible return on investment is difficult to quantify and measure in conventional economic terms since it refers to a variety of benefits associated with science, economy and society development and would call for more elaborated assessment approach.

The consultation aimed at investigating the presence and frequency of socio-economic impact assessments within RI as well as the type of approach used to account for this impact as well as the direct and indirect dimensions considered in such approach.

As Fig. 22 and Fig. 23 demonstrate, although the majority of organisations (62.9%) declare to have assessed at some stage the socio-economic impact, it appears that assessments are not carried out on a regular basis throughout the life cycle of an RI (74.3%).

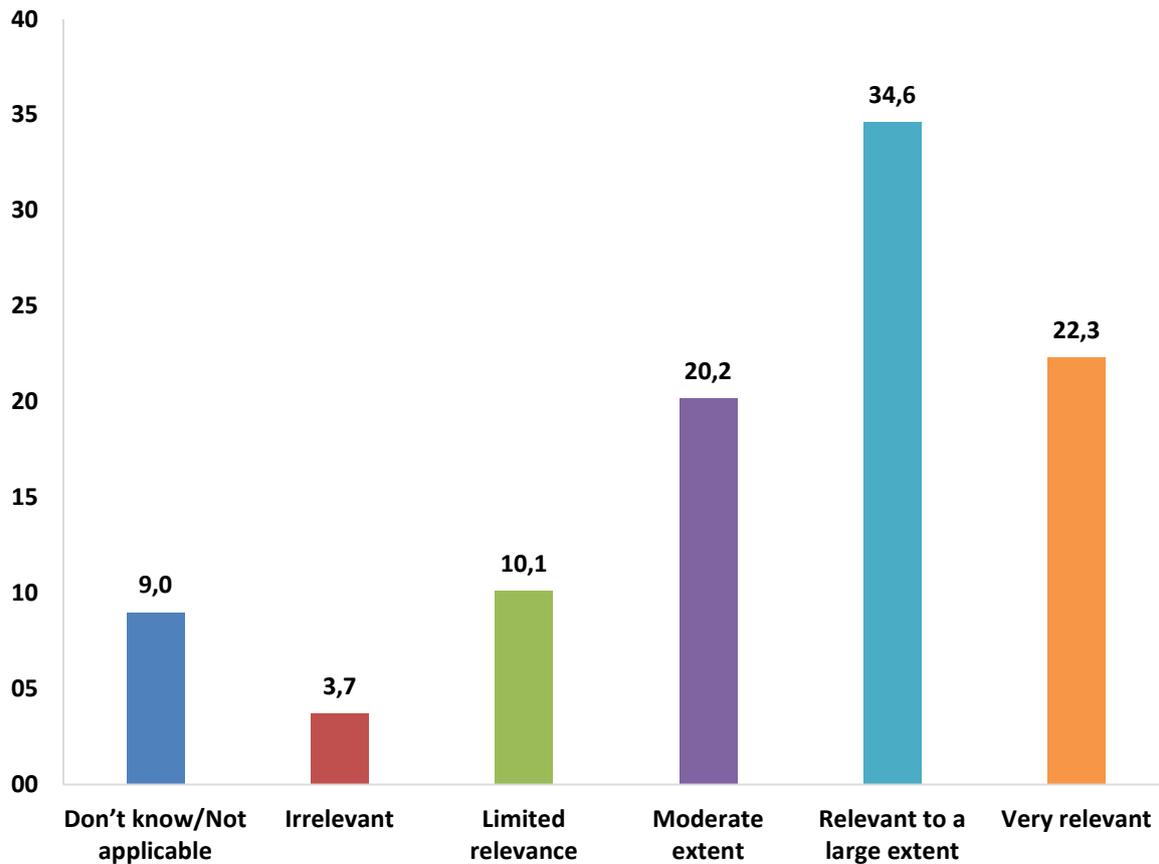


While it is widely recognised that there is no unified and “one-size fits all” framework for evaluating RI socio-economic impact, it is also accepted that any model describing this dimension should address both direct and indirect effects.

48.6% of respondents declared assessing exclusively the direct effects while 51.4% of respondents state they address both dimensions (Fig. 24).

This is an indication of the fact that indirect effects are still not fully taken into account and remain poorly understood in empirical terms. In fact, the majority of respondents (56.9%) recognise the potential value of indirect impacts by highlighting the need to develop a standardised model taking into account the intangible indirect benefits (Fig. 25).

Fig. 25 – How would you rate the need to develop a consolidated model to identify the socio-economic impact of RI that takes properly account of the intangible indirect benefits? (%)

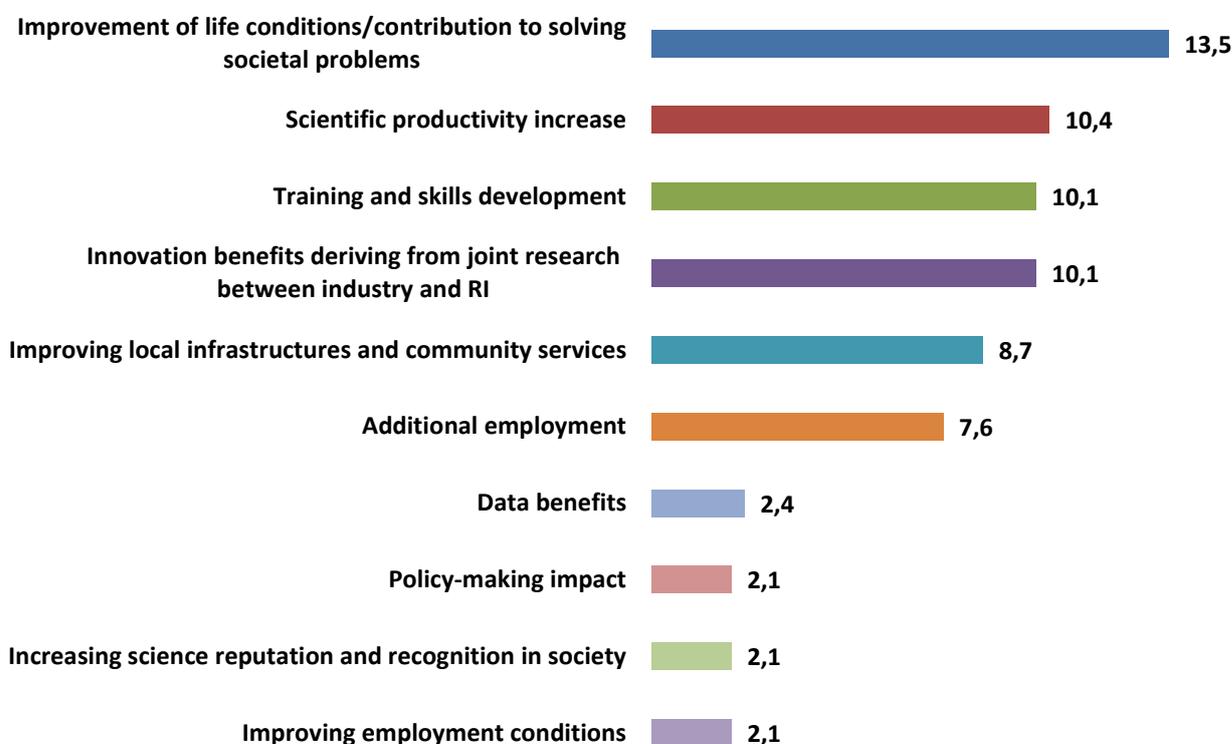


Respondents were also asked to map all socio-economic impacts. Five categories were identified and ordered according to their occurrence:

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

- **Innovation impacts.** These include the effects resulting from joint research collaborations between RI and industry potentially leading to different forms of innovation, such as spin-offs, licences or joint ventures (10.1%).

Fig. 26 – Elements to be included in a RI Socio-Economic impact assessment model (%)



The following excerpt sums up well the possible Socio-Economic impacts that potentially underlie the activities of an RI:

“(...) the improvement of citizen's health and productivity, the cost containment in healthcare systems, the development of innovation and of the health industry sector, the public investment in clinical trials projects, the public investment in clinical trials infrastructure, the public funding programme and evaluation process”

[RI operator]

Overall, the findings demonstrate the perceived relevance of direct and indirect, tangible and intangible benefits deriving from the use of RI services and instruments. This awareness has not yet resulted in a systematic assessment and evaluation of such impacts throughout the life cycle of RI. RI appear to need to overcome the difficulties in capturing multidimensional and complex impacts in a consolidated model.

3.5. Exploiting better the data generated by the RI

This section focused on investigating possible mechanisms and measures aimed at improving data management, better exploiting data and facilitating reuse of research data (Fig. 27).

The first measure emerging from the consultation is related to the responsibilities of the Research Infrastructures to establish adequate e-infrastructure for data storage, management and access.

“(...) data repositories are the key component to ensuring long term storage of data generated by publicly-funded projects. These data are an important product of public investments, and should be managed.”

[International organisation]

Interoperability and the need for harmonizing policies, rules and guidelines for data storage management and access then emerge as the enablers that would also require further attention:

“Create appropriate repositories, make repositories inter-operable (if applicable), make them accessible via portals, avoid duplication of efforts and access points”

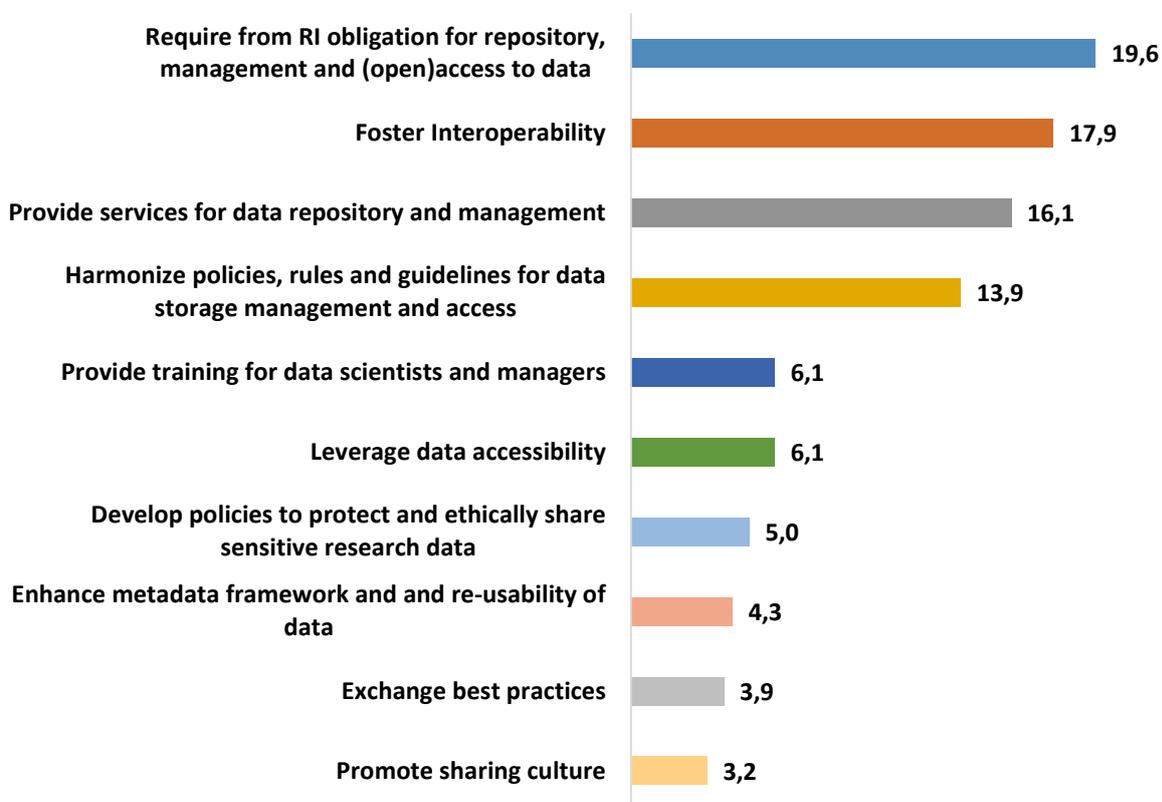
[Other type of organisations]

“Standardisation for data management: metadata, data format, using common vocabularies, procedures and services. Technical and semantic interoperability with other relevant data management systems and initiatives (...)”

[Public research organisation]

The training of data scientists and managers (6.1%) and the introduction of protocols ensuring sensitive and confidential research data is ethically shared (5.0%) are identified as additional possible measures that could help in solving the data exploitation challenge.

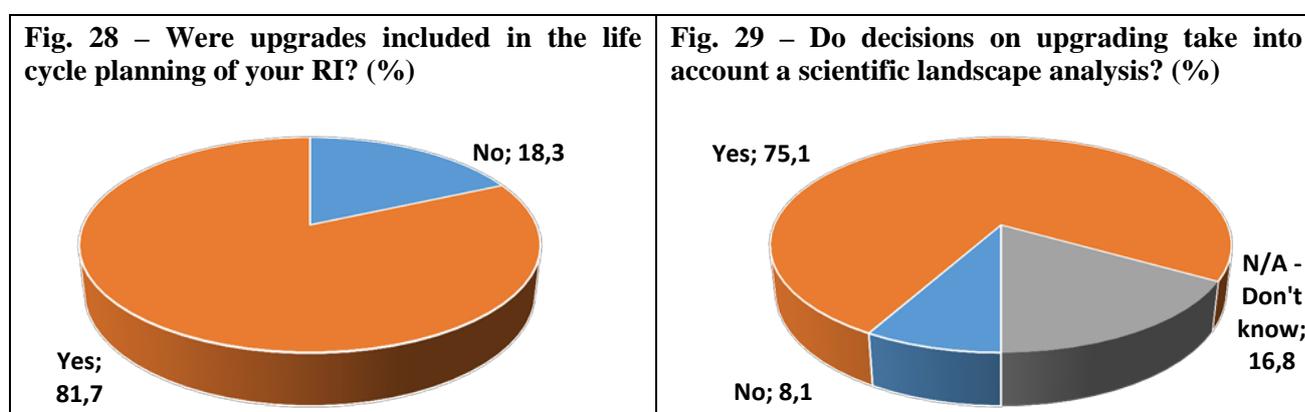
Fig. 27 – Measures to improve data management policies at national, European, International level (%)



Summarising, respondents highlighted the need for RI to take responsibility of the Data Management dimension with specific reference to the data storage, curation, access and re-usability aspects as the main measure to be further developed to ensure an efficient data ecosystem. In addition, the respondents also stressed the requirement for a more integrated and interoperable approach to the data challenge keeping into account, whenever necessary, the ethical, privacy, security and copyright and IP constraints.

3.6. RI Life cycle – Upgrading

Regular upgrades are a crucial part of the life cycle of the RI to allow it to stay at the forefront of scientific output. When requested to indicate if upgrades were included in their life cycle planning, the vast majority of respondents replied positively (Fig. 28). Cost-benefit and scientific landscaping analysis are widely considered in the upgrading decision process (Fig. 29)



“The necessity of upgrading is a natural consequence of the mere existence of a RI. To identify upgrading necessities we carry out regular consultations with user communities”

[Public research organisation]

In some cases, user consultations are complemented with the inputs from scientific advisory boards, panels of experts, other RI and industrial partners:

“Upgrading of the infrastructure (...) will be most importantly based on available facts and figures from the actual usage of the RI services and user feedback. In addition, any decision on upgrade will be taken based on close communication with the nodes, (...), researchers on their technology needs and expectations, (...) technology trends, (...) relevant industry (...) on latest instrument and prototype developments, advice from independent and internationally leading senior scientific and technical experts”

[RI operator – public]

Global benchmarking of peer and competitor infrastructures and scientific and technological gap analysis appears to be also used for decisions on upgrades:

“Any decision on upgrading and/or construction of a brand new research infrastructure should be based on a thorough research infrastructures landscape analysis keeping in mind not only the national, but also the macro-regional research infrastructures landscape”

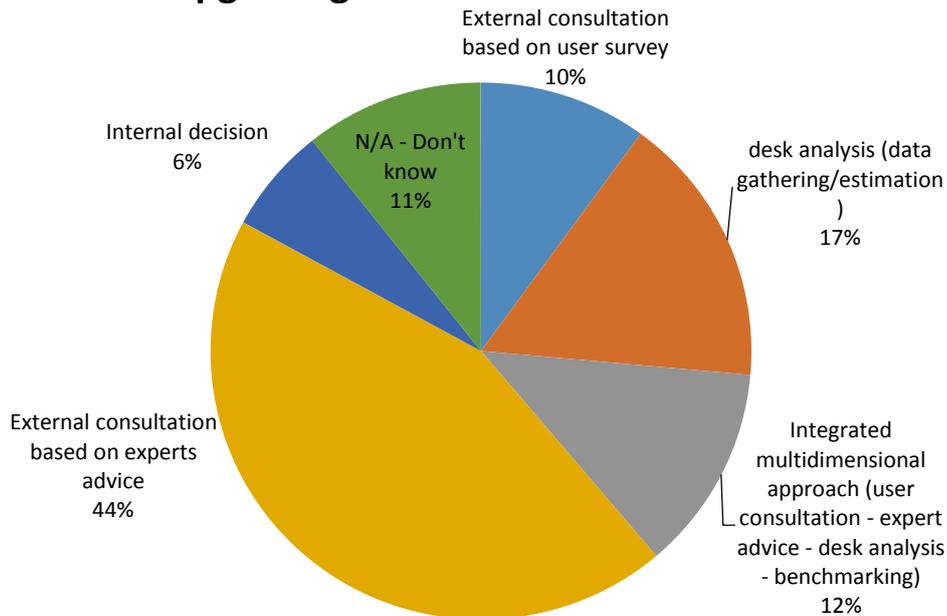
[National Government]

“In our vision the science landscape analysis is an essential part of the upgrade process. (...), we have to continuously monitor new technological options as well as new relevant user groups. We see this as a continuous process.”

[Public research organisation]

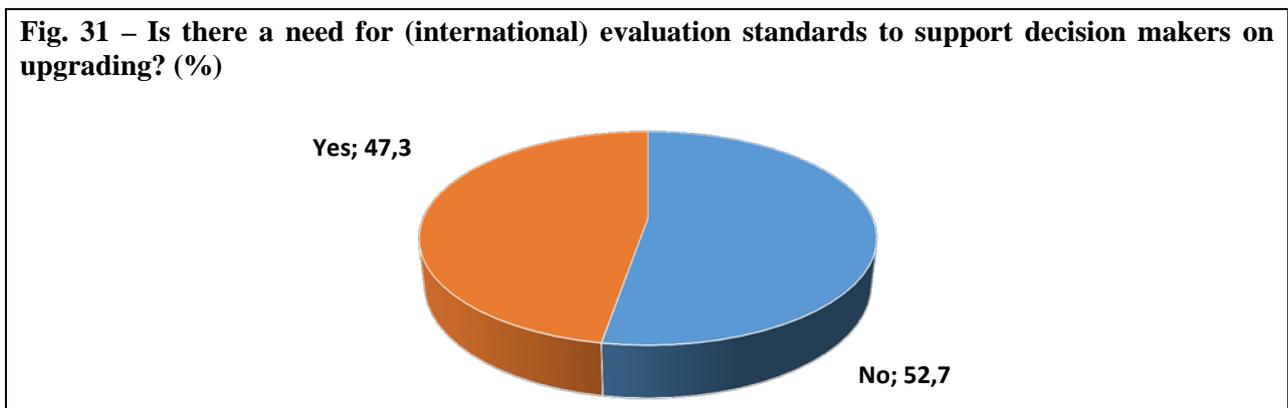
Fig. 30 – Do decisions on upgrading take into account a scientific landscape analysis? If so, please specify at which level it is conducted (%)

Decision on upgrading



The majority of the respondents (52.7%) declared not seeing a need for (international) evaluation standards to support decision makers on upgrading (Fig. 31).

Fig. 31 – Is there a need for (international) evaluation standards to support decision makers on upgrading? (%)

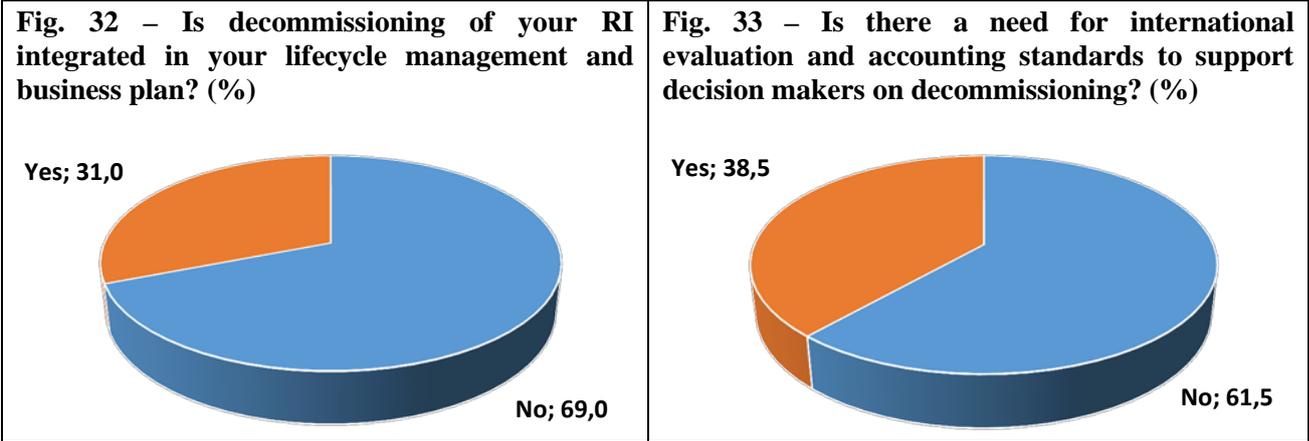


In summary, the responses demonstrate that RI consider upgrading as a normal phase in their life-cycle management processes. This is mostly based on a landscape analysis which is then based on a multi-level approach taking into account inputs from several stakeholders such as

users, scientific advisory boards, industry and funders. At the same time most RI do not consider international evaluation standards to be needed.

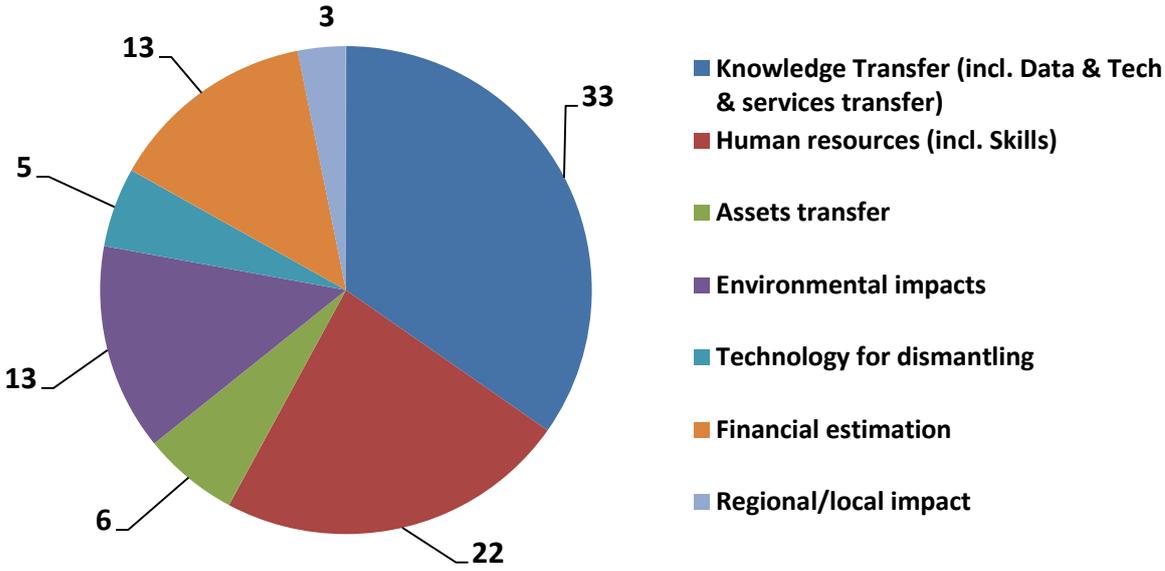
3.7. RI Life cycle – Decommissioning

Differently from upgrading, decommissioning is often not integrated in the RI lifecycle management and business plan (Fig. 32). In line with this finding, international evaluation and accounting standards to support decision makers on decommissioning is also not perceived as relevant by the majority of respondents (Fig. 33).



Among the respondents that have addressed the decommissioning section of the questionnaire, it appears that channelling of knowledge and Human Resources are the two dimensions that require particular consideration. Besides costs, environmental and local impacts are also dimensions that have been also put forward in this context (Fig. 34).

Fig. 34 - Dimensions to be considered in RI decommissioning (number of recurrences)



The following statements illustrate the multidimensional nature of decommissioning:

"The nature of the RI will have a significant effect on the selection of an appropriate decommissioning strategy. In this case, decommissioning dimensions should cover: Financial requirements (cost estimation and funding); Human resources; Environmental issues (waste management: recycle and reuse of material; reuse of sites); Health and safety; Stakeholder Risks; Information record; Technology for dismantling and other decommissioning operations; Decommissioning contractor organisations; Agreement of the involved parties."

[Public Research Organisation]

"All the aspects related to winding up - staff, equipment, ownership, IPRs, finances, liability, governance and management during the winding up. In addition, the decommissioning plan should include the process, steps and timelines for winding up. Common guidelines for decommissioning and for exchange of experiences are highly recommended efforts that EC should support."

[Other]

3.8. Ensuring sustainable governance of RI

This section of the questionnaire investigated governance mechanisms, decision-making and planning processes to support RI sustainability. In this context, respondents were asked how to address the lack of national roadmaps synchronisation with corresponding budgetary commitments for the implementation and operation of RI.

The European Commission is identified by the respondents as the entity that would need to have the main role in monitoring, coordinating common actions and synchronising the different dimensions (22.6%):

"Synchronisation of national roadmaps has a key role in optimizing investments for the implementation and operation of Pan-European RI. This aspect must be addressed at EU political level"

[RI operator – public]

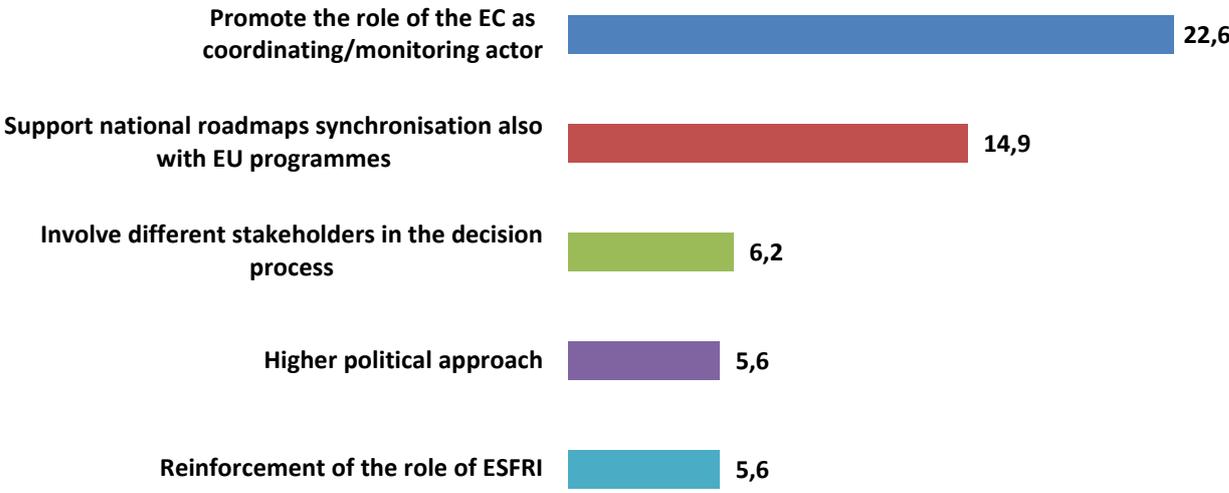
"The lack of national roadmaps synchronisation can be addressed through a stronger role of the EC, inviting national research authorities to set up and harmonize their actions"

[Public research organisation]

The responses highlighted in parallel a possible need to:

- Reinforce the role and prominence of ESFRI;
- Align the process related to roadmapping at national and European level;
- Finance national roadmap synchronisation through dedicated EU programmes.

Fig. 34 – How could the lack of national roadmaps synchronisation with corresponding budgetary commitments for the implementation and operation of RI be addressed?



As the next figure shows, the analysis of the responses indicates a general understanding that monitoring should be carried out on a regular basis. Particular emphasis was put on the requirement for the use of Key Performance Indicators as well as on the establishment of independent and international expert panels in the monitoring process (Fig. 35). To be also noted how a number of respondents does not see the need for the setting up of a monitoring mechanism.

Fig. 35 – Measures to reinforce the monitoring of the implementation and operation of ESFRI projects, ERICs or other RI?



When asked to indicate if and how the ERIC instrument could be further developed (Fig. 36), most responses indicated that the current version of the ERIC framework itself needs to be still fully stress-tested before looking into any possible future evolution. :

“the ERIC instrument is still in infancy. We need more time to take significant conclusions about efficiency and impact on RI-sustainability”

[Other type of organisations]

“Before developing further the ERIC instrument, we need to see how it works and to gain experience”

[Other type of organisations]

Some responses highlighted the need for simplifying its implementation process and harmonising rules among Member States making the ERIC legal framework independent from local financial regulations such as the VAT exemption:

“Implementing an ERIC would be facilitated if the ERIC status could be known in the law of the different nations that can host an ERIC especially for the VAT exemption issues”

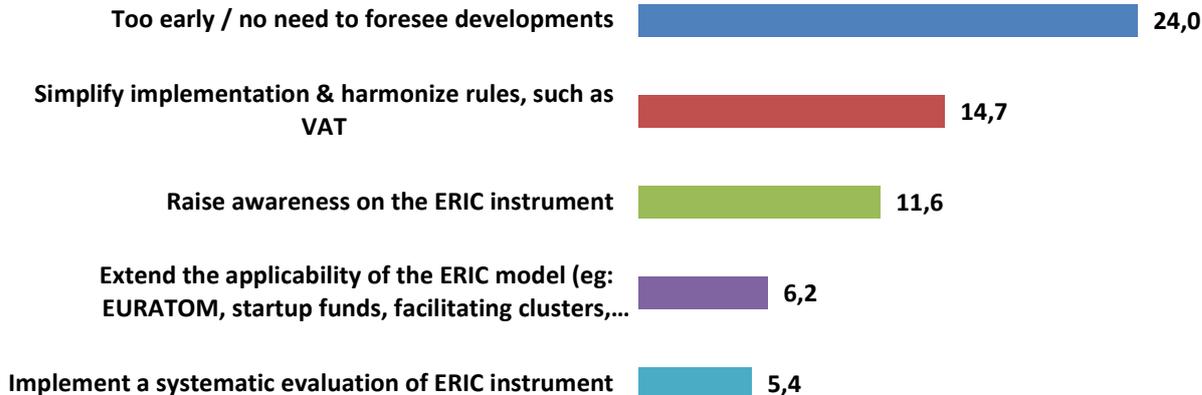
[International organisation]

Other respondents expressed a requirement to extend its applicability to a number of different domains such as EURATOM and research networks and, in addition, to have the ERIC framework better reflecting other regulatory aspects such as international staff mobility:

“Strengthen the ‘enforcement’ of the regulation and recognition of ERICs in national and regional governments; Continue to try to develop the ‘mobility’ aspects for staff as ‘international staff’ have all the issues related to relocating to another country”

[International organisation]

Fig. 36 – How would you see further developments of the ERIC instrument?



Summarising, to optimise the process related to RI development in the EU, the outcomes of the consultation highlight a requirement to establish better synergies among national roadmaps and to have these synchronised with the financial planning processes. The national processes would need to be aligned into a harmonised European picture, reason for which the European

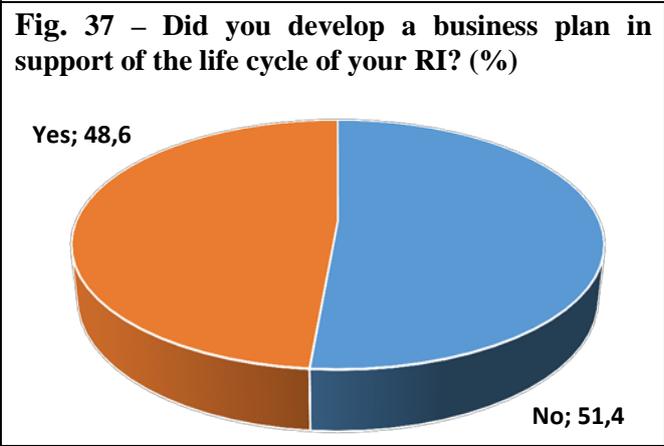
Commission should take responsibility for monitoring, supporting and facilitating the whole exercise.

For the ERIC, as it is still a relatively new legal instrument, there appears to be a general view not to propose immediate changes as much as to continue overseeing its implementation. At the same time, the respondents proposed a number of areas for further development of the instrument such as extension of the ERIC applicability to EURATOM, to international consortia and to research networks.

3.9. Funding the construction and operation of RI

This section of the consultation focused on the types of funding instruments available to RI for their construction and operation and on their current approach to bankability.

Fig. 37 – Did you develop a business plan in support of the life cycle of your RI? (%)



While the development of a business model is defined as a critical tool to facilitate the funding for construction and operation of an RI, more than half of the RI declare not having developed or regular updated a business plan in support of their entire life cycle (Fig. 37).

However, the development of a credible business plan is recognised as imperative when respondents are asked which measures could improve the bankability of RI (Fig. 38):

“Bankability and risk minimisation should all be considered before monies are made available for an RI. Therefore the main measure should be improved and increased robustness in the business plan and in the decision making based on the plan. Too often, this is a political decision and political concerns are not included in the business planning step, or at least not formally”

[Research funding organisation]

In addition, the requirement for synergies between public national and European funding is recognised as a priority. The following statements provide an interesting insight on the appropriateness for financial schemes such as EFSI and the RSFF to adequately support RI cash flows.

“the EC thinks that the budget shortage difficulties, met by governments for RI construction, can be overcome with banking instrument, while the solution should better be harmonisation between EU research/structural funds”

[Other type of organisations]

Together with a business plan and a harmonization of different types of funding, respondents propose new funding instruments such as private funding:

“EFSI does not seem to be really adapted to the funding of RI, as it is too focused on capital-risk investment, with very significant involvement of the private sector. Our experience is that industry usually only brings a very limited fraction of the funding and resources of RI (a few percent or less), preferring to invest in dedicated market-based facilities or its own labs (...)”

The main problem is the lack of ambition and adequate funding in R&D activities for most European Countries”

[Research funding organisation]

Besides the development of business plans, respondents were asked to identify measures to improve RI bankability. The diversity of responses appeared to indicate a lack of common understanding of the term "bankability". The proposed measures identified by the respondents included:

- The development of a sound business model;
- The encouragement of new sources of funding, including private funding;
- The better channelling of public funding/ structural funds;
- A stronger cooperation with industry.

Fig. 38 – Measures that could improve the bankability of RI (%)

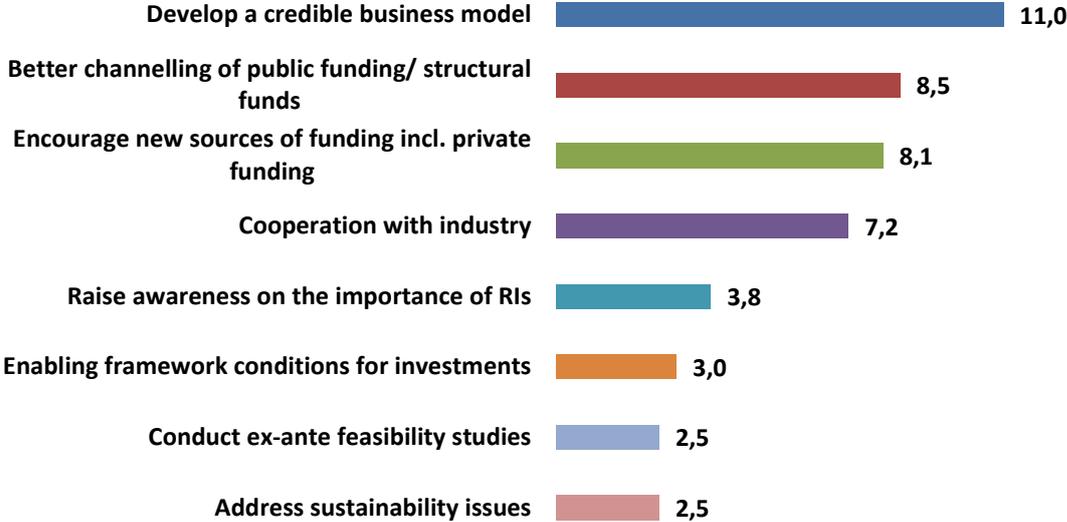
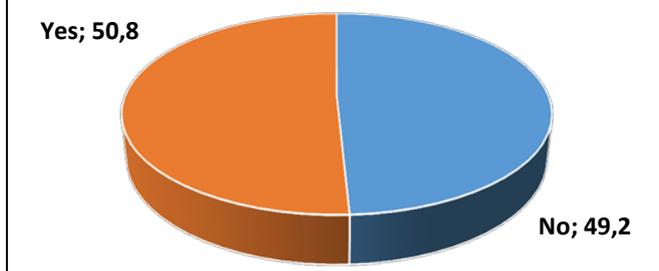


Fig. 39 – Would you consider investing in the joint development of commercial technologies and services with other RI, industry and academia? (%)



When dealing with the possible development of Public-Private Partnerships, more than half of the respondents positively considered the possibility of investing in the cooperation with other RI, industry or academia for the joint development of commercial technologies and services (Fig 39)

However, only 36% of the responses indicate the usefulness of joint investment by public and private bodies (Fig. 40). In setting up new start-ups,

“(...) private investors could share equity in the new company to be established. Public sources could mitigate risks to facilitate exploitation by involving the industry at early stages of the development”

[RI operator – private]

Private funding could be incentivised by tax exemption and other benefits as emphasised in the following examples:

“Tax-related investment schemes, especially as regards to ERICs if the overall tax status of ERICs can get anchored; for example, private sector could ‘invest’ in co-development with ERICs and receive a tax-credit in exchange; Technological and scientific ‘challenges’ can be very cost effective and promote competition”

[International organisation]

“Private funding could for example be encouraged through tax benefits. For instance the "Crédit Impôt Recherche" tax credit for expenditure relating to scientific and technical research activities carried out in France is a very effective mechanism for fostering innovation”

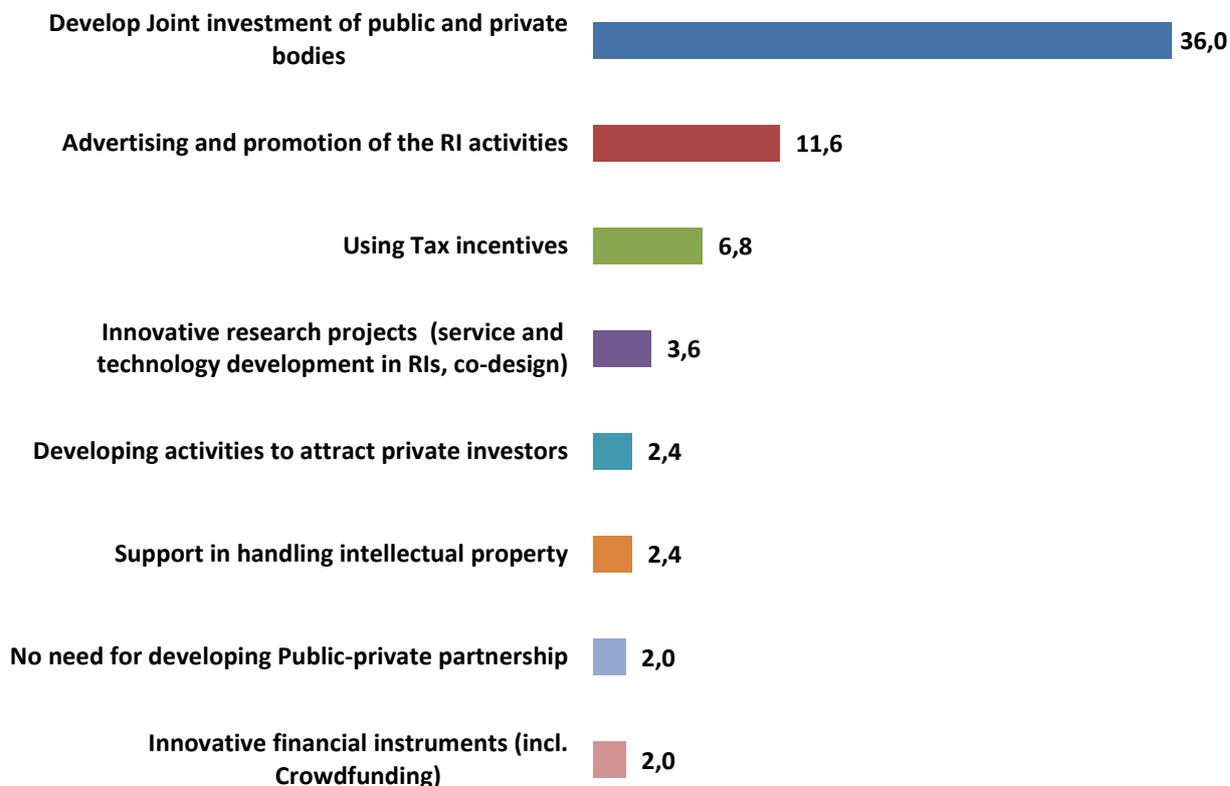
[RI operator – public]

The lack of visibility on RI activities and of their intrinsic value is identified as a barrier to potential private funding that could be overcome by better promoting RI services and activities:

“Private funding can be encouraged by demonstrating that to work with RI and research centers represent added value to all their activities”

[Public research organisation]

Fig. 40 – Measures to encourage private funding for the development of commercial technologies and services (%)



Overall, the promotion of the development of a business model, the encouragement of industrial investment for the joint development of products and services as well as the fostering of new sources of funding would need to be further stimulated. Among the possible measures identified to overcome such situation are possible tax incentives for private investment as well as widely promoting RI services.

3.10. Structuring the international dimension of RI

The nature and complexity of the societal challenges require a global approach for the design and operation of RI. International cooperation is also highly strategic when pooling of resources is necessary for construction and operation of RI and in order to achieve scientific excellence. Moreover, international cooperation is a tool to support or complement the EU external policy and contribute to Science Diplomacy.

Fig. 41 – Measures to support the international outreach and visibility of pan-European RI (%)



When asked to identify measures that could better promote the international outreach and visibility of pan-European RI (Fig. 41), the main recurring theme seems to be connected to the improvement of the communication strategies and networking events. Going more in detail, some responses highlighted the requirement to enhance cooperation with strategic partners and stakeholders (17.3%):

“[...]create a world scale RI roadmap; exchange and coordination of research science visions between countries and agencies; regular informal meetings of science financing agencies from EU, US, Japan, Russia, China, India, Brazil, [...]”

[International organisation]

“The establishment of global wide collaboration within the community in order to increase the development and use of RI with international partners/communities beyond Europe, ensuring scientific and technological excellence of European RI”

[Public research organisation]

Other suggested measures mentioned better promoting dissemination and communication actions (15.4%) and increasing the number of International outreach events by organizing workshops, seminars and conferences (11.3%).

The urge for an effective communication strategy is well expressed by the words of this respondent:

“Adopt a communication strategy that, beyond outreach, education and training activities, involves also: - a public debate as a basis to integrate societal needs, ideas and expectations in the definition of research programs, and - a dialogue between research and

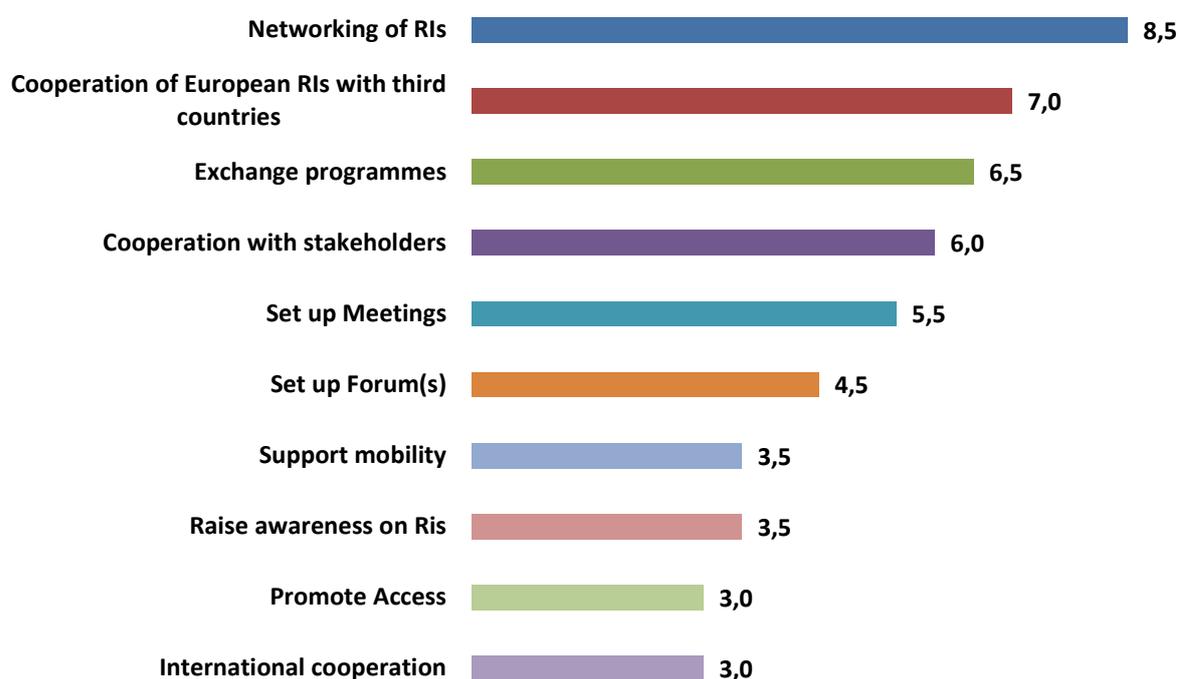
innovation actors (for instance by organising workshops between scientists and companies' representatives”

[Public research organisation]

Dedicated funding to ESFRI projects and ERICs is once again recognised as another relevant measure to support the international outreach and visibility of pan-European RI (13.8%).

Respondents were also asked to specify what additional measures could be considered in order to enhance cooperation with strategic partners on the development of global Research Infrastructures (Fig. 43).

Fig. 42 – Additional measures to enhance cooperation with strategic partners



According to the respondents, RI networking (8.5%), cooperation of European RI with third countries (7.0%) and exchange programmes (6.5%) should be also further promoted in this context.

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

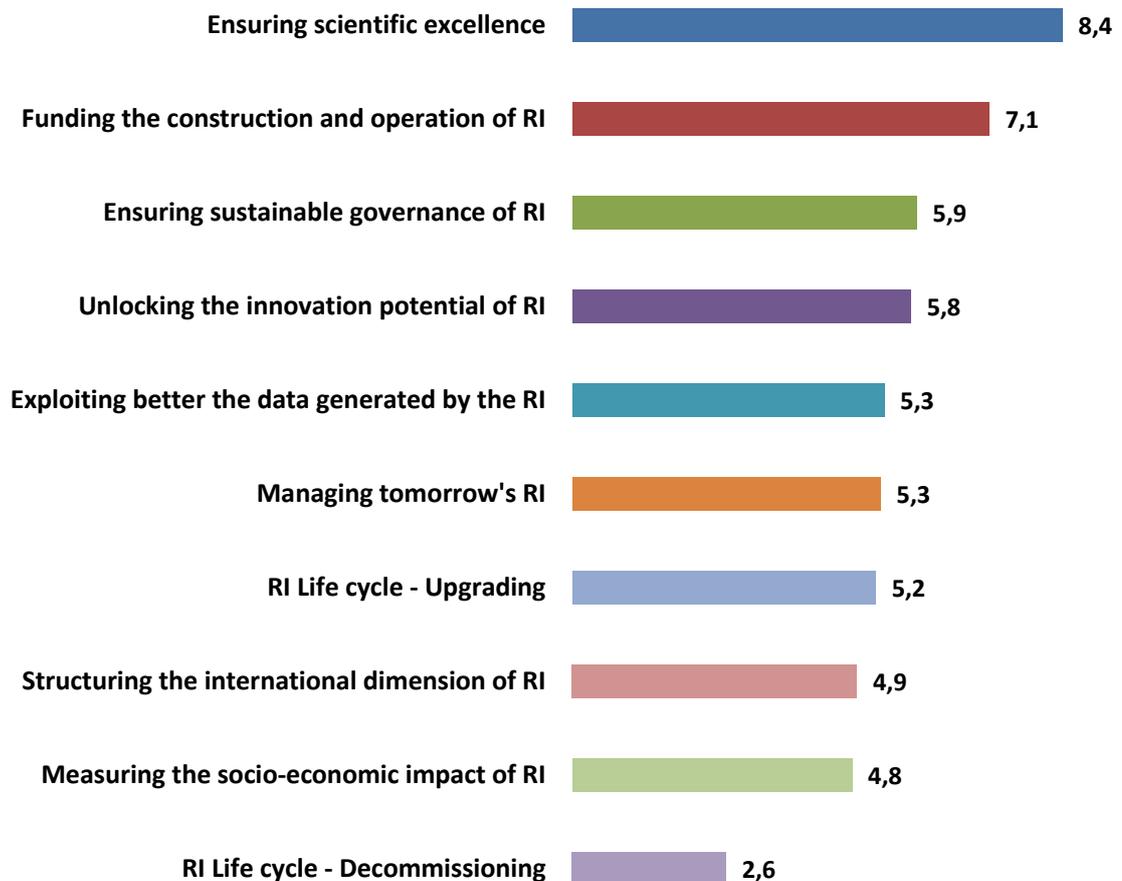
3.11. Priority order of the pre-conditions

The last section of the questionnaire was dedicated to establishing an overall ranking of the 10 pre-conditions for long term sustainability as addressed by the consultation.

Respondents were thus asked to rank the pre-conditions from 1 to 10, with 1 meaning the “least relevant” and 10-the “most relevant”.

The next figure represents the priority order of the pre-conditions, according to the mean values of the scores given by respondents to each variable (Fig. 44).

Fig. 44 – Ranking of the pre-conditions for sustainability (mean values)



The ranking highlights how “Ensuring scientific excellence” (8.4) is well ahead of “Funding the construction and operation of RI” (7.1), of “Ensuring sustainable governance of RI” (5.9) and of “Unlocking the innovation potential of RI” (5.8). The less relevant pre-condition according to interviewees is by far the “RI Life cycle decommissioning” (2.6).

It is to be noted how the ranking of the pre-conditions varies in some cases significantly according to the respondents’ profile. As such, the RI operators do not rank the measuring socio-economic impact as high as funders that rank it as the third most relevant pre-condition.

Another significant difference occurs when analysing “Ensuring sustainable governance of RI” by type of organisation: RI operators ranked this preconditions higher than research performing organisations (6.2 vs 4.9) thus indicating a potential disconnect between the users and the operators.

Summing up, while there is a general and clear agreement over the relevance of pre-conditions as “Ensuring scientific excellence” and “Funding the construction and operation of RI”, other pre-conditions tend to rank closely one to the other. Only the “RI Life cycle decommissioning” pre-condition ranks significantly lower.

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In December 2015 the European Commission launched a targeted consultation on the long-term sustainability of pan-European Research Infrastructures. The purpose of this consultation was to identify trends and possible corresponding actions that could be implemented at regional, national and European level, to strengthen the long-term sustainability of Research Infrastructures.

The results of the consultation are presented in this report and highlight the need to strengthen the involvement of industry to develop credible business models as well as efficient governance models to develop research infrastructures. It is also necessary to look into the different existing funding schemes both to ensure appropriate synergies and to explore possible new solutions.

Studies and reports

