



Background Report

Review of the RTDI policy in Greece, in order to further support and upgrade the National Research Infrastructures

Horizon Europe Policy Support Facility



Research and
Innovation

EUROPEAN COMMISSION

Background Report

**Review of the RTDI policy in Greece,
in order to further support and upgrade
the National Research Infrastructures**

Hellenic Ministry of Development and Investments General Secretariat for
Research and Innovation

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2022EN

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Executive Summary

The 4th Industrial Revolution, the 'Big Societal Challenges' and 'Internationalization' are the main factors that shape the international scene in research, technological development and innovation (RTDI) today. Addressing the Big Societal Challenges, such as healthy aging, clean energy, food security, zero poverty, scarcity of natural resources etc., requires a large-scale mobilization of research effort internationally. Development strategies should therefore include measures for smart education in the areas mostly affected by technological developments, as well as lifelong learning and training for existing human resources to prevent job loss. In this context, the mobility of scientists and researchers, networking and "brain circulation" are crucial to an inclusive growth model.

In Greece, the RTDI sector is still lagging behind the European average and the country remains trapped between low-cost and knowledge-intensive economies. In addition, Greece is characterized by large regional disparities both in terms of GDP and funding dedicated to research. However, Greece's performance in the European Innovation Scoreboard 2021 (EIS) has significantly improved between 2014 and 2021. Greece's strengths, with performances above the value of 100 corresponding to the EU average, lie in small and medium-sized enterprises (SMEs) that innovate (Innovators), interconnection and co-operation (Linkages) and employment (Employment impacts).

Public Sector Research in Greece is conducted mainly in Higher Education Institutes (HEIs) and Public Research Centres (RCs) and Technology Bodies (TBs). HEIs operate under the supervision of the Ministry of Education and Religious Affairs, while RCs and TBs operate under the supervision of the General Secretariat of Research and Innovation – GSRI. GSRI is a public service assigned with the task of defining as well as coordinating the implementation of the national policy for Research, Technological Development and Innovation. It supports the activities of research and industry bodies through competitive research programmes and supervises research and technology bodies which provide local communities with the skills necessary for producing knowledge and boosting innovation. GSRI actively follows EU and international developments in the field of RTDI and represents the country to the EU and International Organisations within its competence.

The 2014-2020 Programming Period consisted of one national and 13 regional RIS3 strategies, one for each of the country's 13 regions. R&D intensity at regional level is mostly due to the presence of active public research bodies such as universities or associated with the presence of a critical mass of companies in specific sectors. The national RIS3 Strategy constituted the main guidance for defining and promoting Research and Innovation Policy. It highlighted areas where Greece had already achieved, or could achieve, a competitive advantage. Priorities emerged as a result of the entrepreneurial discovery process aimed at

identifying new business opportunities to put into use newly-produced knowledge and integrate it into value chains. The RIS3 Priority Areas identified were:

- Agro-food sector
- Bioscience and Healthcare / Pharmaceuticals
- Information and Communication Technology (ICT)
- Energy
- Environment and Sustainable Development – Climate Change
- Transport and Logistics
- Materials – Manufacturing
- Cultural and Creative industries – Tourism

National Strategy for Smart Specialization 2014-20 channelled most of its financing into four main pillars:

- Pillar 1: Collaboration between Academia and Enterprises
- Pillar 2: Research Infrastructures
- Pillar 3: Financing of postdoctoral and doctoral students
- Pillar 4: Venture Capital –EquiFund

Pillar 2 revolved around the creation and strengthening of National Research Infrastructures (NRIs). This strategic choice was made since RIs have the capability of supporting high-level research activities in specific scientific fields, while strengthening the connection between research, education and innovation. They can attract talent and investment from both domestic and international companies and can provide critical infrastructure so as to reduce the risk of innovative business ideas as well as support in a more coordinated way broader policy objectives. They can also contribute to local and regional development through employment of scientific and technical staff and play a vital role in their training and developing high added value skills. At the same time, some of the National Research Infrastructures are interconnected with corresponding European ones in the context of international cooperation and promotion of excellence.

This initiative was based on the internationally recognized practices followed by most of the Member States of the European Union, while, at the same time, the formulation of a National Strategy and Multiannual Budgeting Plan for Research Infrastructures was a prerequisite condition (ex-ante conditionality) for their financing by the Structural Funds for the 2014-2020 Programming Period. It is important to emphasize that the multiannual NRIs support plan was not limited to building facilities and equipment, but includes human resources, know-how, information, networking and all the intangible elements required for their operation and full utilization.

Out of this initiative 28 NRIs were selected for funding after two rounds of calls for tenders. According to the available expenditure data the original financing plan was fully or almost fully implemented for most of the NRIs. It should be noted

that the latest available data were collected until 31/12/2021 and that some NRIs have been given an extension, until April 2022, in order to complete their work.

As the 2014-2020 Programming Period came to its completion and with the policies and details of the 2021-2027 Programming Period being currently developed, it is critical to assess the NRIs and to formulate a clear framework to further support and upgrade them within the next Programming Period. GSRI in its letter of 18 June 2021 outlined a number of key areas to be controlled and evaluated as part of the Horizon Europe Policy Support Facility (PSF) of the European Commission review exercise. The letter indicates that the PSF review should support the Greek authorities in implementing an in-depth study of a key element of the Greek research and innovation ecosystem, namely the National Research Infrastructures. The PSF review should focus on providing external advice and operational recommendations to the country's authorities on increasing national and global visibility and competitiveness of the 28 National Research Infrastructures supported by RIS3 2014-20 funding.

The current report is the background report for PSF Review pertaining to the Research and Innovation policy in Greece in order to further support and upgrade the National Research Infrastructures. Its main purpose is to provide relevant context information on the National Research Infrastructures (NRIs) included in and supported by the National Multi-Annual Budgeting Plan 2014-20 and assist the external independent experts for the final PSF review. The information gathered and summarized in the report was based in answers provided by the 28 NRIs to an extensive questionnaire (Annex I) including questions covering 3 main aspects: (i) a description of the NRI identity, services provided and targeted end-users, (ii) a self-evaluation of their governance structure and maturity level with respect to other competitive RIs, and (iii) a vision and suggested measures for their future development and sustainability.

The background report consists of 8 main chapters, an additional ninth chapter containing the references used within the document as well as five Annexes. The first two chapters are dedicated to a short presentation of the current RTDI landscape in Greece and the RTDI system of the country and the specifics of the Programming Period 2014-2020. Chapter 3 presents the specifics of the S3-RDTI Policy for NRIs (2014-2020) and the selection rules, but most importantly presents the 28 Greek NRIs.

Chapters 4-6 summarize the results obtained from the questionnaires. In more detail, Chapter 4 revolved around the services, governance, human resources, legal constraints and the maturity self-assessment of the NRIs. Chapter 5 concentrated on the NRIs Networking and Internationalization, while Chapter 6 delved in to the specifics of the envisioned future operation and sustainability aspects of the NRIs (including the Key Performance Indicators, KPIs). Finally, Chapter 7 makes a preliminary attempt to connect the upcoming Greek RDTI policy 2021-2027 options with the specific NRIs. Chapter 8 summarizes the main findings from chapters 4-6.

The main findings of this report are:

1. Most NRIs (25/28) provide access to their facilities and equipment in accordance to their mission. The most common type of services with at least 50% of the NRIs offering them fall within four major categories: (1) Access services, (2) Expertise (consultancy) services, (3) Support services, and (4). Education and training.
2. The strongest focus of most NRIs is in the generation of new knowledge and providing services to the academic sector (within and outside the NRIs). Education and training play a prominent role in their missions. Most NRIs position themselves highly in terms of scientific excellence and about 50% of them regard themselves as “moderately mature” in overall operation and performance.
3. The majority of the NRIs (22/28 or 79%) consider Researchers from both the NRI partners and other universities as the most important target groups. Approximately 50% of the NRIs acknowledge the private sector (start-ups, SMEs and Large companies) as of top importance and place it at an equal footing to the academic. However, only 10 out of 28 NRIs (36%) have increased the time allocated to the non-academic sector during the pilot phase.
4. Only four NRIs so far have managed to start creating income through services offered by the NRI (albeit relatively small compared to the other funding sources). It should be pointed out that service fees can be collected only through the individual partners (see point 8).
5. Despite the importance on the generation of new knowledge and their perception of the maturity level in terms of “innovation potential” and “knowledge management” which they believe as being largely, “mature”, IP management has scored the lowest in importance as a KPI.
6. Funding has mostly come from the EPAnEK program. A lot of the NRIs strive to allocate funds from the state budget of the participating institutes to maintain their operation. The correlation between funding from other sources or projects in favour of NRIs development during 2019-21 is a grey area.
7. Human resources are a major issue. Most NRIs recognize the need to hire dedicated highly-skilled personnel for the NRI node daily operation, administration and management, however (i) funding is non-adequate, (ii) salaries are not attractive so as to maintain highly-skilled personnel, and (iii) large bureaucracy does not allow for swift hiring complicating procedures unnecessarily.
8. Most NRIs identified as their main constraint in operation the lack of legal status and the fact that the NRIs are not separate legal entities with their own VAT and PIC numbers. Governance structure of most of NRIs is like the governance of a non-profit network. This fact does not allow them to participate in European projects nor larger European and international RIs and as a corollary they cannot profit from the respective European calls of Pillar I acquiring funds that could contribute to their sustainability. In addition, this has implications in applying costing policies and distributing the generated income in the NRI.

9. Networking and promotional activities are considerably limited. Nonetheless, a large percentage of the NRIs have recognized the need to create dedicated departments or at least hire specialized personnel to increase such activities. This has not been possible though because of the constraints in funding and hiring/retaining personnel (see above).
10. Most NRIs tried to model themselves according to large European infrastructures (ERIC or ESFRI), however the different legal status, the related registration and the level of state funding was prohibitive for them to be built or operate as such.
11. Large European infrastructures (ERIC and ESFRI) are obviously the main competitors. Several Greek NRIs are associated to them to a lesser or larger degree and aspire to become full members in order for them to continue to exist.
12. All NRIs are concerned about their sustainability. In addition to the problem of retaining personnel, most NRIs stretched the need of renewing/maintaining aging equipment or acquiring new to align themselves to the scientific developments. Maintenance cost is possibly the most important cost category since there is no programme or financing scheme that is eligible.
13. Numerous NRIs pointed out the need to have their services certified in order to become competitive and trustworthy service providers. However, this is an issue that is challenged since certification of procedures implies restrictions in R&D activities of the certified laboratories.
14. NRIs were not supported by any other horizontal activity although a number of them was planned in the multiannual plan. Several issues may have been solved/addressed if that had been the case, especially with regards to issues of internationalisation and purchase/maintenance of equipment and procurement consumables.

1. Introduction

1.1 Framework

The 4th Industrial Revolution, the 'Big Societal Challenges' and 'Internationalization' are the main factors that shape the international scene in research, technological development and innovation (RTDI) today. Addressing the Big Societal Challenges, such as healthy aging, clean energy, food security, zero poverty, scarcity of natural resources etc., requires a large-scale mobilization of research effort internationally. In technologically advanced countries, the 4th Industrial Revolution is already transforming every aspect of the economy and the society with consequences that cannot always be predicted. At the same time, digital technologies are accelerating the cycles of innovation, upgrading the innovative content of the service sector, and increasing the importance of data.

Most importantly, though the 4th Industrial Revolution affects the labour market in profound and non-reversible ways. New technologies will change the current landscape in supply and type of work. Development strategies should therefore include measures for smart education in the areas mostly affected by technological developments, as well as lifelong learning and training for existing human resources to prevent job loss. An important and unique aspect of this new era of fast-pacing and deeply affecting technological changes is the possibility of greater participation of society in innovation processes. Assessing technological risks, ethical issues and informing the public are crucial in the acceptance of new technologies by society and their successful integration into production processes.

In this context, the mobility of scientists and researchers, networking and "brain circulation" are crucial to an inclusive growth model. Addressing the ever-increasing international competition for attracting highly trained human resources presupposes the strengthening of scientific and technological capabilities at national level in combination with policies and interventions for the creation of new markets and jobs (market shaping rather than simply market fixing policies).

In Greece, the RTDI sector is still lagging behind the European average¹ and the country remains trapped between low-cost and knowledge-intensive economies. More specifically, in terms of innovation, Greece is characterized by the transfer of know-how and innovations from abroad, low value-added exports, low cooperation between universities and companies and introverted companies. In addition, Greece is characterized by large regional disparities both in terms of GDP and funding dedicated to research. Most Greek regions are small² and often do not include all the components of an effective innovation ecosystem (quadruple helix model of innovation). Thus, the Greek "productive-business system" in conditions of

¹ According to the European Innovation Scoreboard 2021, Greece's Innovation Index was 88.49, while the average in Europe was 104.74

² OECD REGIONS AND CITIES AT A GLANCE - COUNTRY NOTE, GREECE, 2020

globalization is pressed bilaterally by: a) producers of low-cost labour countries, which are constantly upgraded and b) "qualitatively superior producers", operating in countries of high standard of living and important technological & productive skills.

Based on the above, the 2014-2020 Structural Funds programme was designed to strengthen RTDI in the country both at the national and regional level. During the 2014-2020 Programming Period, about 1.1 billion Euros were activated (issuance of Action Calls) from ERDF resources. Actions were implemented to support research and innovation infrastructure and were divided into 7 Policy Pillars:

1. Interconnection of companies with research bodies
2. Innovation / Business research
3. Strengthening of human resources / Basic research
- 4. National Research Infrastructures**
5. International cooperation
6. Science & Society / Policy Support
7. Addressing societal challenges

The following chart (Figure 1) presents the distribution of RTDI expenditure over time per policy Pillar (the time axis also includes the previous programming periods for comparison)

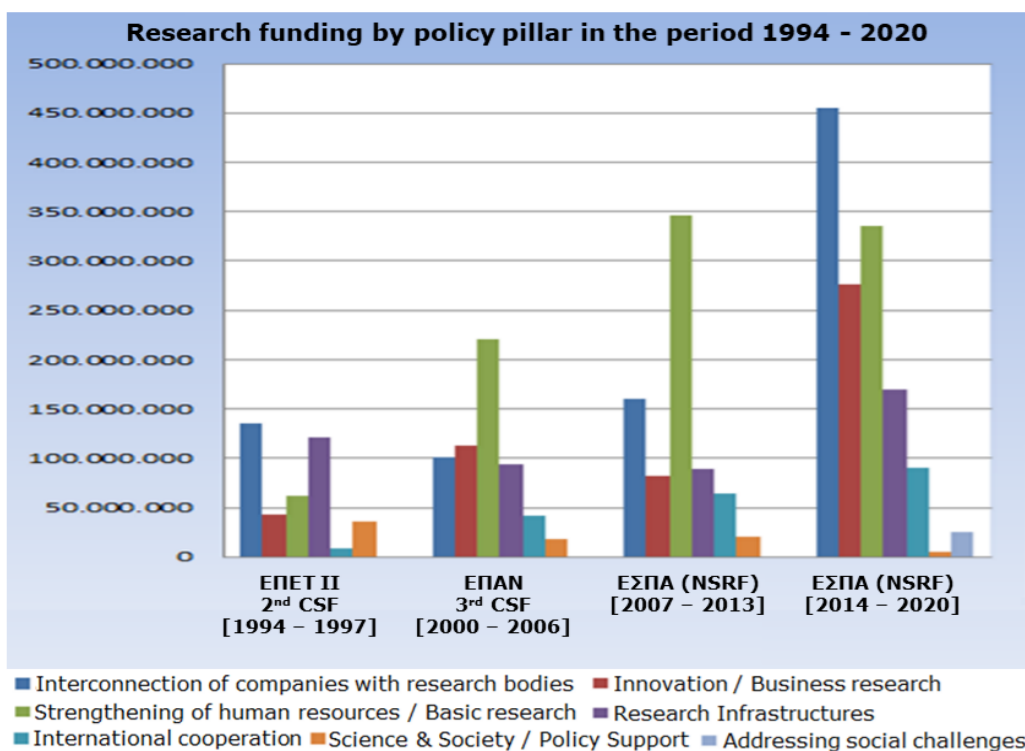


Figure 1: Research funding by policy pillar in the period 1994 - 2020³

³ Source: GSRI

The main points that can be derived from Figure 1:

- During the programming period 2014-20, particular emphasis was given to strengthen the links between companies and research institutions, in order to address the relative weakness (to counteract for the small demand of RTDI by companies and large supply by the research sector)
- During the same period, emphasis was also given to the development of research and innovation activities by companies, so that they would not resort only to the purchase of machinery and equipment but to produce innovation themselves.
- Despite the economic difficulties that the country went through, considerable effort was put into supporting human resources in order to counteract for the adverse effects of brain-drain;
- **Emphasis was also given to the creation and strengthening of National Research Infrastructures**
- In order to strengthen the competitiveness of the Greek economy, both in traditional sectors and through the export of high value-added products, bilateral cooperation actions with countries of strategic interest (Germany, Israel, Russia, China, etc.) were supported.

In particular, a strategic choice was made to invest in the development of National Research Infrastructures (NRIs), since it has been recognized, both at the European and global level, that RIs are one of the most essential components of the research and innovation system. RIs have the capability of supporting high-level research activities in specific scientific fields, while strengthening the connection between research, education and innovation. They can attract talent and investment from both domestic and international companies and can provide critical infrastructure so as to reduce the risk of innovative business ideas as well as support in a more coordinated way broader policy objectives. They can also contribute to local and regional development through employment of scientific and technical staff and play a vital role in their training and developing high added value skills. At the same time, some of the National Research Infrastructures are interconnected with corresponding European ones in the context of international cooperation and promotion of excellence.

The General Secretariat for Research and Innovation (GSRI), as the competent body of the State for RTDI policy, had completed the drafting of the **National Strategy for Research Infrastructures**, and the formation of a **Multi-annual Budgeting plan**⁴, that highlighted the country's priorities for long-term investments in large-scale National Research Infrastructures. This initiative was based on the internationally recognized practices followed in most of the Member States of the European Union, while, at the same time, it should have been noted that the formulation of a National Strategy and Multiannual Budgeting Plan for Research Infrastructures was a prerequisite condition (ex-ante conditionality) for their financing by the Structural Funds in the 2014-2020 Programming Period.

⁴http://www.gsrt.gr/Financing/Files/ProPeFiles20203/ex-ante-1-2_Nov%202016%20V.11.pdf

As a result, the Multiannual Budgeting Plan for National Research Infrastructures alongside the action "Regional Excellence" were created (detailed description in Chapter 2) and put into motion with the aim to strengthen low-performing regions (mainly border regions) and to help all regions to bring their respective RIS3 priorities into life. Within this framework 28 NRIs were conceptualized, funded and created. Apart the aforementioned importance of RIs and their key and integral role in the national research policy, these actions also aimed to enhance knowledge production and further promote the excellence of the Greek research bodies, while at the same time confronting the fragmentation with the creation of a critical mass through the geographically distributed networks of NRIs. Moreover, it was envisioned that the 28 NRIs would be pivotal in smoothing out the regional disparities in terms of knowledge-based development as well innovation-driven economic development (see SWOT analysis / Annex III).

Therefore, as the 2014-2020 Programming Period came to its completion and with the policies and details of the 2021-2027 Programming Period being currently developed, it is critical to assess the NRIs and to formulate a clear framework to further support and upgrade them within the next Programming Period.

Based on the above it is essential to examine whether:

- the existing NRIs should be further support, based on the results of a detailed evaluation foreseen to take place during 2022-23 by the GSRI and on the results of the current PSF scheme.
- in particular, the NRIs that will be assessed to have the highest performance in terms of impact on the economy and society, contribution to business innovation, open access and use, international networking and recognition and the emergence of regional nodes of excellence will be selected for further support.
- in the new period, activities will be used to consolidate / mature / expand the excellent and sustainable NRIs, in order for them to emerge as internationally competitive poles of scientific excellence able to enhance innovation, growth and competitiveness in strategically critical sectors of the economy.
- their interconnection with the corresponding European ones should be supported
- if there is the need to develop new RTD infrastructures, missing from the current NRI landscape and which can further contribute to the economy and society, and satisfy newly-emerging RIS3 needs not included in the previous Programming Period (based on gap analysis in the existing Multiannual Research Infrastructure Budgeting Plan).

1.2 Objective of the Report

As mentioned above, the Greek General Secretariat for Research and Innovation (Hellenic Ministry for Development and Investments) in its letter of 18 June 2021 outlined a number of key areas to be controlled and evaluated as part of the Horizon Europe Policy Support Facility (PSF) of the European Commission review exercise.

The letter indicates that the PSF review should support the Greek authorities in implementing an in-depth study of a key element of the Greek research and innovation ecosystem, namely the National Research Infrastructures. The PSF review should focus on providing external advice and operational recommendations to the country's authorities on increasing national and global visibility and competitiveness of **the 28 National Research Infrastructures** supported by RIS3 2014-20 funding.

The current report is the background report for PSF Review pertaining to the Research and Innovation policy in Greece in order to further support and upgrade the National Research Infrastructures. Its main purpose is to provide relevant context information on the National Research Infrastructures (NRIs) included in and supported by the National Multi-Annual Budgeting Plan 2014-20 and assist the external independent experts for the final PSF review.

The PSF Review should address the National Research Infrastructures (RIs) in the following three areas:

1. NRIs governance and management efficiency
2. National framework for the NRIs
3. Indicators for monitoring and assessment of the NRIs

For each of three areas, the review should provide to the Greek authorities' policy recommendations aimed to increase the contributions of the National Research Infrastructures to the Greek R&I ecosystem along three dimensions:

- enhancing socio-economic impacts, innovation potential exploitation, technology transfer, access policy efficiency and business collaboration,
- reinforcing international value chains and European networks and facilitating effective internationalization policies,
- boosting the scientific and technological excellence of the RIs and their role in attracting and retaining talents.

The background report has been drafted by external experts of the PSF and provides indications for the Final review, which will support the Greek authorities in implementing an in-depth study of a key element of the Greek research and innovation ecosystem, namely the National Research Infrastructures. The PSF review should provide external advice and operational recommendations to the country's authorities focused on increasing national and global visibility and competitiveness of the National Research Infrastructures.

2. Greek R&I policy 2014-2020

2.1 Governance of the Greek RTDI System and Funding Bodies

Public Research –Governance and Funding

Public Sector Research in Greece is conducted mainly in Higher Education Institutes (HEIs) and Public Research Centres (RCs) and Technology Bodies (TBs). HEIs operate under the supervision of the Ministry of Education and Religious Affairs, while RCs and TBs operate under the supervision of the General Secretariat of Research and Innovation – GSRI (formerly the General Secretariat of Research and Technology – GSRT). In July 2019, the GSRI was transferred from the Ministry of Education and Religious Affairs and since then operates within the Ministry of Development and Investments – a governmental choice indicative of a determination to ensure that public research forms stronger ties with the market and industry. Figure 2 depicts in a summarized way the organizational and funding structure of public research. All NRIs are under the auspices & coordination of the GSRI.

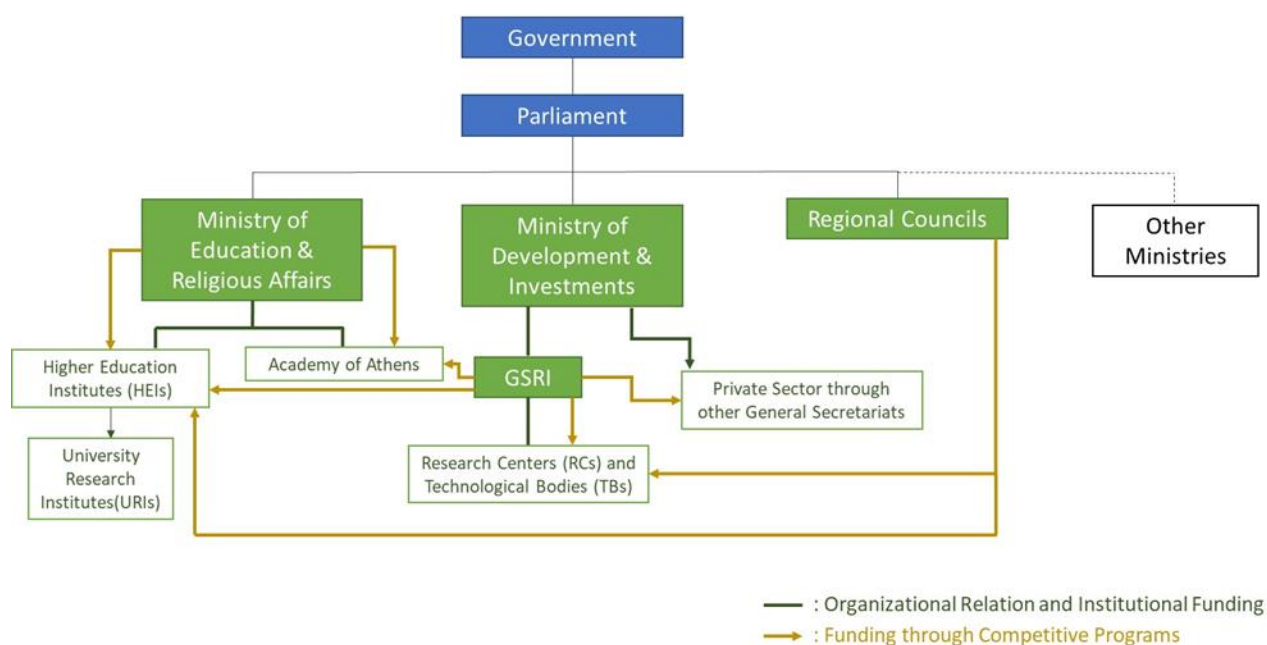


Figure 2: Schematic representation of the organization and funding of public research in Greece⁵

GSRI is a modern public service assigned with the task of defining as well as coordinating the implementation of the national policy for Research, Technological Development and Innovation. It supports the activities of research and industry bodies through competitive research programmes only, highlighting economic performance and a socially fair allocation of outcomes. Furthermore, it supervises research and technology bodies, which provide local communities with the skills necessary for producing knowledge and boosting innovation. GSRI actively follows EU and international developments in the field of RTDI and represents the country to the EU and International Organisations within its competence.

⁵ Own elaboration

In the face of the current economic conjecture, investing in science, research and technology becomes a key strategic priority towards a socially and economically sustainable model of development, based on highly-qualified human resources and novel ideas.

The GSRI mandate consists of:

- Defining and promoting a comprehensive strategy for research, technology and innovation;
- Fully exploiting the highly-qualified research staff to boost economic growth, generate new employment and reverse the current trend of expert Greek scientists migrating abroad;
- Transferring and facilitating the uptake of innovative technologies by the country's industry, through targeted use of research outcomes;
- Supporting initiatives to raise awareness among Greek people in the fields of Research and Technology;
- Supervising and funding Research and Technology Bodies across the country;
- Promoting international S&T cooperation with EU and third countries and making best use of the opportunities to participate in relevant EU, bilateral and international initiatives.
- Evaluating the outcomes of research & innovation projects, with a view to adjusting research policy on an on-going basis.

During the 2014-2020 Programming Period for European Structural and Investment Funds, the Strategy for Smart Specialisation (S3) constituted the main guidance for defining and promoting the Research and Innovation Policy in Greece. It highlighted areas where Greece had already achieved, or could achieve, a competitive advantage. Priorities emerged as a result of the so-called entrepreneurial discovery process aimed at identifying new business opportunities to put into use newly-produced knowledge and integrate it into value chains. This process was carried out through continuous and active consultation of all actors involved in the innovation "ecosystem" (including private enterprises, higher education institutions and research centres, ministries, regional authorities, etc.), with private enterprises and the industry at large also playing a central role.

The Smart Specialisation Strategy Priority Areas are:

- Agro-food sector
- Bioscience and Healthcare / Pharmaceuticals
- Information and Communication Technology (ICT)
- Energy
- Environment and Sustainable Development – Climate Change
- Transport and Logistics
- Materials – Manufacturing
- Cultural and Creative industries – Tourism

Actions planned by GSRI in each of the above areas were aimed at developing innovative products and services, transferring knowledge, supporting research staff and further developing and using research infrastructure. The European dimension (synergies and complementarity with the “Horizon 2020” strategy and other activities within the European Research Area) is strongly promoted; top priorities also include fostering an innovation culture and broadening the participation of social partners in research institutions.

At the same time, the country participates in many transnational research and technological bodies (the European Space Agency, or ESA; the European Agency for Nuclear Research, or CERN; and the European Molecular Biology Conference / Council, or EMBC-EMBL, etc.) and European initiatives, where it derives significant benefits from. Thanks to such collaborations, its human resources and its excellence in critical technological sectors, Greece has attracted investment that could potentially reshape its economic profile.

The Greek Research, Technological Development and Innovation (RTDI) System shows strengths, such as good performance in co-financed EU Framework Programmes, a substantial Greek representation in international research networks and projects of the European Roadmap for Research Infrastructures. In addition, there is a strong Greek research community abroad, as well as highly educated human resources within the country, along with pockets of excellence in public research and academic institutions and the private sector.

During the economic crisis, core research funding to universities was reduced, but was partly compensated for by an increase in research funding through the National Strategic Reference Framework (which prioritized the strategic and economic value of the research it financed). In total, government funding of research in higher education rose slightly between 2011 and 2013, when the downturn was at its peak. Research funding from international investments fell by around 4% over that time.

In 2016, the government made a strategic investment in science and research and created the Hellenic Foundation for Research and Innovation (HFRI / ΕΛΙΔΕΚ) as a funding and evaluation agency for investigator-led research, for postdoctoral fellowships and doctoral scholarships. The HFRI is funded in the government budget and through loans from the European Investment Bank.

The Greek government has developed over the past few years a **four-tier research funding system** (OECD, 2018 [**Σφάλμα! Δεν έχει οριστεί σελιδοδείκτης.**]):

- **Capability funding** through the core funding for universities and research institutes
- **Blue Sky Research** funded through the new HFRI
- **Research Programme Funding on applied topics of strategic importance** to Greece, mainly through the National Strategic Reference Framework (NSRF) and with some additional project funding from other government budgets and from municipalities

- **Support for the acceleration of the commercialization** of research through government equity investment funds and low-interest loans.

Under this funding framework, the government’s share of the funding of research declines as a project matures and approaches the transfer and commercialization stages, and as risk reduces.

The performance of Greece – Short Overview

Greece's performance in the European Innovation Scoreboard 2021 (EIS)⁶, published by the European Commission on 21 June 2021, has significantly improved. Between 2014 and 2021, Greece maintained a continuous upward trend, in the Summary Innovation Index, increasing from 63 points in 2014 to 79 in 2021 (Figure 3). Specifically, Greece increased its performance by 25.9%, while the European average was 12.5%. This increase was greater in the last three years. At 25.9%, Greece is among the 5 countries (Estonia, Cyprus, Lithuania, Italy and Greece) with an improvement of more than 25% in the period 2014-2021, but still remaining in the group of Member States with mediocre performance in innovation.

Greece's strengths, with performances above the value of 100 corresponding to the EU average, lie in small and medium-sized enterprises (SMEs) that innovate (Innovators), interconnection and co-operation (Linkages) and employment (Employment impacts).

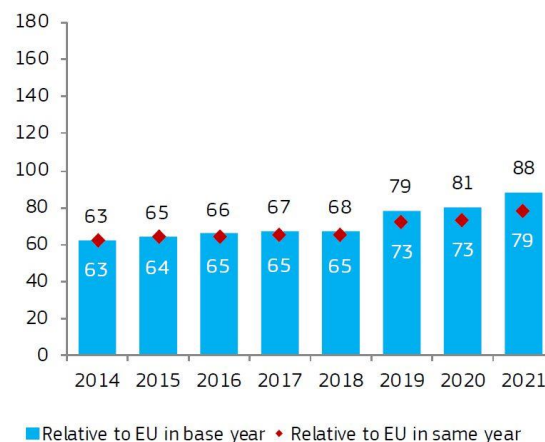


Figure 3: Increasing trend in the composite innovation indicator for Greece in the period 2014-2021⁷.

⁶ https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3048

⁷ National documentation Center (EKT), <https://www.ekt.gr/en/news/26308>

Greece's top three performers are sales of innovative products, innovative SMEs collaborating with others, and product innovators. Indicators for the population with higher education, expenditure on innovative activities (excluding R&D), public-private partnerships for the production of scientific publications, business process innovations and innovative business employment are also higher than the European average (Figure 4). The indicators showing the largest increase after 2018 are due to broadband networks development, venture capital, product innovators, job-to-job mobility of human resources in science and technology and exports of medium and high-tech goods.

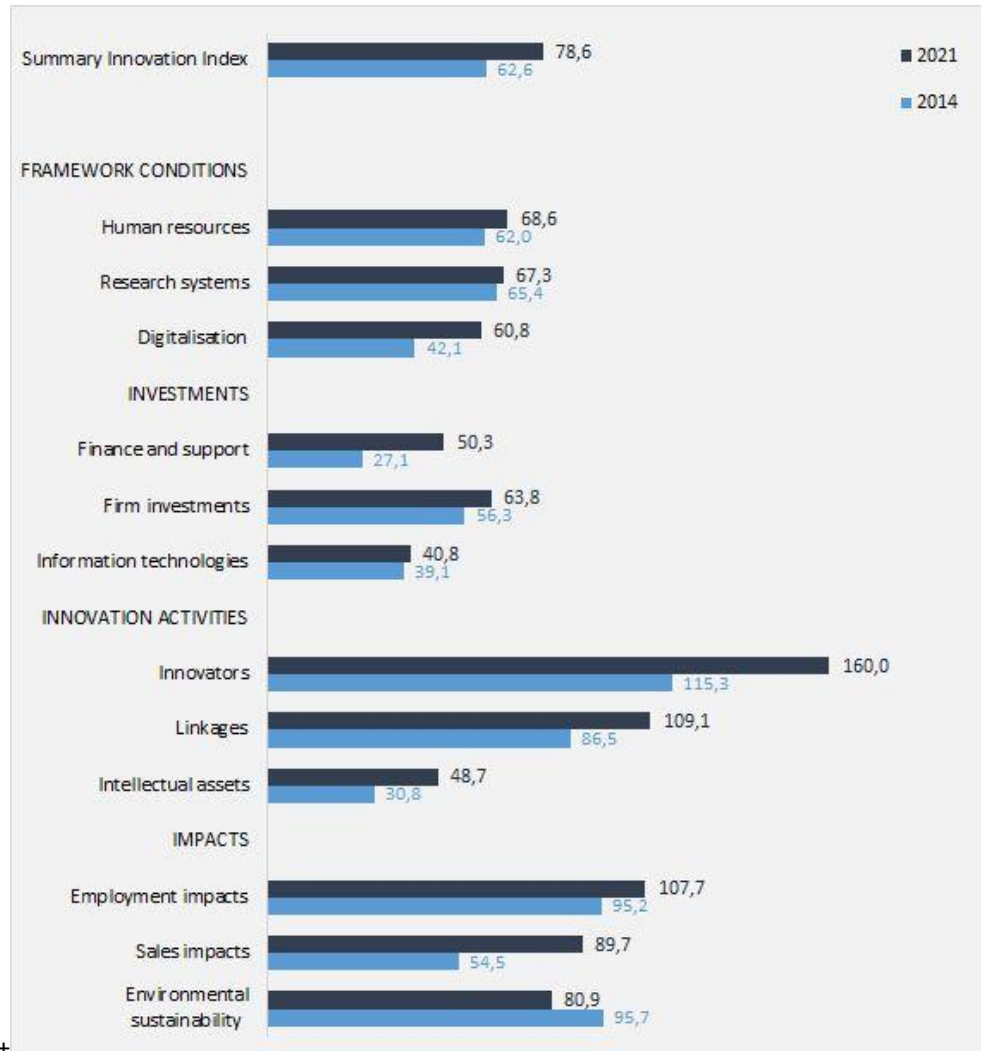


Figure 4: Greece's performance in the individual categories of the European Innovation Scoreboard, 2024 & 2021[6]

In terms of the structural characteristics of the innovation environment in relation to the EU (Figure 5), Greece performs better than the EU average in the Innovation Profiles category. The percentage of Greek enterprises that innovate internally (develop innovations within the company, in house) is higher than the EU average.

Finally, the performance of Greece is close to the European average in terms of Climate Change Indicators.

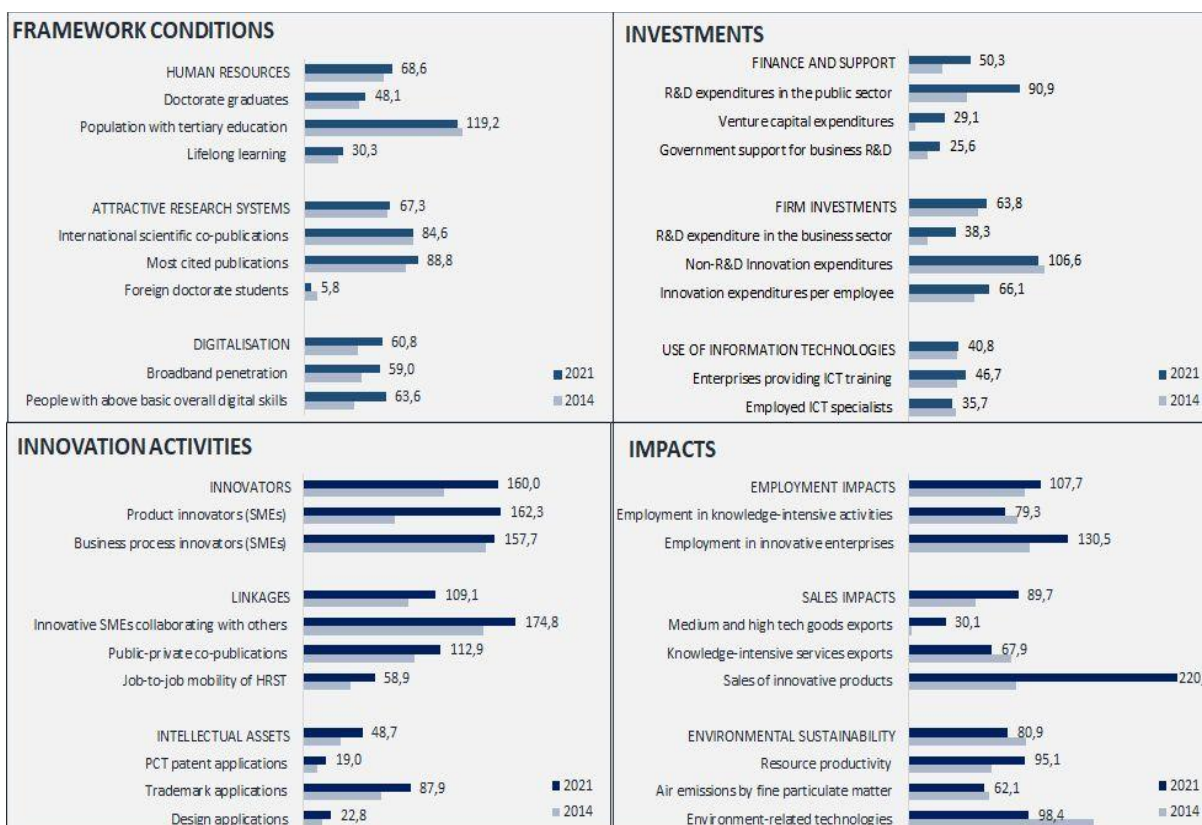


Figure 5: Detailed presentation of Greece's performance in the indicators and sub-divisions of the European Innovation Scoreboard, 2014 & 2021[6]

This year's European Innovation Scoreboard is based on a revised framework, with new indicators for digitalization and environmental sustainability, aligning the scoreboard with EU policy priorities. In addition to the indicators used to rank countries, the Scoreboard lists a set of indicators that capture the structural features of the innovation environment in each country comparative to the EU. Based on their ranking, EU countries are divided into four performance groups: innovation leaders, countries with strong innovators, countries with moderate innovators and countries with emerging performance innovation (emerging innovators).

According to new data, innovation performance is steadily improving across the EU. As the European Commission points out, 'There is continued convergence within the EU, with lower-performing countries growing faster than higher-performing countries, bridging the innovation gap between them, a trend that also applies to innovation in all EU regions.' Sweden continues to be the EU innovation leader, followed by Finland, Denmark and Belgium, with innovation performance well above the EU average (Figure 6⁸). Greece ranks 20th among the 27 EU countries, remaining

⁸ Colored columns show innovation performance in 2021, horizontal columns show performance in 2020 and grey columns reflect performance in 2014, all comparative to the EU average in 2014.

in the group of member states with a mediocre performance in innovation, below the European average. In the same category with Greece are 8 other countries including Italy, Spain, Portugal and Cyprus.

According to the Regional Innovation Scoreboard 2021, four Greek regions (Attiki, Kriti, Epirus, Ionian Islands) featured in the top10 fastest-growing European regions (between 2014 and 2021(EC,2021⁹). The considerable growth means that Greece qualifies as a moderate innovator.

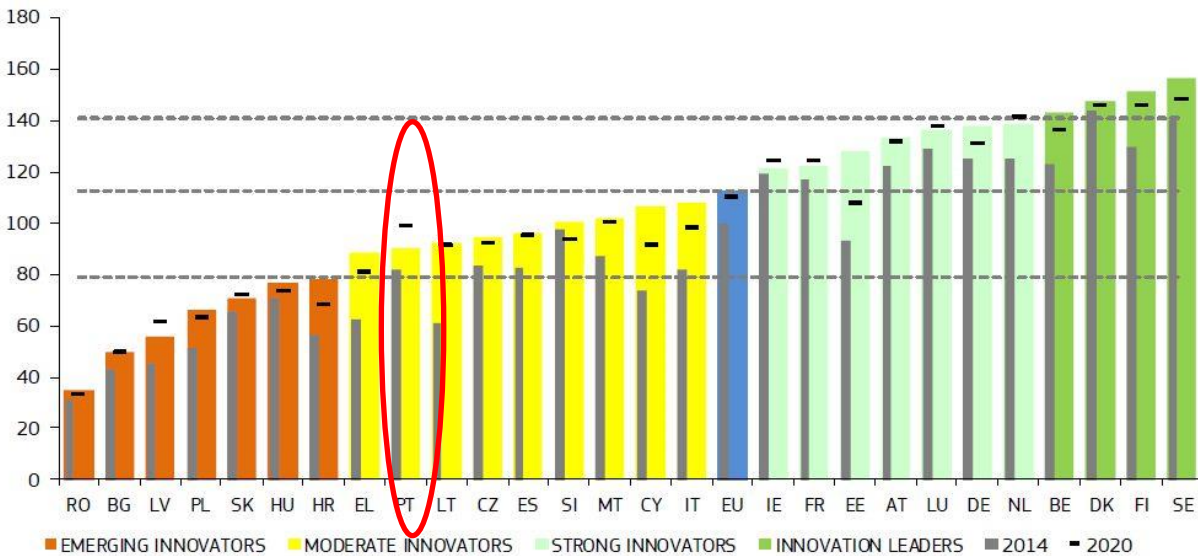


Figure 6: Ranking of countries in the European Innovation Scoreboard [6]

The evolution of business participation in R&D actions (BERD) was impressive during the last five years. In 2019, the volume of Greek R&D (i.e., gross domestic R&D expenditure as a percentage of GDP) amounted to 1.27% of GDP (from 0.58% of GDP in 2008) with the business sector representing the 46% of total R&D expenditure. This fact is directly related to the beginning of the absorption of the funds of the NSRF 2014-2020 and the implementation of the interventions of NS3. It is characteristic that through a single program of R-C-I¹⁰ (pillar 1); more than 604 million were channelled for cooperation between companies and the research community. Also important was the number of new companies that participated in E-D-K for the first time, opening new technological horizons to a new generation of entrepreneurs.

⁹EC (2021), *Regional Innovation Scoreboard 2021*, European Commission

¹⁰ Ερευνώ - Δημιουργώ - Καινοτομώ (R-C-I, Research-Create-Innovate)

Triadic patent families Total, Number, 2010 – 2019

Source: Patents by main technology and by International Patent Classification (IPC)

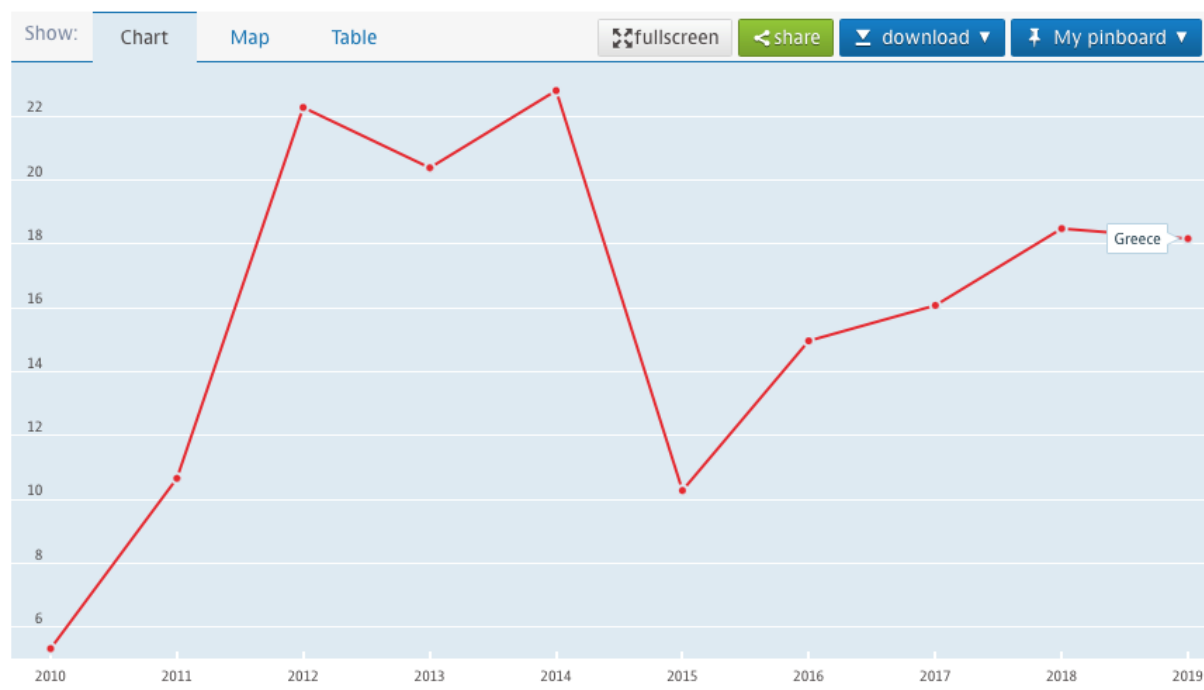


Figure 7: Triadic patent families, Greece, total number, 2010-2019¹¹

Furthermore, according to provisional data published by the National Documentation Centre (EKT) R&D expenditures reached 1.50% of GDP in 2020. In 2020, a year marked by the COVID-19 pandemic and its impact on the economy, R&D expenditure in Greece was € 2,473.45 million, an increase of € 135.8 million compared to 2019 (growth rate 5.8%). Based on the 5.8% increase in R&D expenditure and the 9.8% decrease in GDP in Greece in 2020, the 'R&D Intensity' index, which expresses R&D expenditure as a percentage of GDP, stood at 1.50% compared to 1.28% in 2019 (see Figure 9 below).

¹¹ <https://data.oecd.org/rd/triadic-patent-families.htm>

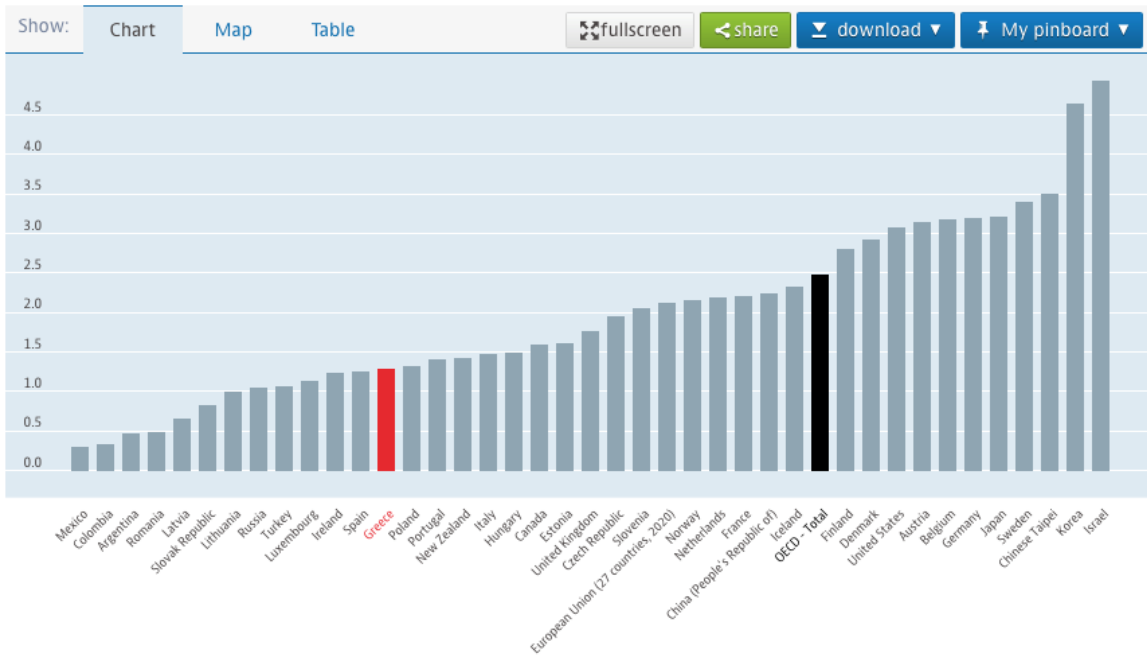
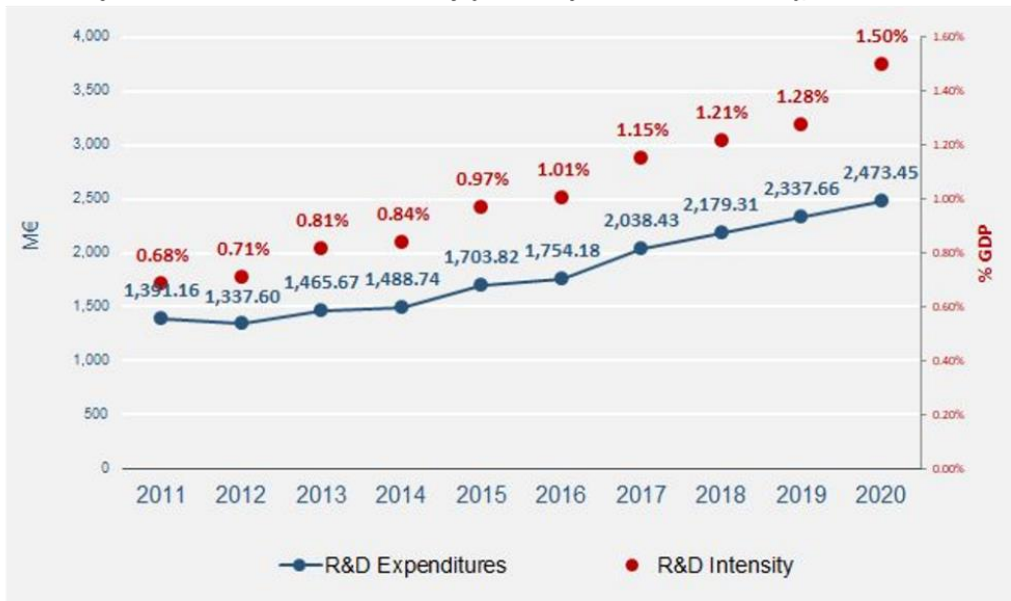


Figure 8: Gross domestic spending on R&D, Total % of GDP¹²

R&D Expenditures and R&D Intensity (R&D expenditures of GDP), 2011-2020



Source: National Documentation Centre (EKT)

Figure 9: R&D Expenditures and R&D Intensity, 2011 – 2020¹³

¹² OECD, 2019

¹³ National Documentation Centre (EKT), <https://www.ekt.gr/en/news/26705>

Finally, it is worth mentioning that university research performance in Greece is reasonably good. Universities and Research Centres are responsible for the majority (~80%) of Greece's research output and research citations (Foundation for Economic and Industrial Research (IOBE, 2017¹⁴; OECD, 2018¹⁵). Several universities appear in many of the main world university rankings systems (which focus on measures of research performance).

2.2. General Description of S3-RTDI Policy (2014-2020)

In Greece, one national and 13 regional strategies for each of the country's 13 regions were developed for the 2014-2020 Programming Period: The reason behind such a choice was the fact that Greek regions are small and do not often have all the necessary components of a 'vibrant' innovation ecosystem. R&D intensity at regional level is mostly due to the presence of active public research bodies such as universities (for example in Epirus and the North Aegean) or associated with the presence of a critical mass of companies (Central Greece, Thessaly, and Peloponnese). Therefore, Programming Period 2014-2020 aimed at enhancing RTDI at the same time both at the national and at the regional level.

As the General Secretariat for Research and Innovation of the Hellenic Ministry of Development and Investments reported:

"The vision driving the National Research & Innovation Strategy for Smart Specialisation (RIS3) prioritises people and society, resulting in a high level of quality of life, low environmental footprint and respect for cultural heritage and creativity. The main objective of the National RIS3 is a transformation of the productive sector through research, technological development and innovation, while mitigating regional disparities and creating sustainable employment".

Towards that end the National Strategy for Smart Specialization 2014-20¹⁶ and most of its financing was allocated into **four main pillars** (schematically depicted in Figure 7)

- Pillar 1: Collaboration between Academia and Enterprises
- Pillar 2: Research Infrastructures
- Pillar 3: Financing of postdoctoral and doctoral students
- Pillar 4: Venture Capital –EquiFund

This strategy substantially affected EPANEK (main programme for competitiveness). NRIS3 financing, until 2023, was approximately 1.4 billion and influenced the

¹⁴ IOBE (2017), Higher Education in Greece: Effects and Challenges of the Crisis, Foundation for Economic & Industrial Research

¹⁵ OECD (2018), Education for a Bright Future in Greece, Reviews of National Policies for Education, OECD Publishing, Paris, <https://dx.doi.org/10.1787/9789264298750-en>

¹⁶ <http://www.gsrt.gr/Financing/Files/ProPeFiles19/Executive%20Summary-2015-09-17-v04.pdf>

implementation of more than 3.5 billion public expenditure (mainly EPANEK) as well as loans from the European investment Bank (EIB).

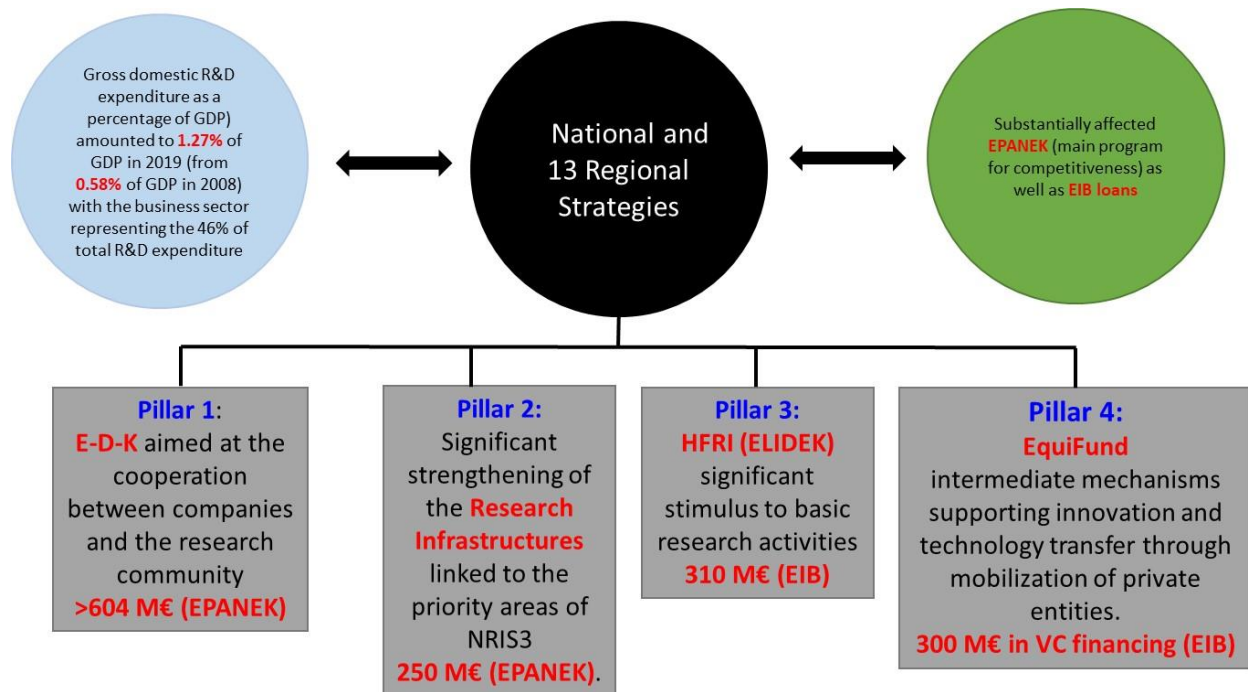


Figure 10: Schematic representation of the 4 pillars of NRIs¹⁷

In brief those pillars are:

Pillar 1. To enhance the potential of Greece's regions in the fields of innovation, knowledge transfer and science- industry co-operation, the country has implemented support measures funded by the Operational Programme of Competitiveness, Entrepreneurship and Innovation 2014-2020. This gave birth to the RTDI (Research, Technological Development and Innovation) flagship Programme of Greece, i.e., the Single RTDI State Aid Action "RESEARCH-CREATE-INNOVATE". The programme was launched in 2017, and the total public funding for the 1038 projects financed calls was EUR 535.65 million, with research organisations being granted almost half of that amount (EUR 267.58 million). The intervention categories of the strategy the following three, notably, i.e., research and development by SMEs; partnerships of enterprises with research institutes; and exploitation of research results.

The programme's funds were allocated based on the size of each region (Table 1), to reduce the gap in state-of-the-art innovation in the local context. Less developed regions receive more funding per capita. The experience of the RESEARCH-CREATE-INNOVATE Programme is thus an exemplary initiative to encourage regional innovation and to bring Greece, as a whole, to a further elevated innovation capacity.

¹⁷ Source: GSRI, data treated by G. Stroglyopoulos

Table 1: Regional allocation of public funding through Single RTDI State Aid Action "Research- Create- Innovate",2017-20¹⁸

Regions	Public funding (EUR)
Less developed regions (Anatoliki Makedonia,Thraki, Kentriki Makedonia, Ipeiros, Thessalia, Dytiki Ellada)	151,200,000
Regions in transition (Dytiki Makedonia, Ionia Nisia, Peloponnisos, Voreio Aigaio, Kriti, Sterea Ellada)	49,000,000
More developed regions (Attiki, Notio Aigaio)	79,800,000
Total	280,000,000

In RESEARCH – CREATE – INNOVATE Programme the strongest presence is held by Information and Communication Technologies (ICT, with 233 projects) with a very small deviation from the Agri-food sector and the Food Industry (216 projects). They are followed by Health and Medicine (176 projects) and Tourism, Culture and the Creative Industries (165 projects). Finally, with over 100 integrated projects, comes the Environment and Sustainable Development (102 projects).

The Greek system is also developing Competence Centres to support co-operation between HEIs and the productive sectors. The current Programming Period of the National Structural Funds, and in particular the national Smart Specialisation Strategy 2014-20), provide funding for the creation and operation of Competence Centres. This policy has a dedicated action launched in 2020 by the General Secretariat for Research and Innovation (GSRI) with a EUR 30 million budget, aimed to support the Greek economy in the provision of specialized, innovative services, know-how and technology transfer to companies, especially small and medium-sized enterprises (SMEs).

Pillar 2. During this period, a significant strengthening of the **Research Infrastructures** related to the priority areas of RIS3 was carried out with a total amount approaching 250 million euros. The national roadmap of the research infrastructures is already a basis for the next Programming Period as it is oriented towards the internationalization of the Greek research excellence and the reduction of the Brain Drain. National Research Infrastructures belong in this pillar and their development was part of the conditionality that Greece had to fulfil for R&D and Innovation.

Pillar 3. At the same time, with the channelling of these funds to infrastructures and the market, a significant stimulus was given to basic research activities through the Hellenic Foundation for Research and Innovation (HFRI / ΕΛΙΔΕΚ) with a budget

¹⁸ Source: EC (2020)], "Single RTDI State Aid Action "Research – Create – Innovate" Draft)", <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/support-measure/single-rtdi-state-aid-action-research-create-innovate-draft>

that reaches 310 million euros. Together with the E-D-K and the Research Infrastructures, ELIDEK was pillar 3 aiming at retaining the research potential in the country through the financing of postdoctoral and doctoral students.

Pillar 4. EquiFund was the fourth pillar. The delay in funding the intermediate mechanisms for supporting innovation and technology transfer such as Technology Transfer Offices or technology parks has resulted in the mobilization of private entities that covered part of the vacuum. EquiFund (+300 million in VC financing) has played a pivotal role towards this direction. Nevertheless, support of intermediate mechanisms started to become a reality in 2020 & 2021 where call for tenders were initiated for Clusters, Competence Centers and technology transfer offices.

During 2020 & 2021, important regulatory reforms are already taking place relating to the spin-off's creation legislation, intellectual property, strengthening of start-ups through Elevate Greece and other support mechanisms. At the same time, two more areas in which the country was lagging behind are being strengthened. Hellenic Industrial Property Organization through the establishment of Greek Academy for Industrial Property supports the accreditation of patent attorneys in Greece which will assist technology transfer activities. Tax reliefs are also being promoted which favour companies investing in R&D and new personnel in research activities.

3. The 28 Greek NRIs of the Multiannual Budgeting Plan

3.1 Specifics of S3-RTDI Policy for NRIs (2014-2020)

The NRIs were one of the initiatives of GSRI for the support of research infrastructures. Table 2 contains information related to initiatives in the Investment Priority 1a.

Table 2: Initiatives in the Investment Priority 1a, Source: GSRI

Μέτρο	Investment Priority	Specialised (PE€)	Announced calls (PE€)	Legal commitments (PE€)	Payments (PE€)	Funded projects	Participating organizations
Support for National Research Infrastructures	1a	93.000.000	95.538.798	91.546.050	73.555.428	28	212
Strategic development of Research Centers	1a	31.860.000	31.860.000	30.324.368	29.041.444	30	30
Regional Excellence	1a	45.000.000	87.160.763	87.160.763		44	
Exploitation of Academic and Research Results (Technology Transfer Offices)	1a	15.000.000	15.000.000				
	1a Total	184.860.000	229.559.561	209.031.181	102.596.871	103	242

The General Secretariat for Research and Innovation (GSRI), as the competent body of the State for RTDI policy, had completed the drafting of the **Strategy for National Research Infrastructures**, and the formation of a **Multi-annual Budgeting plan**¹⁹, that highlighted the country's priorities for long-term investments in large-scale National Research Infrastructures. This initiative was based on the internationally recognized practices followed in most of the Member States of the European Union, while, at the same time, it should have been noted that the formulation of a National Strategy and Multiannual Budgeting Plan for Research Infrastructures was a prerequisite condition (ex-ante conditionality) for their financing by the Structural Funds in the 2014-2020 Programming Period.

The policy behind is that NRIs play an increasingly important role in promoting scientific and technological knowledge. They are key tools for mobilizing the factors of the innovation ecosystem in order to deal with complex scientific problems and seek solutions to many of the challenges faced by modern societies. In addition, NRIs are a vital element for the European Research Area as well as the international research domain, offering services to users from different countries, attracting young scientists to research, forming interdisciplinary communities and fostering innovation and economic growth. NRIs are necessary tools to support all scientific fields and connect innovation and education to research for the effective operation of the knowledge triangle (Education-Research-Innovation). Their contribution to tackling the phenomenon of brain drain, especially of highly specialized scientific and technical staff, is crucial.

Recognizing the importance of NRIs for the formation of the new development model envisioned by the Greek state for the 2014-20 Programming Period, the Greek authorities decided to strengthen the most important research infrastructures of the country through the co-financing of the European Structural Funds, in particular the Operational Program "Entrepreneurship, Competitiveness and Innovation" (EPANEK /ΕΠΑνεΚ) 2014-20, through the Specific Objective 3.1" Upgrading or / and

¹⁹http://www.gsri.gr/Financing/Files/ProPeFiles20203/ex-ante-1-2_Nov%202016%20V.11.pdf

development of research and innovation infrastructures to improve the country's innovative capacity to support entrepreneurship”.

It is important to emphasize that the multiannual NRIs support plan is not limited to building facilities and equipment, but includes human resources, know-how, information, networking and all the intangible elements required for their operation and full utilization. GSRI had designed and implemented a transparent and reliable process, based on European standards, to record the needs of the Greek research community and the productive sector, to promote the required synergies and collaborations, to evaluate and finally to identify the integrated infrastructures national and open access with elements of extroversion, sustainability and support for innovation, which should have been implemented and operated as a matter of priority during the 2014-2020 Programming Period and beyond.

In this context, as early as 2012, GSRI organized a process of mapping, evaluation and strategic prioritization of the country's potential NRIs, combining bottom up and top-down approaches and guided by scientific excellence, the contribution to innovation and economic growth and the servicing the objectives of the National Smart Specialization Strategy (RIS3). The creation of a critical mass through networking, the open access of the users, the response to the needs of the companies, the extroversion and the international recognition were also the main criteria for the selection and prioritization of NRIs promoted for funding by the Operational Programme EPANEK (ΕΠΑνΕΚ). This process led to the development of a **Roadmap for National Research Infrastructures**²⁰(2014) that includes strategically important infrastructures for economic and social development. A first draft of the roadmap was already published by GSRI in December 2014, which was revised based on the results of the successive stages of evaluation and prioritization of the RIs, as described below.

The two ex-ante conditionalities that have been needed to be fulfilled were:

- a) The conditionality 1.1 was **the existence of a national RIS3**. The National RIS3 was approved by the Greek Government under No. 82193/EYSSA 1810/4-8-2015 Join Ministerial Decision of Economy, Infrastructures, Shipping and Tourism and the deputy minister for Research. With the letter of 22-10-2015 of the General Directorate of Regions, European Commission (EC) recognizes the fulfilment of the relevant conditionality 1.1.
- b) The conditionality 1.2 was **the existence of a multi-annual plan for budgeting and prioritization of investments**. The conditionality was fulfilled with the issuance by the GSRI of an Indicative Multiannual Budgeting Plan for the Research Infrastructures, and the letter of 21/2/2017 of the EC: “the Commission concludes that the ex-ante conditionality 1.2 on “research and innovation infrastructures” is fulfilled”.

²⁰ http://www.gsrt.gr/News/Files/New987/road-map-web_version_final.pdf

3.2 Rules of RI Selection

Criteria based on which the evaluation of the proposals submitted in the framework of the 1st Call for expression of interest was carried out -June 2013 (Group A)

Table 3: Criteria applied for the evaluation and selection of NRIs²¹

I. Scientific, technological potential & maturity of the RI (1-5)	
1.	Scientific excellence (significance of the RI for the specific research fields addressed)
2.	Degree of interdisciplinarity
3.	Perspectives for scientific & technological breakthroughs in the field of operation of the RI
4.	Maturity of the RI
II. Effective networking (1-5)	
1.	Competence complementarity of the partners and added value of the national RI network at the regional, national and international level
2.	Synergies, degree of networking and creation of critical mass
3.	Education and training for students, researchers, technicians, engineers and administrators of RIs
4.	Synergies and networking capacity in relation to other Research and Innovation initiatives at the national and international level (with emphasis on ERA integration effects, e.g. ESFRI participation)
III. Access policy, governance and sustainability (1-5)	
1.	Access policy for researchers
2.	Access policy for industry (addressing IP rights – if applicable – fees and confidentiality issues)
3.	The management structure & governance of the proposed research infrastructure
4.	Technical feasibility, incl. human resource issues & cost-effectiveness of the proposed infrastructure
IV. Innovation potential and socio-economic benefits (1-5)	
1.	Contribution to increase the potential for innovation and technology transfer through the construction and operation of the RI, based on expected results and spill-over effects of the RI
2.	Addressing major societal challenges
3.	The integration of the RI in scientific, business and social environment in Greece and expected socio-economic benefits at the regional and national level

According to the instructions of the call for expressions of interest the threshold of the score is 16/20 and ≥ 4) for each sub-criterion.

²¹ GSRI, Ex-ante Conditionality (EAC/1-2) Research and Innovation Infrastructures, 2016

Table 4: Criteria on the basis of which the High-Value Advisory Committee evaluated the 26 proposals to be included in the NRI Roadmap[21]

Criteria	RESEARCH INFRASTRUCTURE ASSESSMENT CRITERIA (Qualitative assessment on the basis of submitted proposals)	YES	NO
	CONTRIBUTION TO RIS3 PRIORITY SECTORS		
1	RI main activities are fully aligned to product/process/organizational innovation of RIS3 priority sector(s).	1	0
2	The majority of the RI deliverables and services contributes to RIS3 priority sector(s)	1	0
	CONTRIBUTION TO PRIVATE SECTOR INNOVATION		
3	Foresees the collaboration with SMEs (open access policy to SMEs)	1	0
4	Foresees support to SMEs in organizational innovation	1	0
5	Contributes to creation of high growth SMEs	1	0
	CONTRIBUTION TO NATIONAL OR REGIONAL GROWTH		
6	Contributes to private sector R&D investment	1	0
7	Contributes to creation of new employment in knowledge-intensive activities	1	0
8	Contributes to exports of products or services	1	0
9	Generates revenue from licensing and / or patent commercialisation	1	0

According to the instructions of the EC: criteria 1 & 2 needed to be answered in a positive way (1) otherwise (0) the proposal was eliminated. All criteria were scored and those proposals that met criteria 1 & 2 and achieved overall score of 5/9 and above were included in the list for the first round of support.

Table 5: Evaluation criteria of RIs submitted under the 2nd Call for Expressions of Interest (Group B) [21]

1. ON/OFF criteria
A. Compliance with the definition of research infrastructure
Reference to the definition of RIs in EU Regulation 651/26.6.2014
B. Contribution to the RIS3 priority areas:
a. Its main activities are fully aligned to product / process / organizational innovation of RIS3 priority sectors
b. The majority of the RI deliverables and services contribute to the RIS3 priority sectors
2. Ranking criteria
A. Scientific, technological potential and maturity of the RI (1-5)
a. Scientific excellence (significance of the RI for the specific research fields addressed)
b. Degree of interdisciplinarity
c. Perspectives for scientific and technological breakthroughs in the field of operation of the RI
d. Maturity of the RI
B. Effective Networking, Synergies within the Knowledge Triangle and International Visibility (1-5)
a. Competence and complementarity of the partners and added-value of the national RI network at the regional, national and international level

b. Synergies, degree of networking and creation of critical mass
c. International networking, openness and visibility of the RI with emphasis on ERA integration effects, e.g., ESFRI participation
d. Education and training for students, researchers, technicians, engineers and administrators of RIs
C. Access Policy (1-5)
a. Access policy for researchers
b. Access policy for industry and enterprises (addressing IP rights – if applicable – fees and confidentiality issues - collaboration with enterprises - open access policy to enterprises and the private sector in general)
c. International Openness and Access for International Users
D. Governance and Sustainability of the RI (1-5)
a. Clear management structure & governance of the proposed research infrastructure
b. Involvement of private sector representatives in the Research Infrastructure
c. Technical feasibility, including human resource issues & cost effectiveness in the proposed infrastructures
d. Clear investment plan securing the long-term viability of the RI
E. Innovation Potential & Contribution to Private Sector Innovation (1-5)
a. Contribution to increase the potential for innovation and technology transfer through the construction and operation of the RI, based on expected results and spillover effects of the RI
b. Contributes to the creation of high growth SMEs
c. Foresees support of SMEs in organizational innovation
F. Contribution to National and Regional Growth & Socioeconomic Benefits (1-5)
a. Contributes to private sector R&D investment
b. Creation of an attractive environment for knowledge intensive activities and new employment for highly skilled scientists and engineers
c. Contributes to exports of products or services
d. Generates revenue from licensing and/or patents commercialization
e. Economic and social benefits for Greece as a location for conducting cutting edge research at national, regional and international level
f. Expected impact of the RIs on additional socioeconomic issues (e.g., employment, environment, related commercial/business activities) in the national & regional economy.

The rating scale ranges from 1 to 5 with an excellent score of 5. According to the Invitation, the proposals that will qualify for funding must have a score greater than or equal to 4.

3.3 Overview of Greek NRIs

The following table summarizes the 28 Greek NRIs that were financed after two calls of tenders. More information about these infrastructures is provided in Annex II.

Table 6: The 28 National Research Infrastructures (A' and B' Group) [21]

a/a	Acronym	Title	Thematic Priority	Number of Partners	Initially proposed Budget (M Euros)
Group A					
1	OMIC-ENGINE	Synthetic Biology: from omics technologies to genomic engineering	Agrofood	9	4.00
2	PlantUP	Upgrading the Plant Capital	Agrofood	3	4.00
3	APOLLONIS	Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation	Culture – Tourism – Creative Industries	11	4.00
4	FUVEP	Centre of Excellence for Future Vehicle Environmental Performance	Energy	3	4.00
5	PROMETHEUS	A Research Infrastructure for the Integrated Energy Chain	Energy	2	4.00
6	CMBR	Centre for the study and sustainable exploitation of Marine Biological Resources	Environment & Sustainable Development	7	3.99
7	HELPOS	Hellenic Plate Observing System	Environment & Sustainable Development	8	4.00
8	HiMIOFoTs	Hellenic Integrated Marine and Inland Water Observing, Forecasting and Offshore Technology System	Environment & Sustainable Development	7	4.00
9	PHILIA	Hellenic Research Fleet/reconstruction of the research vessel PHILIA	Environment & Sustainable Development	2	3.64
10	INVALOR	Research Infrastructure for Waste Valorization and Sustainable Management of Resources	Environment & Sustainable Development	7	3.89
11	BIOIMAGING-GR	A Greek Research Infrastructure for Visualizing and Monitoring Fundamental Biological Processes.	Health & Pharmaceuticals	11	4.00

12	INFRAFRONTI ER-GR / PHENOTYPOS)	The Greek Research Infrastructure for Molecular and Behavioral Phenotyping of biological model organisms for chronic degenerative diseases	Health & Pharmaceuticals	5	4.00
13	INSPIRED	The National Research Infrastructures on Integrated Structural Biology, Drug Screening Efforts and Drug target functional characterization	Health & Pharmaceuticals	13	4.00
14	OPENSREEN- GR	An Open-Access Research Infrastructure of Target-Based Screening Technologies and Chemical Biology for Human and Animal Health, Agriculture and the Environment	Health & Pharmaceuticals	7	3.99
15	pMED-GR	The Greek Research Infrastructure for Personalised Medicine	Health & Pharmaceuticals	3	4.00
16	ELIXIR-GR	Managing and Analyzing Biological Data	ICT	15	4.00
17	HELIX	National Digital Infrastructures for Research	ICT	3	4.00
18	CALIBRA	Nuclear Science, Technology and Applications Research Infrastructure (only for the CALIBRA part – Cluster of Accelerator Laboratories for Ion Beam Research).	Materials - Construction	1	4.00
19	HELLAS-CH	The HiPER, ELI and LASERLAB Europe Synergy & IPERIONCH.gr	Materials - Construction	12	4.00
20	INNOVATION- EL	National Infrastructure in Nanotechnology, Advanced Materials and Micro/Nanoelectronics	Materials - Construction	7	4.00
Group B					
21	FoodOmicsGR	A consortium for comprehensive molecular characterisation of food products	Agrofood	8	3.18
22	Food Innovation RI	Research Infrastructure on Food Bioprocessing Development and Innovation Exploitation	Agrofood	6	3.00
23	PANACEA	Panhellenic infrastructure for atmospheric composition and climate change	Environment & Sustainable Development	14	4.00

24	So.Da.Net_CE SSDA_GR	The greek RI for social sciences	ICT	7	1.07
25	DeTAnet	Detector Development and Technologies for High Energy Physics	ICT	3	0.50
26	EATRIS-GR	Infrastructure for preclinical and early-phase clinical development of drugs, therapeutics and biomedical devices	Life Sciences, Health & Pharmaceuticals	6	0.50
27	BBMRI-GR	Strategic expansion of the Greek Biobanking Infrastructure	Life Sciences, Health & Pharmaceuticals	8	0.50
28	EN.I.R.I.S.S.T.	Intelligent Research Infrastructure for Shipping, Supply chain, Transport and Logistics	Transport & Logistics	11	3.00

3.4 NRIs in numbers

The following Figures 11 and 12 show the final distribution of financing for NRIs per RIS3 2014-2020 priority and per region

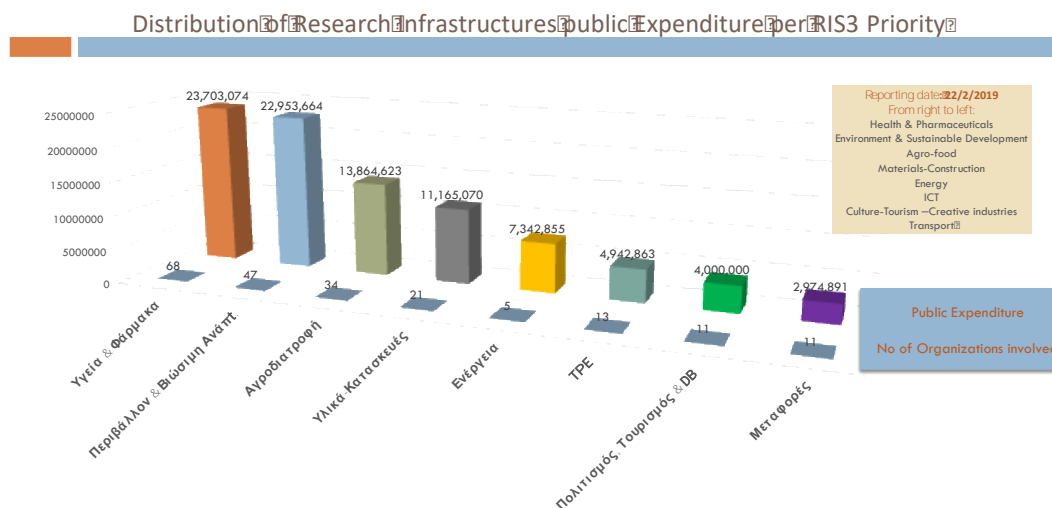


Figure 11: Distribution of Research infrastructures public Expenditure per RIS3 Priority [21]

Distribution of approved Public Expenditure per Region (22/02/2019)

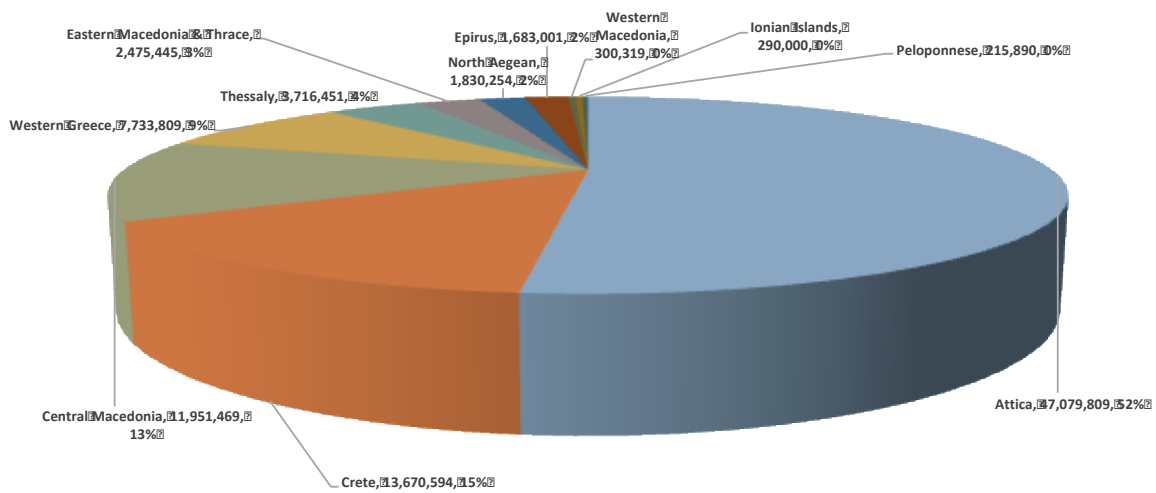


Figure 12: Distribution of approved Public Expenditure per Region [21]

Figure 13 shows the relevance of the 28 NRIs to the European Road Map of ESFRI.

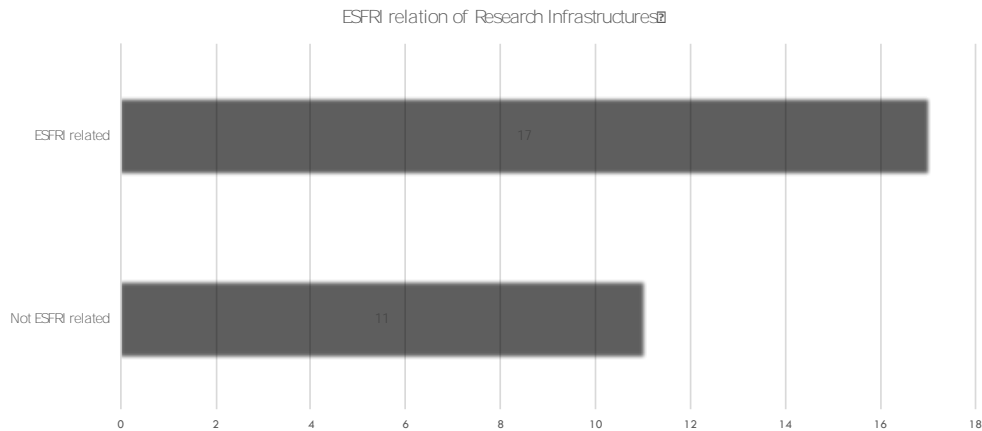


Figure 13: Relevance to the European Roadmap ESFRI [21]

In the table below are listed all the actions that were initially planned to support NRIs but never took place.

Table 7: Indicative actions to strengthen the NRIs where complementarity is recognized at national / European level [21]

	Preparatory Phase of R.I. Operation	R.I. Consolidation Phase	Innovation support actions	Enhancing access to R.I.	Horizontal actions / support actions
National Level	National networking actions / Enhancing access / Human resources	National action for maturation and extension of E.Y. (emphasis on the possible role of the Greek node ESFRI / I3)	Strengthening R.I. with competence centers / incubators / science parks / infrastructure clusters of innovation (collocation facilities, co-working spaces, joint testing laboratories)	Action to open access to national infrastructure at European level	Promotion of (inter) thematic cooperation Register of R.I. / O.A. implementation plan Valuations / revision O.X.
European Level	E.g., Support to the national network for participation in an ESFRI preparatory action	Participation in the construction phase of ESFRI R.I.	Involvement of national nodes in European PPPs - innovation support actions	Support for participation in I3 Calls	Enhancing extroversion / international cooperation / EU clustering

The categories of actions for the strengthening NRIs are as follows:

- a) actions to support R.I. and support of the use / access to R.I. (preparatory operation phase and consolidation / maturation phase: upgrading equipment and facilities where required, human resources enhancement, accessibility, research activity, etc.)
- b) actions to enhance innovation / mobility (networking actions, strengthening the regional dimension, training of human resources, etc.) development of synergies with Regional RIS3
- c) horizontal support actions (creation of a register of research infrastructures, evaluations of the financed infrastructures, revision of the roadmap.

3.4.1 Current status

The available expenditure data, in Table 8 below, shows that the original financing plan was fully or almost fully implemented for most of the NRIs. It should be noted that the latest available data is from 31/12/2021 and that some NRIs have been

given an extension, until April 2022, in order to complete their work. This was the only source of public financing for each NRI²².

Table 8: Indicative, Approved and Actual Financing of NRIs

National Research Infrastructure	Initial indicative Budget (M Euros)	Approved Budget (Euros)	Actual Financing (Euros)	Budget execution
Agrofood	14.18	13,864,623	13,646,112	98.4%
Food Innovation	3.00	3,000,000	2,965,070	98.8%
FoodOmicsGR	3.18	2,998,998	2,883,921	96.2%
OMIC-ENGINE	4.00	4,000,000	3,935,285	98.4%
PlantUp	4.00	3,865,625	3,861,836	99.9%
Culture, Tourism & Creative Industries	4.00	4,000,000	4,000,000	100.0%
APOLLONIS	4.00	4,000,000	4,000,000	100.0%
Energy	8.00	7,342,854	5,878,521	80.1%
FuVEP	4.00	3,662,591	3,072,434	83.9%
PROMETHEUS	4.00	3,680,263	2,806,087	76.2%
Environment & Sustainable Development	23.52	22,990,488	22,636,930	98.5%
CMBR	3.99	4,000,000	4,000,000	100.0%
HELPOS	4.00	3,965,844	3,705,319	93.4%
HIMIOFoTS	4.00	3,991,975	3,947,566	98.9%
INVALIDOR	3.89	3,899,713	3,899,713	100.0%
PANACEA	4.00	3,999,950	3,953,701	98.8%
PHILIA	3.64	3,133,006	3,130,631	99.9%
Health & Pharmaceuticals	24.99	23,584,117	22,682,776	95.2%
BBMRI-GR	0.50	497,210	492,210	99.0%
BIOIMAGING-GR	4.00	4,000,000	3,997,482	99.9%
EATRIS-GR	0.50	499,897	499,897	100.0%
ELIXIR-GR	4.00	3,991,100	3,983,335	99.8%
InfrafrontierGR/ Phenotypos	4.00	4,000,000	3,738,666	93.5%
INSPIRED	4.00	3,818,820	3,513,862	92.0%
OPENSREEN-GR	3.99	3,025,090	3,025,090	100.0%
p MED-GR	4.00	4,000,000	3,432,234	85.8%
ICT	5.57	4,942,863	4,136,231	76.2%

²² Each NRI partner could connect/relate/integrate other activities (equipment, personnel, services in order to enrich the activities)

DeTAnet	0.50	500,000	500,000	100.0%
HELIX	4.00	3,859,823	2,569,891	66.6%
So.Da.Net.	1.07	1,066,340	1,066,340	100.0%
Materials & Constructions	12.00	11,419,216	11,255,345	98.6%
CALIBRA	4.00	3,422,200	3,301,990	96.5%
HELLAS-CH	4.00	3,997,016	3,997,016	100.0%
INNOVATION-EL	4.00	4,000,000	3,956,339	98.9%
Transport & Logistics	3.00	2,974,891	2,413,206	81.1%
EN.I.R.I.S.S.T.	3.00	2,974,891	2,413,206	81.1%
Total	95.60	91,850,351	86,649,120	94%

It should be emphasized that the participation of Greek Academic and Research Institutions is extensive. In the case of universities this is almost universal as 23 out of the country's 24 such institutions are partners to at least one RI (leading or not). Moreover, as it can be seen below, other important and versatile infrastructures and/or foundations participate in the Greek RI system, like the "GRNET S.A. – National Infrastructures for Research and Technology", the "Earthquake Planning and Protection Organization", the "Hellenic Institute of Metrology", the "Ormylia Foundation" (a NGO founded by the Holy Monastery of Simonopetra in Mount Athos) and also various University Hospitals around Greece (as in the case of BBMRI-GR Research Infrastructure).

Distribution of partners in Greek RIs

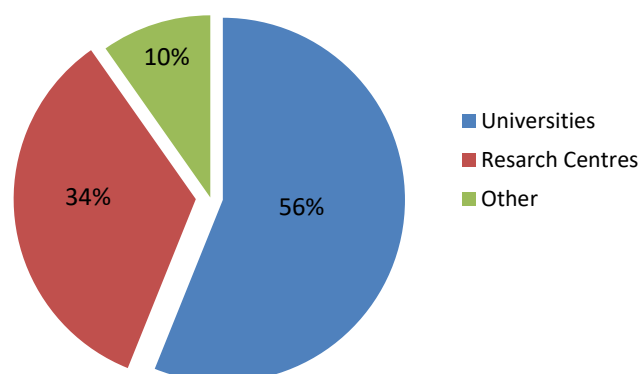


Figure 14: Distribution of partners in Greek RIs

More than half of the 39 different institutions and public bodies are partners in at least one National Research Infrastructure. It is worth noting that high in the list of participations in NRIs are placed universities in less developed regions of Greece, namely the University of Thrace (Eastern Macedonia- Thrace), University of Patras (Western Greece), Aristotle University of Thessaloniki (Central Macedonia) and University of Ioannina (Epirus). One can also note that in the first 10 places of the

same list only three Research Centres are placed (Foundation of Research and Technology, Academy of Athens and NCSR "Demokritos").

Institutions participating in at least 3 RIs

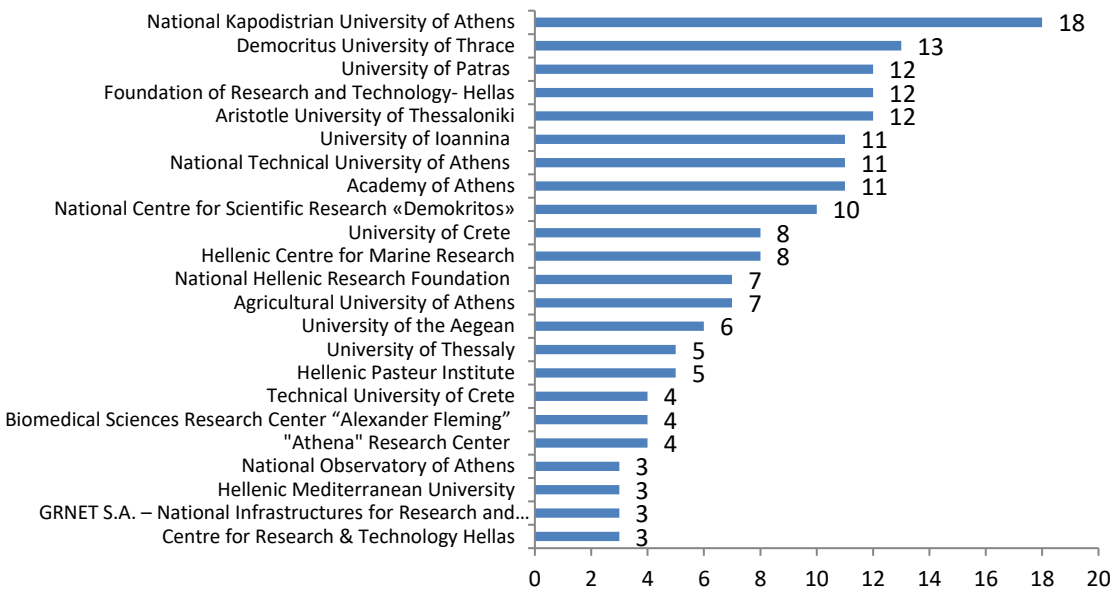


Figure 15: Institutions that participate in at least 3 Research Infrastructures

Institutions participating in no more than 2 RIs

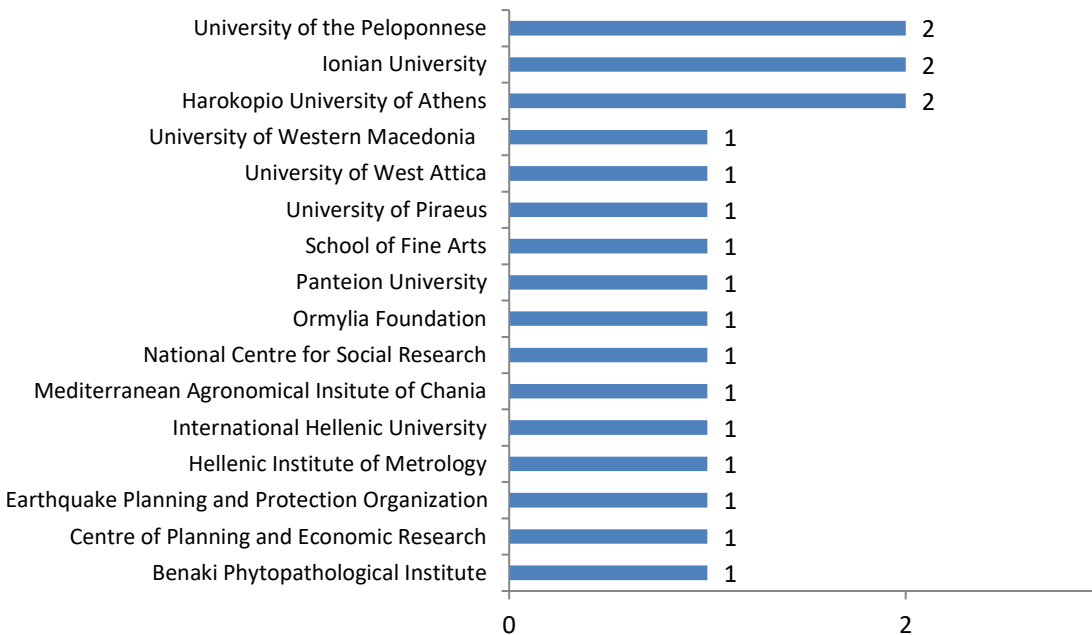


Figure 16: Institutions that participate in no more than 2 Research Infrastructures

3.4.2 Expenses allocation

The total **actual spending** for the whole set of NRIs amounted to **86,125,570 Euros** (data available at 31/12/2021). The breakdown of expenditure shows that in general emphasis was placed on supporting research personnel, in line with Greece's policy of halting and reversing brain drain. For this reason, almost half of the expenses (46%) concerned the personnel involved (salaries and travel expenses) much higher than the expenses for equipment (supplies, consumables, etc.) which accounted for 37% in total. It is also noted that the expenses for publicity were very low.

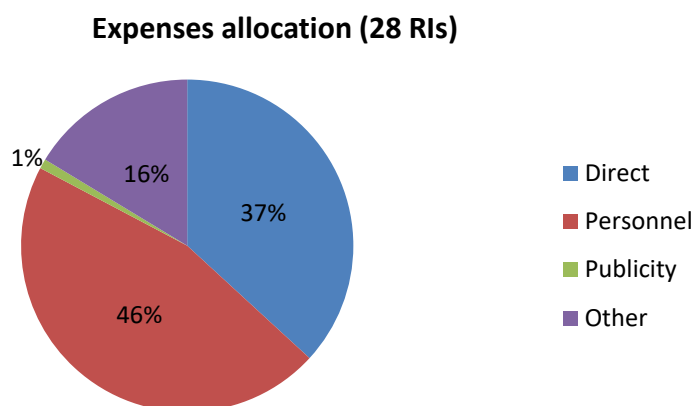


Figure 17: Expenses allocation (28 RIs)²³

However, this trend is not common to all infrastructures. As shown in the figure below, 10 of the 28 RIs have invested more in the supply of equipment, with only 3 being somewhat balanced, while the rest clearly have invested more in human resources. In fact, in the case of "ENIRISST", "SODANET", "INVALOR" and "APOLLONIS" the personnel expenditure exceeds 70% of the total budget for each. The opposite, i.e., budget allocation over 70% towards equipment, can be seen only in the case of "CALIBRA" RI, which is somewhat understandable given its field of research (Ion Beam Research).

²³ Own elaboration based on data provided from the Monitoring Committee of the OP Competitiveness and Entrepreneurship

Percentages of Direct and Personnel Expenses per RI

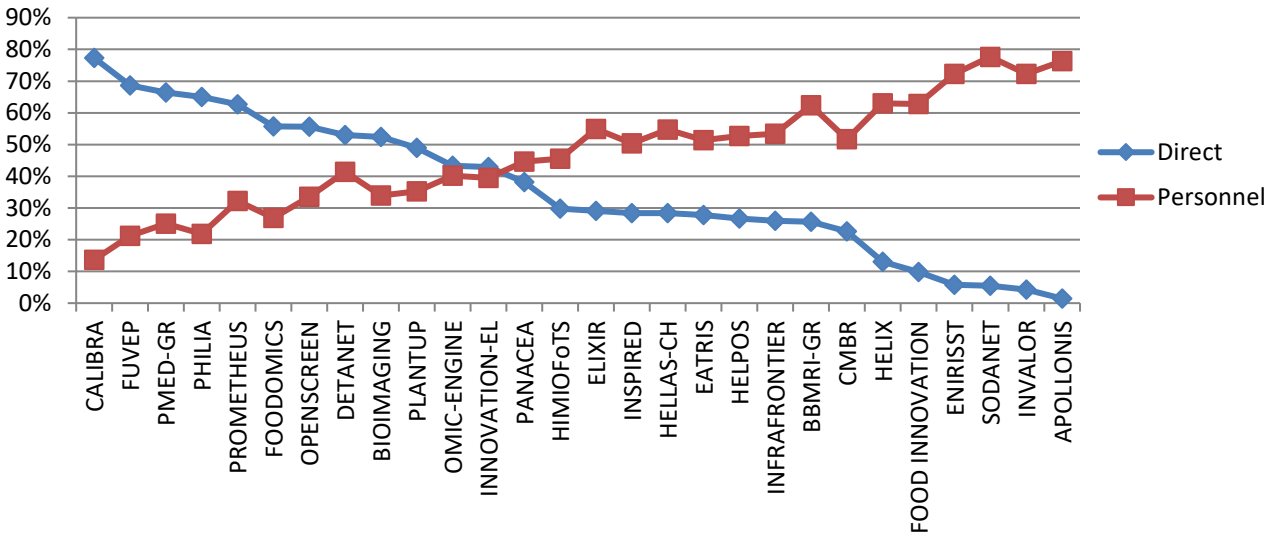


Figure 18: Percentages of Direct and Personnel Expenses per RI [23]

The breakdown of expenditure by Priority Area reveals the different trends that exist. In the table below it obvious that NRIs in the “Energy” Priority Area tend to prioritize their needs in equipment over those in personnel, while the opposite happens in the case of NRIs in the “Environment & Sustainable Development”, “Transport & Logistics” and “Culture, Tourism & Creative Industries” (last two are overly unbalanced).

Table 9: The breakdown of expenditure by RIS3 priority areas

Priority Area	Direct	Personnel
Energy	66%	26%
Materials & Constructions	48%	37%
Agrofood	40%	42%
Health & Pharmaceuticals	42%	43%
Environment & Sustainable Development	30%	49%
ICT	16%	64%
Transport & Logistics	6%	72%
Culture, Tourism & Creative Industries	1%	76%

3.4.3 Budget distribution

More than half of the approved budget was directed to the Attica region. This was to be expected as in this region, the vast majority of the country's universities and research centres are established.

From the table below, it is worth noting that the Greece's less developed regions were approved to receive almost 31% of the total budget. Region of Central Greece had no participating organisation (laboratory).

Table 10: Budget distribution per region

Region	Approved Budget	Approved Budget in %	Status
Attica	48,006,122	52.27%	More developed
Crete	12,318,290	13.41%	In transition
Central Macedonia	12,001,469	13.07%	Less developed
Western Greece	7,943,809	8.65%	Less developed
Thessaly	3,716,450	4.05%	Less developed
Eastern Macedonia and Thrace	2,567,215	2.79%	Less developed
Epirus	1,930,532	2.10%	Less developed
North Aegean	1,830,254	1.99%	In transition
South Aegean	730,000	0.79%	More developed
Western Macedonia	300,319	0.33%	In transition
Ionian Islands	290,000	0.32%	In transition
Peloponnese	215,890	0.24%	In transition
TOTAL	91,850,351	100%	

As for the distribution of the approved budget at the level of institutions a large part was directed to research centres (around 47 mi Euros).

Table 11: Approved budget for institutions

Institution	Approved Budget
Hellenic Centre for Marine Research	8.668.546
Aristotle University of Thessaloniki	8.607.642
National Kapodistrian University of Athens	7.809.744
National Centre for Scientific Research «Demokritos»	7.765.268
Foundation of Research and Technology- Hellas	7.238.230
University of Patras	6.778.962

Biomedical Sciences Research Center "Alexander Fleming"	4.375.377
GRNET S.A. – National Infrastructures for Research and Technology	3.820.824
University of Thessaly	3.716.450
National Technical University of Athens	3.522.890
University of Crete	3.171.301
Centre for Research & Technology Hellas	3.109.708
"Athena" Research and Innovation Center	3.016.499
National Observatory of Athens	2.515.936
Democritus University of Thrace	2.475.445
Academy of Athens	2.406.045
University of the Aegean	1.830.254
University of Ioannina	1.619.532
Agricultural University of Athens	1.610.483
National Hellenic Research Foundation	1.559.058
Technical University of Crete	982.800
Hellenic Mediterranean University	850.283
Benaki Phytopathological Institute	830.000
Hellenic Pasteur Institute	727.279
National Centre for Social Research	464.900
University of Western Macedonia	300.319
Ionian University	290.000
Harokopio University of Athens	285.000
Earthquake Planning and Protection Organization	269.810
University of the Peloponnese	215.890
Mediterranean Agronomical Institute of Chania	160.000
Ormylia Foundation	155.000
International Hellenic University	129.120
Hellenic Institute of Metrology	125.000
University of Piraeus	121.027
Panteion University	97.000
University of West Attica	93.492
Centre of Planning and Economic Research	85.238
School of Fine Arts	50.000
TOTAL	91.850.351

4. Development of Greek RIs (2019-2021)

Chapters 4, 5, 6 & 7 summarize the results obtained from the questionnaires. Chapter 4 focuses on the main development activities of the NRIs during their creation and operational phase. The aim is to describe in a summarized, concise and cohesive way the outcomes of the RIS3 Pillar 2 so as to assist the external independent experts for the final PSF review to formulate suggestions in particular for Area 1 (RIs governance and management efficiency) and Area 3 (Indicators for monitoring and assessment of the RIs).

As defined by the Call for Tenders, the 28 approved NRIs allocate their budget in:

- i. procure and install new equipment at some of their nodes,
- ii. hire young scientists and highly-skilled technical personnel,
- iii. support experienced researchers at improved facilities/nodes,
- iv. develop services to be offered,
- v. explore new scientific endeavours and possibly create new services through Joint Development Actions (JRAs) –oriented towards basic joint research, developmental activities, promotion of scientific excellence and dissemination of scientific results through peer-reviewed journals and conference presentations,
- vi. consolidate the network among its constituent nodes,
- vii. create their own governance scheme and access policies, and
- viii. operate under pilot phases.

As is easily deduced, actions (i)-(v) were to be used to pave the way for the NRI to grow and develop, with actions (vi)-(viii) being their desired outcome and final goals. Under this light, Chapter 4 summarizes how the NRIs were developed by focusing on the types of services they created, the types of users they aimed for and attracted during the pilot phase and the percentage of operational time that was dedicated to the NRI users during the pilot phase. The latter is compared to the percentage of the operational time of the NRI equipment per annum available to internal and external users for the period 2011-2020 in an effort to elucidate whether the creation of the NRIs has planted the seeds for the intended increase in operation by external users.

At the same time, Chapter 4 collates the various governance schemes that were opted, but most importantly how they were assessed by the NRIs themselves in terms of their effectiveness as well as legal and administrative issues and human resources.

A third important aspect of this Chapter, apart from the preliminary mapping of the NRI development, which is based on a set of objective metrics, is that it contains a summary of the *NRIs self-assessment* for an equally important set of more subjective metrics, namely the Level of Maturity they reached, and other important results and success stories they achieved during their development and pilot operation that are not necessarily linked to the output indicators, but are equally significant in demonstrating the level of maturity and the successful implementation of the governance and access schemes.

Subsequently in Chapter 4, the self-assessment of the NRIs is explored in terms and the competition they may face in the European and/or global terrain. Again, such a mapping is necessary to assist the experts in formulating suggestions.

Chapter 4 is concluded with a short mapping of the current funding status of the NRIs. All information contained in this Chapter was gathered by parts of Sections 2 and 3 of the appended Questionnaire and in particular Questions 8-16, 19-22 and 25. It is important to note at this point that one (1) of the NRIs, "HELIX", provide answers to the questionnaire after the completion of the present report. At the same

time the NRI “PROMETHEUS” submitted two separate responses, one from the coordinator (CERTH- Hellas) and one from the other partner (NCSR). The reason was that the two partners had opted to operate as two separate and independent single-partner infrastructures, one managed by “CERTH-Hellas”, which has maintained the name “PROMETHEUS” and the second one managed by NCSR, which is called “ARCHIMEDES”. As declared by “PROMETHEUS” (Question 28):

“The RI “ARCHIMEDES” was at first constrained by the non-voluntary merging with another RI with a different field of focus since the beginning of the current phase. Though this admittedly did not hinder its autonomous development, it did however prove to be inefficient from the governance and administrative point of view. The developed NRI at NCSR “DEMOKRITOS” has now built its own separate identity, marked by its own name “ARCHIMEDES” and own logo, a clearly-defined scope and objective and it is capable of proceeding further in a more independent fashion.”

4.1 Services – Users – Operational Time

This first section of Chapter 4 is a summarized description of the pilot phase operation of the NRIs, which is the culmination of the funding period of the NRI projects. As such, this section summarizes (i) the types of services offered through the NRIs (data derived from Questions 8 and 9), (ii) the main target groups of users (data extracted from Question 10), and (iii) the allocation of operational time between the academic sector and the non-academic users. This time allocation is split into two distinct periods, the first period extending between 2011 and 2020 (period prior to the operation of the NRIs, therefore the data corresponds to the annual sum of allocated time by each of the NRI constituent partners as individual entities) and the second period only referring to year 2021, which corresponds to the period of NRI operation (data derived from Questions 12 and 11, respectively).

Table 12 summarizes the number and percentage of NRIs providing each type of service within the list of Question 8 (which is also included in the Annex). The table additionally provides the cumulative number and percentage of NRIs offering services within the larger service type. The detailed description of the other types of services that the Greek NRIs offer as stated in Question 9 are included in the description of the NRIs in the Annex. Results are also presented in Figures 19, 20 and 21 depict the number of NRIs offering the various sub-types of services per service type, with the exception of types 3, 7 and 9, which do not have sub-types and type 8, which contains only one NRI. Finally, Figure 22 depicts the percentage of NRIs (out of the 28 NRIs) that offer each service sub-type in descending order.

Table 12: Number of NRIs per service type²⁴

Type of Service	Number of NRIs	Percentage of NRIs (out of 28)	Percentage of NRIs per general service type
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²⁴ Own elaboration based on Questionnaire results

1. Access service	25	89%	
1a. access to data	16	57%	64%
1b. access to software	16	57%	64%
1c. access to central infrastructure for IT resources and digital services	11	39%	44%
1d. access to aggregators	4	14%	16%
1e. access to facilities	25	89%	100%
1f. access to equipment	24	86%	96%
2. Analysis service	22	79%	
2a. data analysis service	21	75%	95%
2b. sample analysis service	22	79%	100%
3. Expertise (consultancy) service	27	96%	
4. Data management	13	46%	
4a. maintenance service	11	39%	
4b. data storage service	13	46%	
5. Material processing service	12	43%	
5a. material maintenance and modification	8	29%	67%
5b. material production service	12	43%	100%
5c. material storage service	6	21%	50%
6. Support service	24	86%	
6a. project development	21	75%	88%
6b. development of models and tools	22	79%	92%
6c. development of solutions	21	75%	88%
6d. certification and benchmarking	8	29%	33%
6f. knowledge and technology transfer	24	86%	100%
7. Training and education service	25	89%	
8. Logistics service	1	4%	
8a. financial service	0	0%	
8b. transport service	0	0%	
8c. other logistics services	1	4%	
9. Other	10	36%	

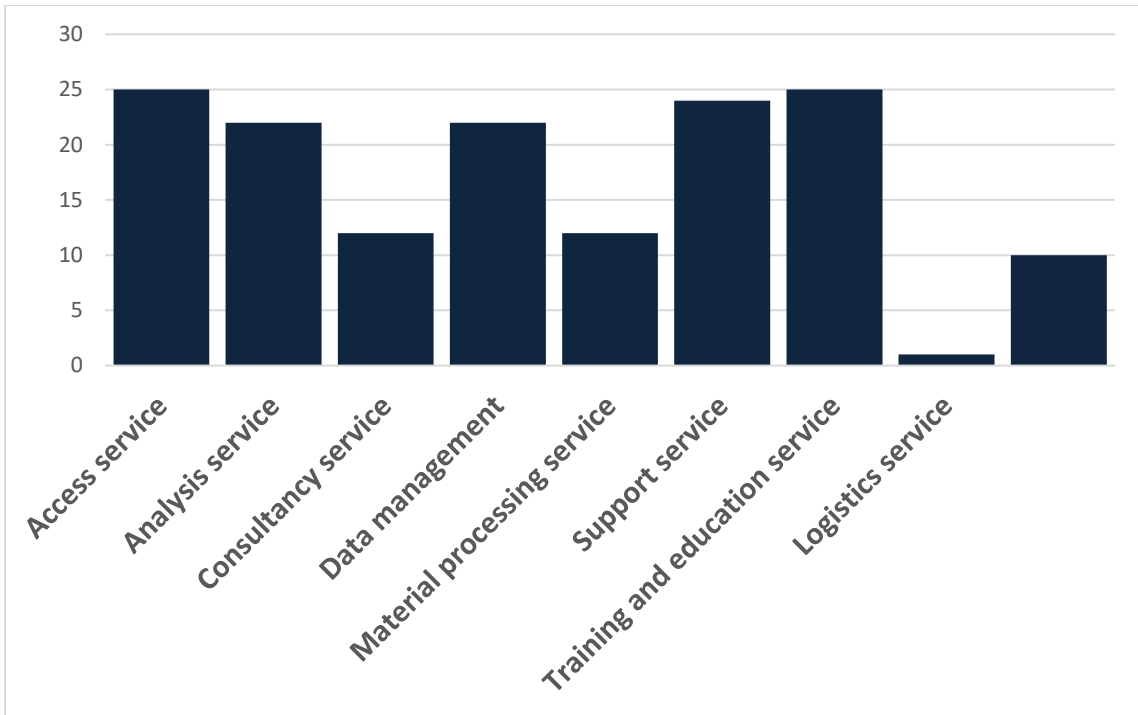


Figure 19: Number of NRIs per service type [24]

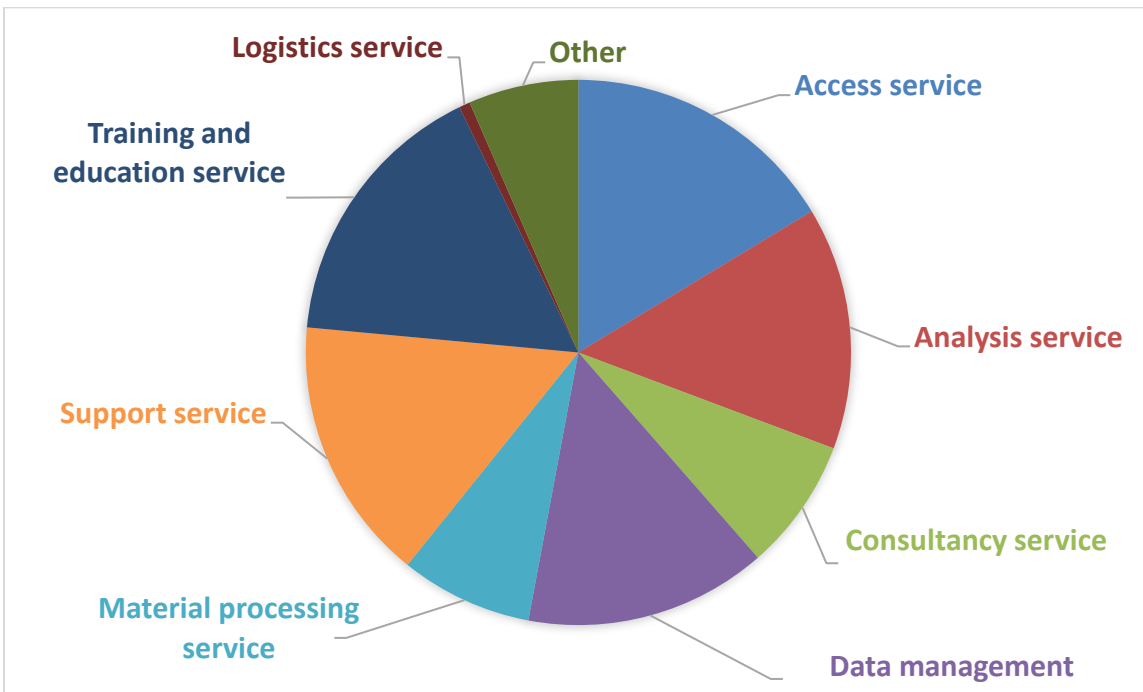


Figure 20: Relative distribution of service types among the 28 NRIs [24]

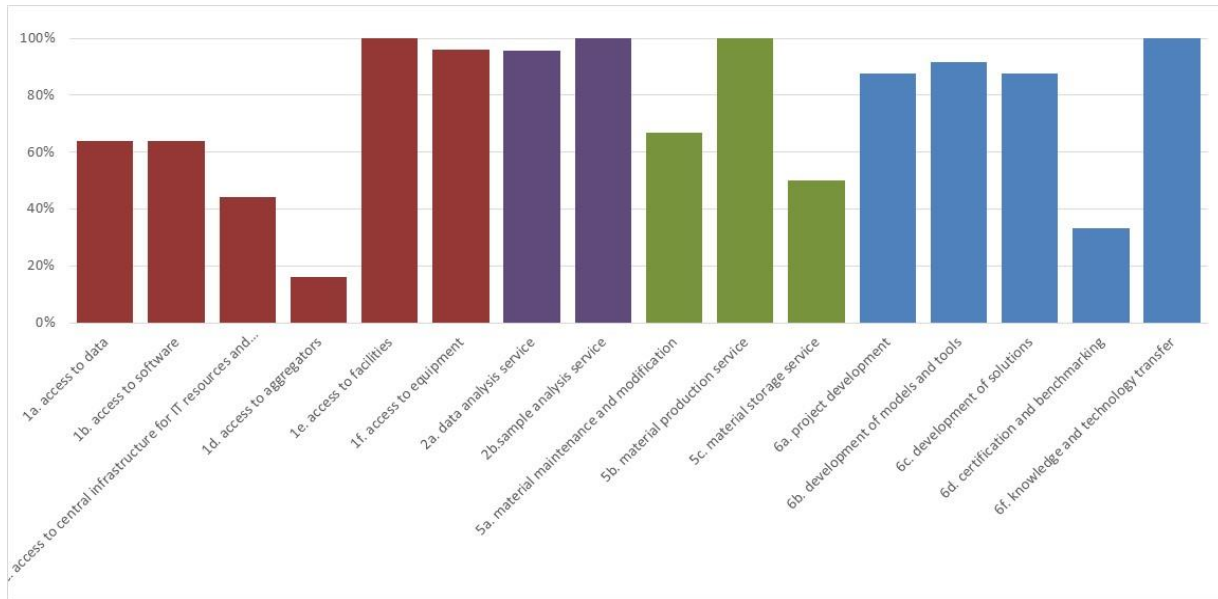


Figure 21: Percentage of NRIs per service sub-type (percentages are calculated with respect to the total number of NRIs offering services within the general service type and not with respect to the total number of NRIs) [24]

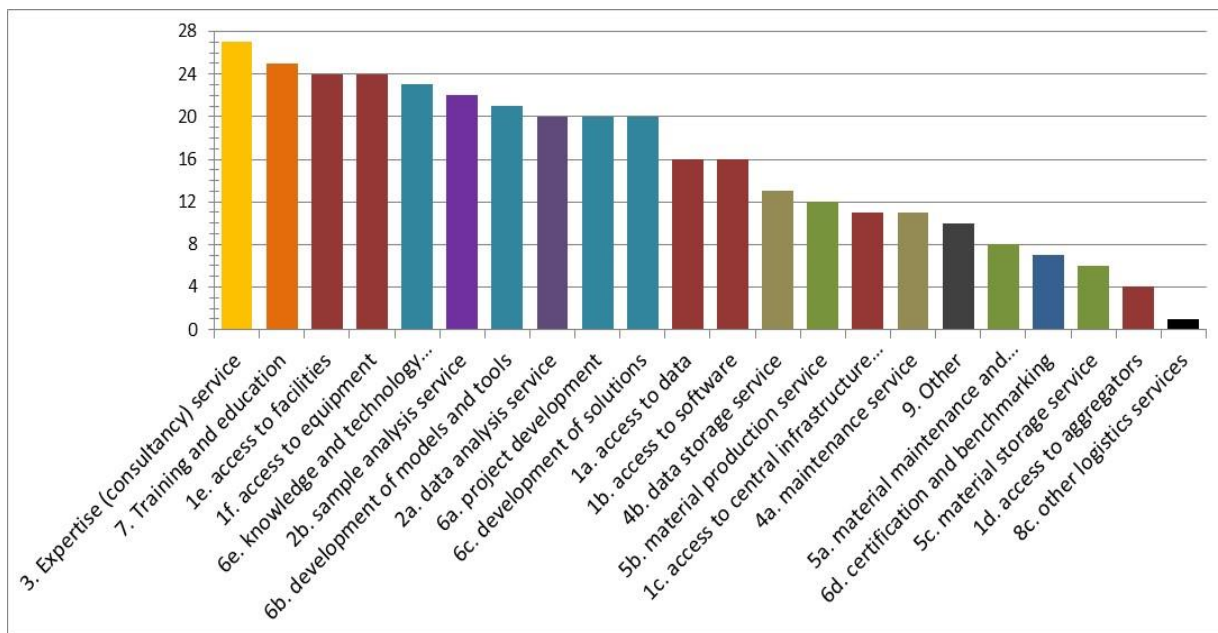


Figure 22: Number of NRIs offering specific service sub-type in descending order (general service types are indicated by color coding; 1. Access service: red, 2. Analysis service: purple, 3. Expertise service: yellow, 4. Data management: light brown, 5. Material service: green, 6. Support service: blue, 7. Training and education: orange, 8: Logistics services: black, 9. Other: grey) [24]

The main findings on **Services** are:

- Most NRIs (25/28) provide **access to their facilities** and equipment in accordance with their mission. Exceptions are “APPOLONIS”, “EATRIS-GR” and “ELIXIR-GR”, which have responded that they *don’t provide access* to their facilities.
- Almost all NRIs (27/28) provide **consulting services** with the exception of “PHILIA”.
- Almost all NRIs (25/28) provide **training and education activities** with the exception of EATRIS-GR, “pMED-gr” and “PROMETHEUS”.
- The most common type of services with at least **50% of the NRIs** offering them fall within four major categories: 1. *Access service*, 3. *Expertise (consultancy) service*, 6. *Support service*, 7. *Education and training*.
- There is limited access to aggregators with only 4 NRIs offering this type of service (“APPOLONIS”, “OPENSREEN-GR”, “INSPIRED” and “HiMIOFoTS”).
- There is only one NRI for logistics services (“EN.I.R.I.S.S.T”), which provides 6 other types of logistics services (see Table 12).

Next, the questionnaire explored the level of importance the NRIs attribute to each of five large categories of end-user target groups, namely (1) Researchers among the NRI partners, (2) Researchers from other universities, (3) Start-ups, (4) SMEs, and (5) Large Companies. The ratings were given within a scale from 1 (most important) to 5 (less important) in Question 10. Table 13 shows the number of NRIs per end-user type per rating and the results are figuratively represented in Figure 23.

Table 13: Number of NRIs per rating of importance per end-user category [24]

	1 (most important)	2	3	4	5 (least important)
Researchers from the NRI partners	22	4	2	0	0
Researchers from other universities	22	2	2	1	1
Start-ups	13	6	6	2	1
SMEs	14	6	7	0	1
Large Companies	14	10	4	0	0

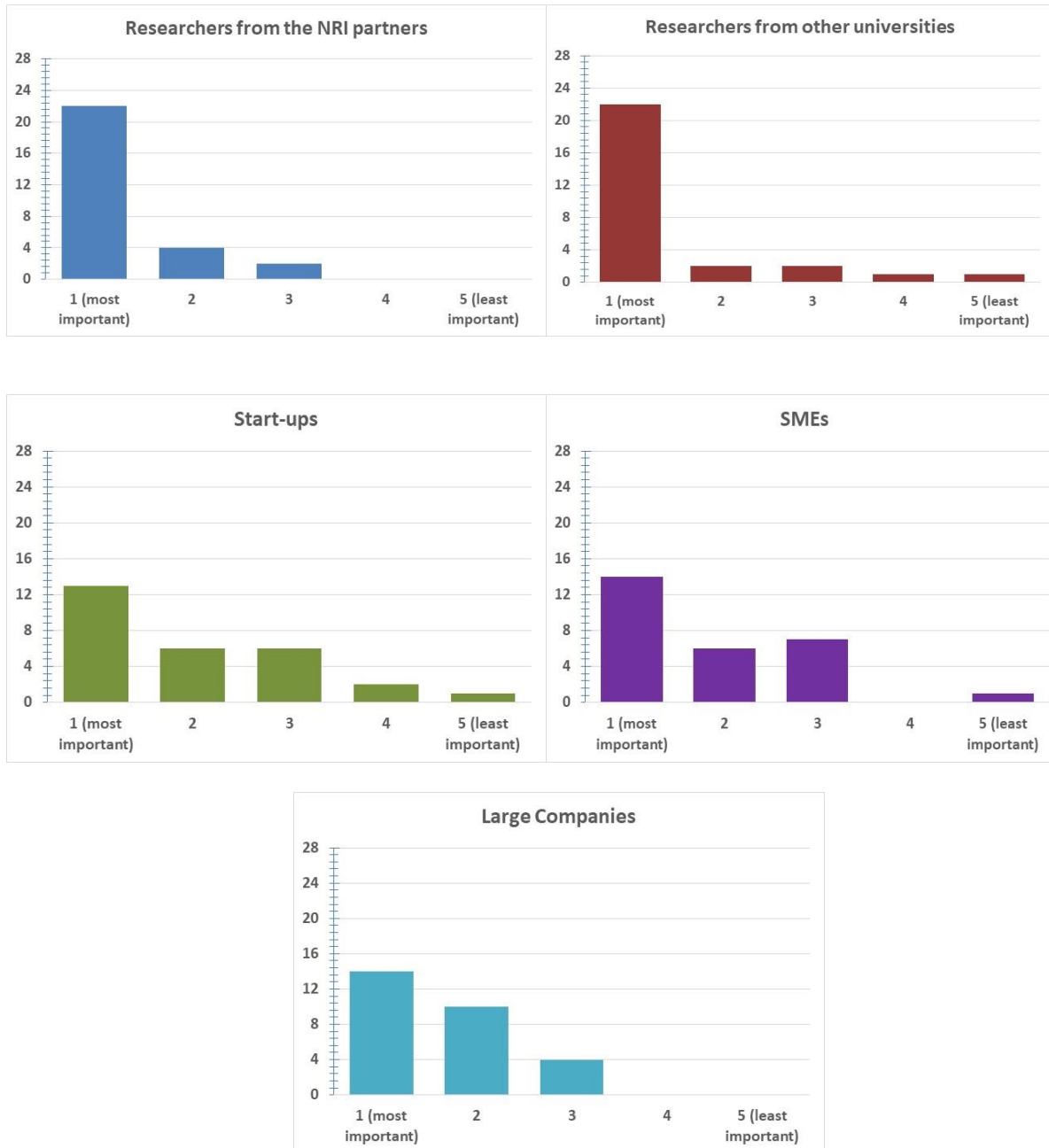


Figure 23: Number of NRIs per level of importance for the target group (a) Researchers from NRI partners, (b) Researchers from other universities, (c) Start-ups, (4) SMEs and (5) Large Companies [24]

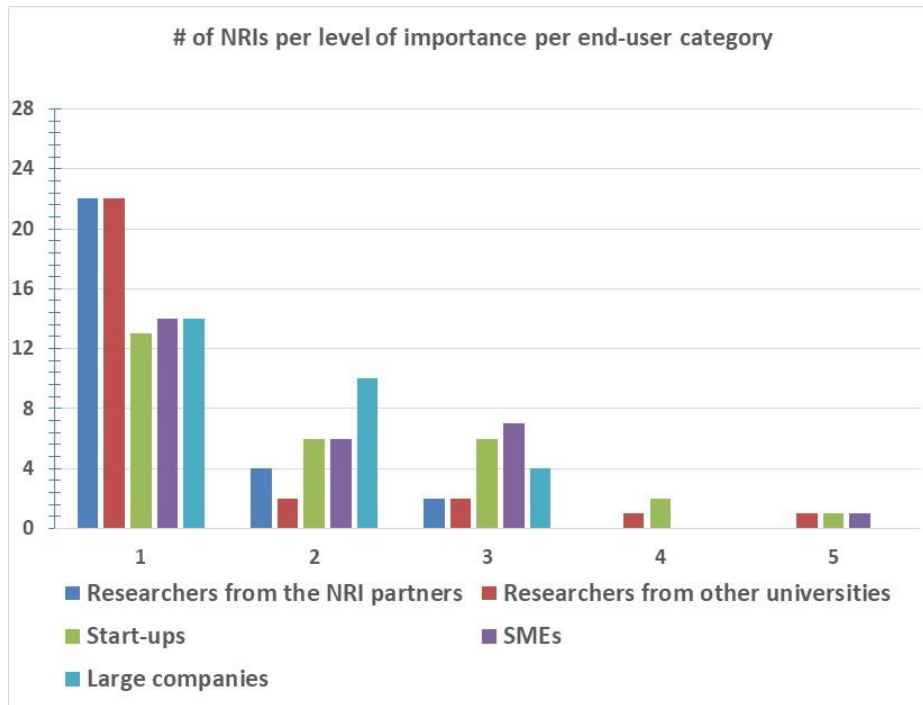


Figure 24: Number of NRIs per importance rating per end-user category presented in a cumulative format [24]

9 out of the 28 NRIs indicated in Question 11 other types of users they offer or wish to offer services to. Table 14 compiles the answers with regards to the other types of users these NRIs identified. Some answers also include the level of importance attributed to these other user types.

Table 14: List and description of other types of end-users as identified by the NRIs [24]

Name of NRI	Other types of end-users
CALIBRA	National authorities (mostly for analytical services)
EN.I.R.I.S.S.T.	Public authorities (national and local authorities): (1); European Commission: (1); European Investment Bank: (1); OECD: (2); UNECE and other international organizations: (2); Research projects in need of relevant data: (1)
FuVEP	National and/or International Organizations, Public Bodies, Policy makers, etc. à Score 1 (most important)
HiMIOFoTs	Governmental authorities which deal with the marine environment and surface waters, State agencies that handle emergency cases (pollution accidents in the sea, floods) such as the Coast Guard and/or the Civil protection agency, National Meteorological Service, general public
Innovation.EL	Students of all levels and junior researchers (2), Public bodies (2)
INSPIRED	"INSPIRED" RIs have been supported by : 13 Greek Industries/Companies/SMEs/Clusters of Enterprises (7 active in Health-Drug-Diagnostics-Biobanks for stem cells and 5 active in Food-

	Agricultural and livestock farming products), 4 Large companies from abroad active in specialized laboratory equipment, 10 Greek academic-research public organizations (4 University hospitals, 6 Higher & Technological Educational Organizations in the country, 1 public organization), 10 European academic and Research Organizations, 2 International academic and Research Organizations, 1 ESFRI Landmark (Instruct-ERIC), 4 Complementary RIs in Greece (also affiliated with ESFRI projects), 4 Regions
OPENSREEN-GR	Farmers, Regional Administration of Epirus (UoI)
PlantUp	Researchers from the university, that are not NRI partners
pMED-GR	Clinicians/Clinical researchers from hospitals and clinics
So.Da.Net	Students, Press/Journalists, Political Bodies, Government, NGOs, Citizens

The main trends that emerged for **Users** are:

- The majority of the NRIs (22/28 or 79%) consider Researchers from both the NRIs partners and other universities as the most important target groups (rating 1), while 6 NRIs place them as second most important (rating:2) and 4 NRIs consider them of medium importance (rating:3). Only 2 NRIs list researchers from other universities as the least important target group (one rating of 4 and one rating of 5)
- Approximately 50% of the NRIs **acknowledge the private sector** (start-ups, SMEs and Large companies) **as of top importance** and place it at an equal footing to the academic. About 20% of the NRIs view the private sector (start-ups, SMEs and large companies) as the next important target groups (giving a rating of 2), while the rest 20% as of medium importance (rating:3). Only 3 out of the 28 NRIs view start-ups and SMEs as the least important target groups.
- Among the other types of target end-users, 7 out of the 9 NRIs indicated **national and European public bodies and authorities**.

The final part of the section gathers information with regards to the **allocation of operational time** to the academic and non-academic sector. The information is divided into two periods, one prior to the pilot phase of the NRIs (2011-2020) and one during the pilot phase, which lasted one year (2021). The data were collected from Questions 11 and 12. Three of the NRIs ("APPOLONIS", "ELIXIR-GR" and "So.Da.Net") provided as an answer that they partition the time 100% to both two sectors. It was assumed that the intention is the equipartition of time to both sectors, therefore the answers were corrected to 50%-50%. Table 15 demonstrates the time allocation for the two periods for each NRI. The aforementioned corrected values are indicated in italic.

Table 15: Percentage of operational time of the NRI equipment per annum for the academic and non-academic sectors prior and during the pilot phase [24]

NRI	2011-2020		2021	
	Academic-Research (% of operation time per annum)	Non-academic (% of operation time per annum)	Academic-Research (% of operation time per annum)	Non-academic (% of operation time per annum)
APOLLONIS	50	50	50	50
ARCHIMEDES	N/A	N/A	N/A	N/A
BBMRI-GR	75	25	65	35
BIOIMAGING-GR	100	0	100	0
CALIBRA	90	10	80	20
CMBR	85	15	90	10
DeTAnet	50	0	50	0
EATRIS-GR	30	30	30	30
ELIXIR-GR	0	0	50	50
EN.I.R.I.S.S.T.	100	0	100	0
Food Innovation RI	24	10	50	11
FoodOmicsGR	85	15	80	20
FuVEP	96	4	95	5
HELLAS-CH	90	10	90	10
HELPOS	95	5	90	10
HiMIOFoTs	80	20	75	25
Infrafrontier – GR / Phenotypos	88	12	84	16
Innovation.EL	25	12	30	15
INSPIRED	15	5	25	5
INVALOR	15	10	10	5
OMIC-ENGINE	80	20	80	20
OPENSREEN-GR	80	20	80	20
PANACEA	85	15	75	25
PHILIA	80	20	0	0
PlantUp	90	10	70	30
pMED-GR	100	0	100	0
PROMETHEUS	80	20	100	0
So.Da.Net	50	50	50	50

The main observations on the **Operational Time** as follows:

- **10 out of 28 NRIs** (36%) have **increased** the time allocated to the non-academic sector during the pilot phase.
- 4 out of 28 NRIs (11%) have increased the time allocated to the academia/research reducing correspondingly the time allocated to the non-academic sector. One (1) of these ("PROMETHEUS") has allocated its time exclusively to academia/research during the pilot phase.
- **8 out of 28 NRIs** (29%) have **maintained practically the same time allocation** for the two sectors during both periods, with the largest time allocated to academia/research (marked in orange). Specifically, three (3) NRIs dedicate all their operational time to academia/research ("BIOIMAGING-GR" and "EN.I.R.I.S.S.T.") and one (1) (FuVEP) reserve only 5% to the non-academic sector.
- 4 out of 28 NRIs (14%) have not changed the annual percentage of time allocated to both sectors, with these percentages equipartitioned between academia/research and the non-academic sector.
- 2 NRIs (7%), "ARCHIMEDES" and "PHILIA", seem to have not allocated time to external users during 2021 (marked in yellow). "ARCHIMEDES" specifically did not report any operational time even for the period 2011-2021.
- 1 NRI ("ELIXIR-GR") started allocating time to external users only with the beginning of its operation in 2021.

4.2 Governance

An important factor of any RI operation is its governance scheme and its subsequent effectiveness. The NRIs were asked to provide a self-assessment on 7 criteria related to the governance structure (Question 13). These 7 criteria were:

1. Representation of partners in the NRI
2. Administrative and financial practices of the partners organisations
3. Project management and coordination of partners' activities
4. Human resources (including gender/diversity) policy
5. (FAIR) data management policy
6. Knowledge management / intellectual property policy
7. Ethics policy

The various criteria were to be scored in a scale from 1 to 5 (1- Requires significant improvement, 2- Requires some improvement, 3- Satisfactory, 4- Good, 5-Very good). There was also the option of answering "non-applicable", since some of the criteria may indeed be non-applicable to specific NRIs due to the nature of their mission or to the nature of the governance scheme they had opted for.

Given the diverse nature of the 28 NRIs and the different needs that arise both by their mission and their thematic areas, the Questionnaire provisioned an additional question that could be answered in free-from allowing comments on the governance structure each NRI has opted for (Question 14).

Question 15 was again in the form of open question where the NRIs would provide the description of their governance scheme.

Figures 25- 31 present the answers provided by the NRIs (Question 13) per self-assessment criterion, while Figure 32 concentrates the average and median values of the satisfaction level per criterion. For the calculation of the average and median values the answers “non-applicable” have not been taken into account.

ANNEX III gathers the free-text answers to Question 14, which provide comments on the ratings. 18 out of the 28 NRIs provided comments to either justify the rationale behind their ratings or to pinpoint particularities on the governance criteria that could not be covered by a simple rating value.

As far as the descriptions of the governance structure (Question 15), each NRI has provided a detailed description of the chosen governance scheme, which can be found in the questionnaires. As a general comment, one might say that in their majority the NRIs have chosen up to now a more “traditional” governance scheme similar to research projects with technical, managerial and dissemination committees. This is logical since all NRIs are not separate legal entities, they cannot decide for themselves for major issues and they cannot pay each other easily for the common provision of services to third parties. Several NRIs are in the process of developing new governance structure more closely related to the models of ESFRI or ERIC RIs. So far only “OMIC-ENGINE” states that has established a dedicated project office.

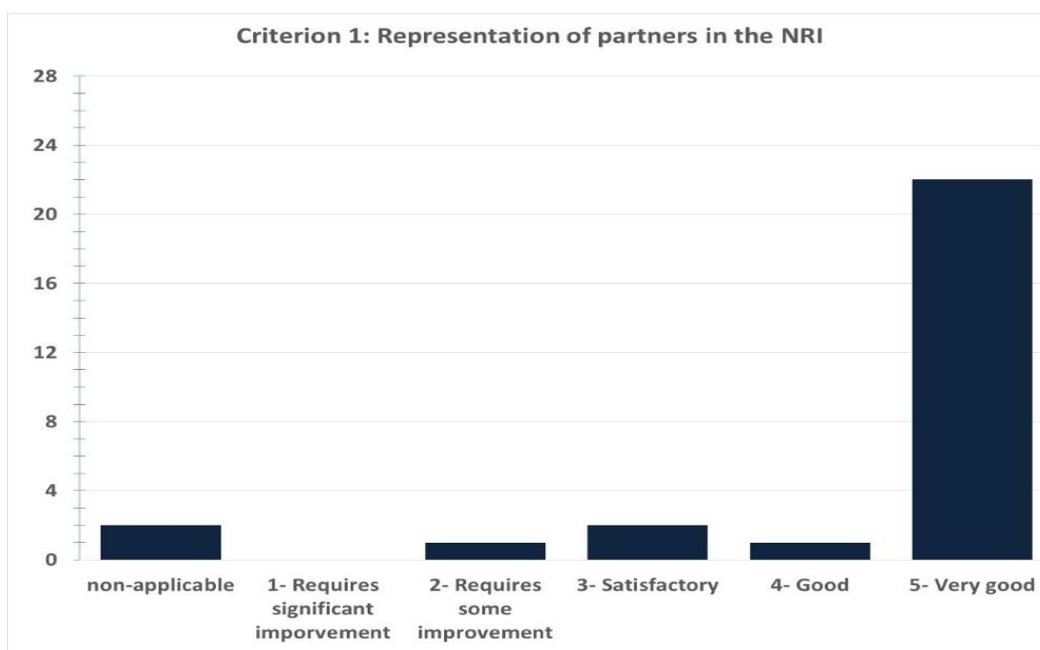


Figure 25: Number of NRIs per rating score for Criterion “Representation of partners in the NRI” [24]

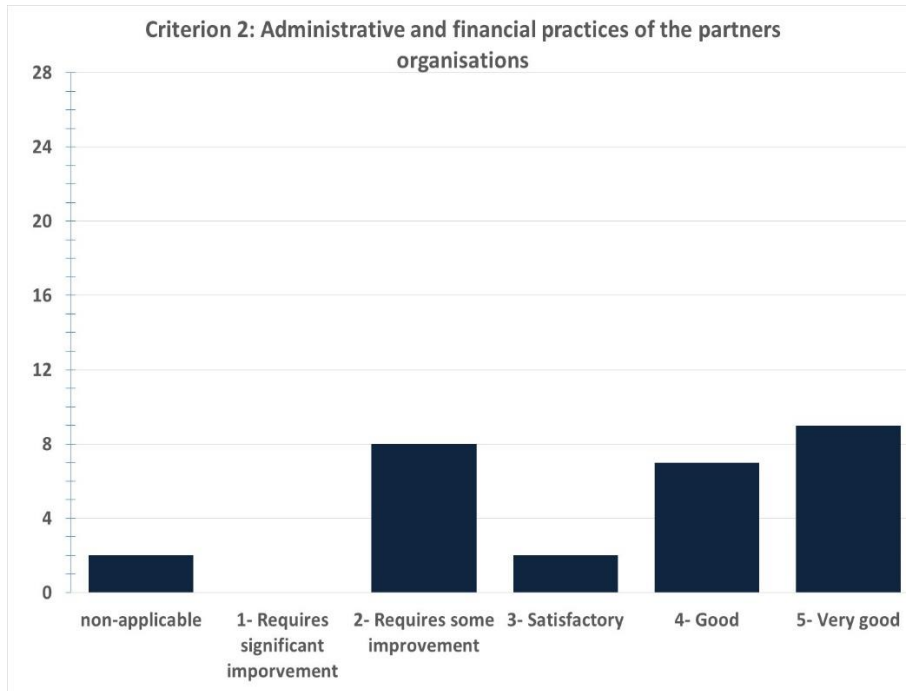


Figure 26: Number of NRIs per rating score for Criterion "Administrative and financial practices of the partners' organizations" [24]

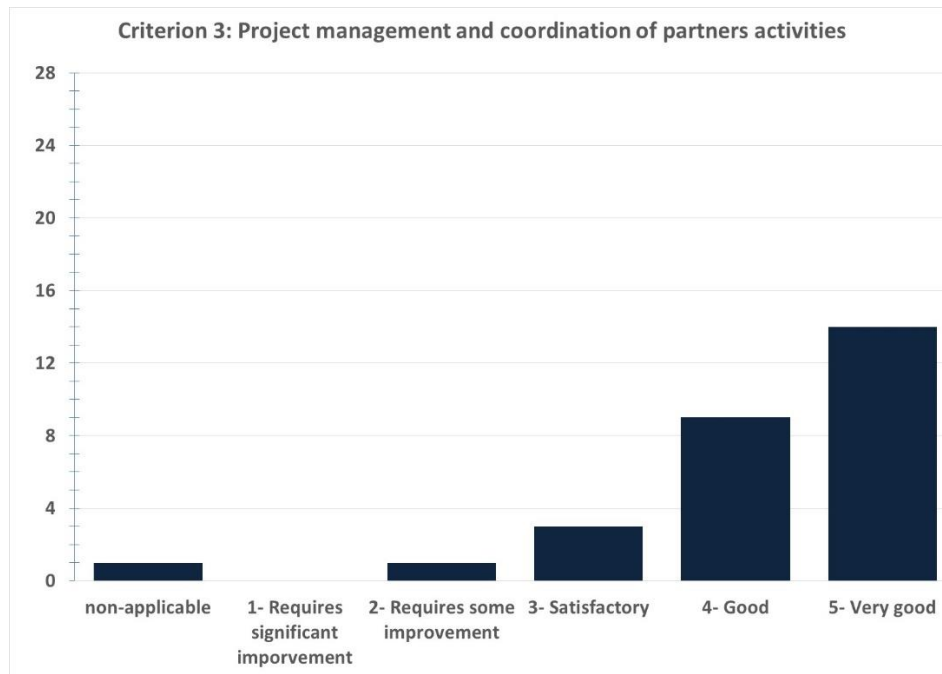


Figure 27: Number of NRIs per rating score for Criterion "Project management and coordination of partners' activities" [24]

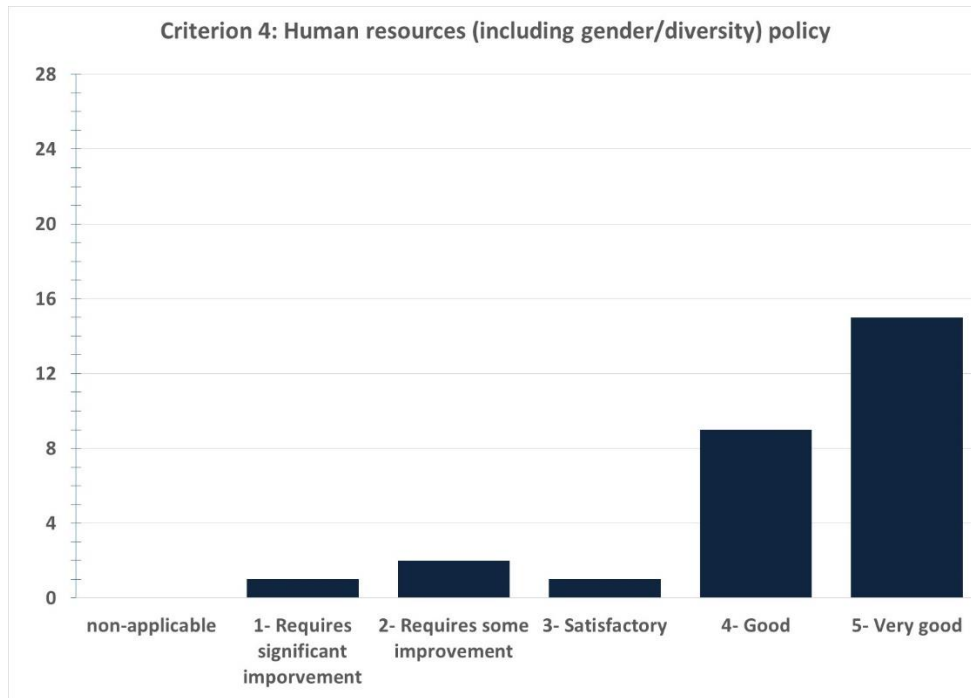


Figure 28: Number of NRIs per rating score for Criterion "Human resources (including gender/diversity) policy" [24]

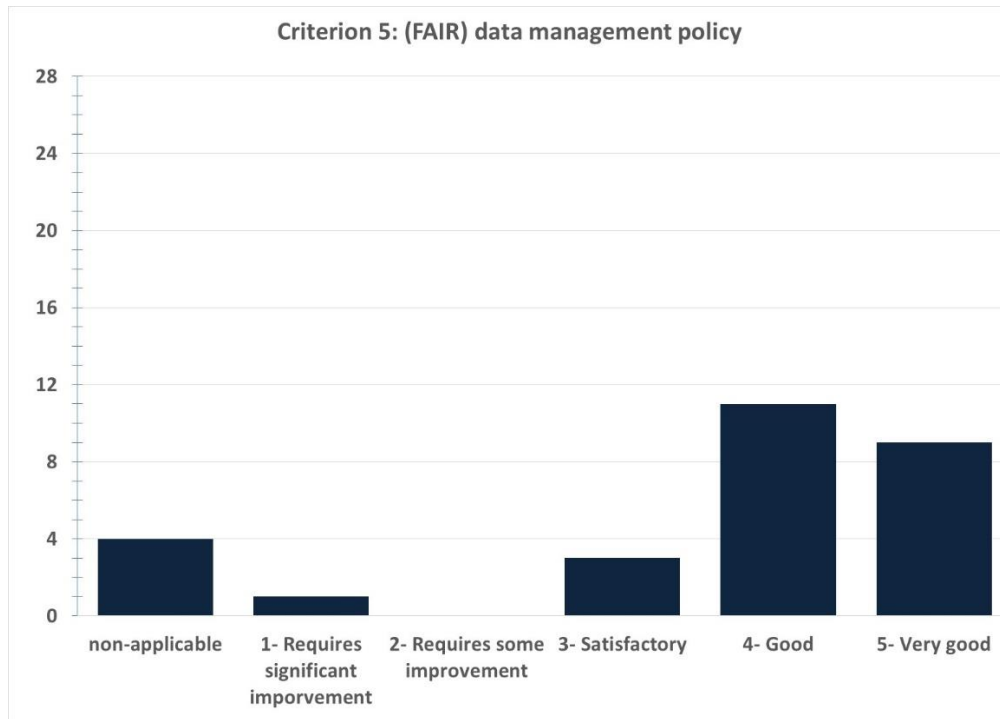


Figure 29: Number of NRIs per rating score for Criterion "(FAIR) data management policy" [24]

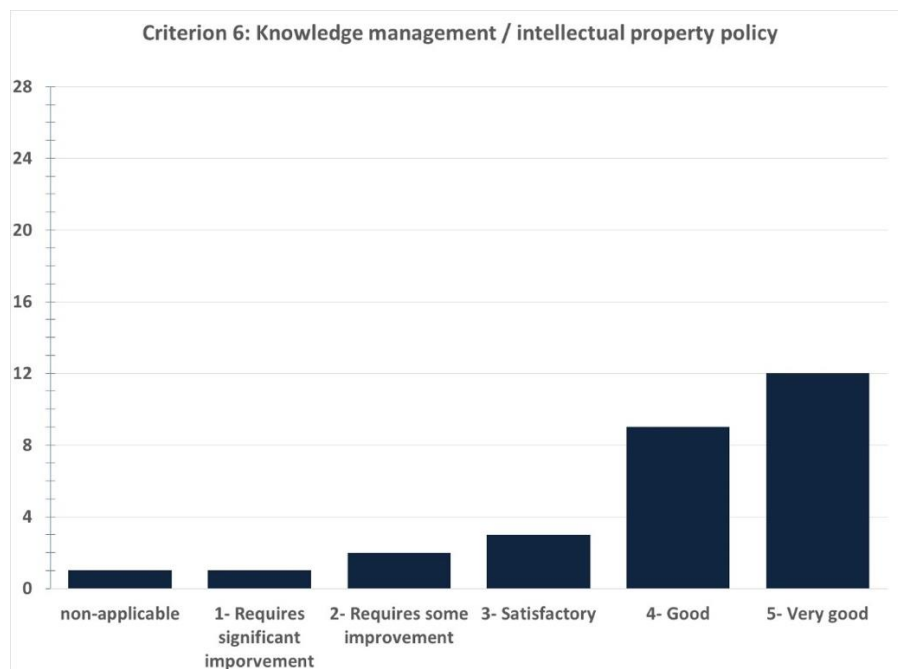


Figure 30: Number of NRIs per rating score for Criterion "Knowledge management / intellectual property policy" [24]

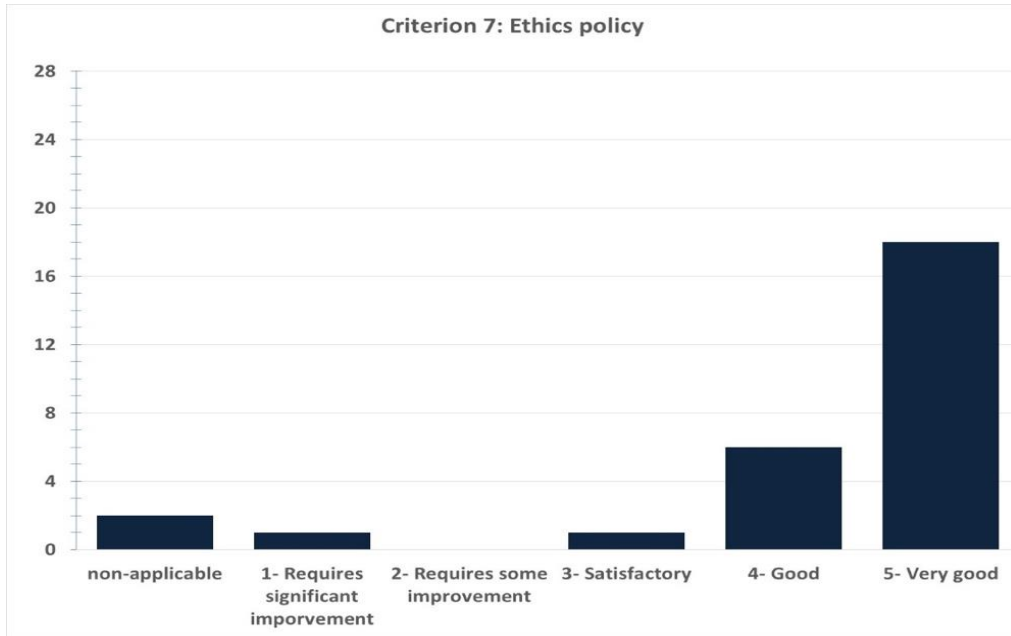


Figure 31: Number of NRIs per rating score for Criterion "Ethics policy" [24]

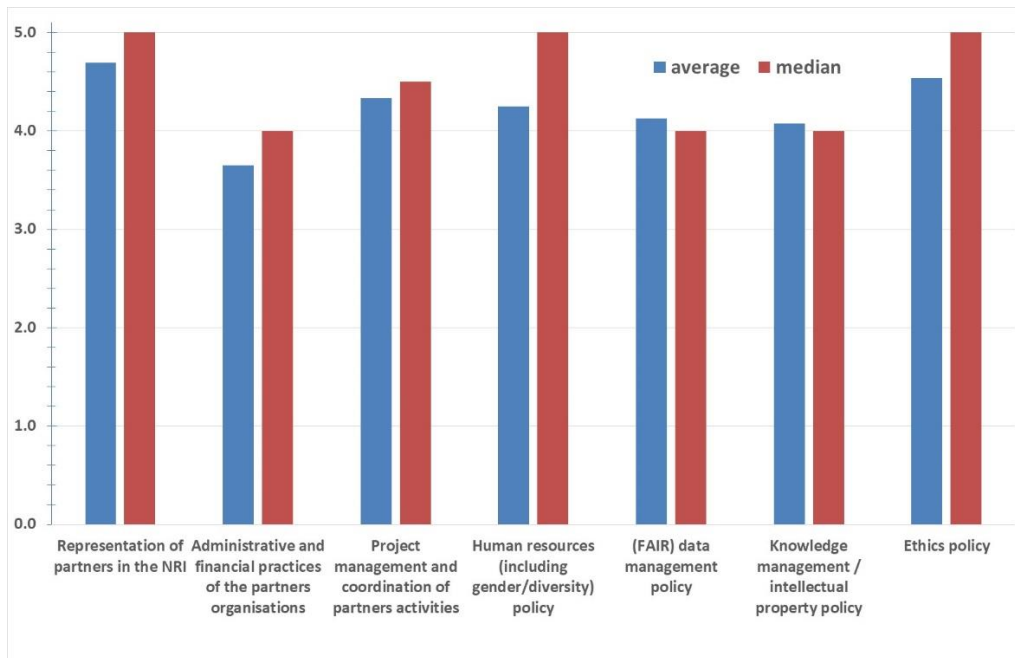


Figure 32: Average (blue bars) and median (red bars) values per governance criterion [24]

As can be seen from the statistical analysis:

- In general, NRIs show a **high degree of satisfaction** with respect to all criteria of governance with the average ratings and median values of the ratings exceeding 4. Only exception is the **“Administrative and financial practices of the partners organisations”** which had the lowest average rating of 3.7 and 30% of the NRIs believing that it requires significant improvement.
- Almost all NRIs (~83%) consider the representation of the partners as Very good (79%) or Good (4%). One (1) NRI considers it (“FoodOmics”) as “Good” and 2 (“CMBR” and “HELPOS”) as “Satisfactory”. This evaluation even applies to single-partner NRIs (such as “CALIBRA” and “PROMETHEUS”), which have interpreted the term “partners” in the sense that are extensively collaborating with external users and therefore have rated this aspect accordingly. In contrast, NRIs “ARCHIMEDES” and “INVALOR”, two other single-partner NRIs, have evaluated this aspect as “Non applicable”.
- 80% of the NRIs have rated **“project management and coordination” as well** as “human resources” highly. 50% consider both criteria as “Very good” and 30% as “Good”. In terms of “project management”, 3 NRIs (“BBMRI-GR”, “CMBR”, “INVALOR”) evaluate this aspect as “Satisfactory”, while “PHILIA” thinks that “Requires some improvement”. “ARCHIMEDES” considers it as “non-applicable”. In terms of human resources, 3 NRIs (“ARCHIMEDES”, “CMBR” and “FuVEP”) judge them as requiring some improvement, and one (1) NRI (“DeTANet”) as “satisfactory”. Regarding gender balance, the NRIs do not have a written policy per se; but it seems that they have managed to maintain roughly 60:40 male-to-female ratios; while in some isolated cases when recruiting the ration changed to 30:70. Only two NRIs state that have a relevant Committee for gender related issues.
- The rating of “ethics policy” is similarly rated highly by the majority of the NRIs, since 64% have evaluated as “Very good” and 21% as “Good”. “ARCHIMEDES” considers that it is “Satisfactory” and “CMBR” that is “Requires significant improvement”. “PROMETHEUS” and “FuVEP” evaluate this aspect as “Non applicable” to them.
- Data management policy (FAIR) is somewhat lower in the ratings, with about 62% of the NRIs evaluating as “Very good” (32%) or “Good” (30%). 3 NRIs (“HiMIOFoTs”, “Innovation-EL”, “INSPIRED”) believe it to be “Satisfactory” and 1 (“FuVEP”) as requiring significant improvement. For “ARCHIMEDES”, “DeTANet”, “PHILIA”, “CALIBRA” this aspect deemed as “non-applicable”. Most NRIs are making provisions to include improved data management schemes should they get a second round of funding.
- Finally, with respect to knowledge management almost 75% of the NRIs believe that its either “Very good” (43%) or “Good” (32%). 3 NRIs (“FuVEP”, “HiMIOFoTs”, “ARCHIMEDES”) consider it “satisfactory”, 2 as requiring some improvement (“PROMETHEUS” and “CALIBRA”) and 1 (“CMBR”) as requiring

significant improvement. "PHILIA" is the only NRI that considers this criterion as "non-applicable". However, through the **free-text answers a significant number of NRIs acknowledge that they don't have a policy for patent applications** and in general are reluctant to pursue patent applications due to the lack of relevant guidance and high costs associated with patenting. IP management is mostly relying on the maturity level of each partner organization. Nevertheless, there are exceptions like for example "BIOIMAGING-GR", which has already developed a roadmap for intellectual property exploitation, according to standards existing in the partner centres.

4.3 Maturity Level Self-Assessment, Important Results & Successes

The NRIs were called through the Questionnaire to provide a self-assessment of the maturity level they believe they managed to reach *with respect to international level standards of excellence and quality* (Question 19). The respective question entailed the rating from a scale to 1-5 (1-Significantly immature, 2- Somewhat immature, 3- Satisfactory, 4- Moderately mature, 5- Very mature) of the following six maturity criteria:

1. Scientific, technological potential - Scientific excellence, degree of interdisciplinarity, prospects for scientific and technological discoveries
2. Effective networking, synergies in the knowledge triangle and international promotion - Capacity and complementarity of the partners, added value at regional, national and international level, synergies, networking, critical mass, recognition, transparency
3. Access policy for researchers, industry, business and international users through openness to international markets
4. Sustainability Management structure, human resources, cost-effectiveness, long-term viability, clear investment plan
5. Innovation potential and contribution to private sector - Contribution to: innovation and technology transfer, creation of knowledge and innovative ideas, creation of high growth SMEs, green supply chain and circular economy
6. Contribution to National and Regional Development & Socio-Economic Benefits - Contribution to: private sector R&D, knowledge/employment-intensive activities, economic and social benefits and the impact of IPs on socio-economic issues

Provision was made so the NRIs had the opportunity to comment in a free-form text the reasoning for their scoring. Comments are included in ANNEX IV (Question 20).

Figures 33- 38 present an analysis of the answers provided by the NRIs (Question 19), a cumulative overview of the answers provided and the average and median values of the perceived maturity level per criterion, respectively. In addition, the average score of maturity per NRI was calculated as the average of the scores for the 6 criteria. The distribution of the average scores is shown in Figure 39.

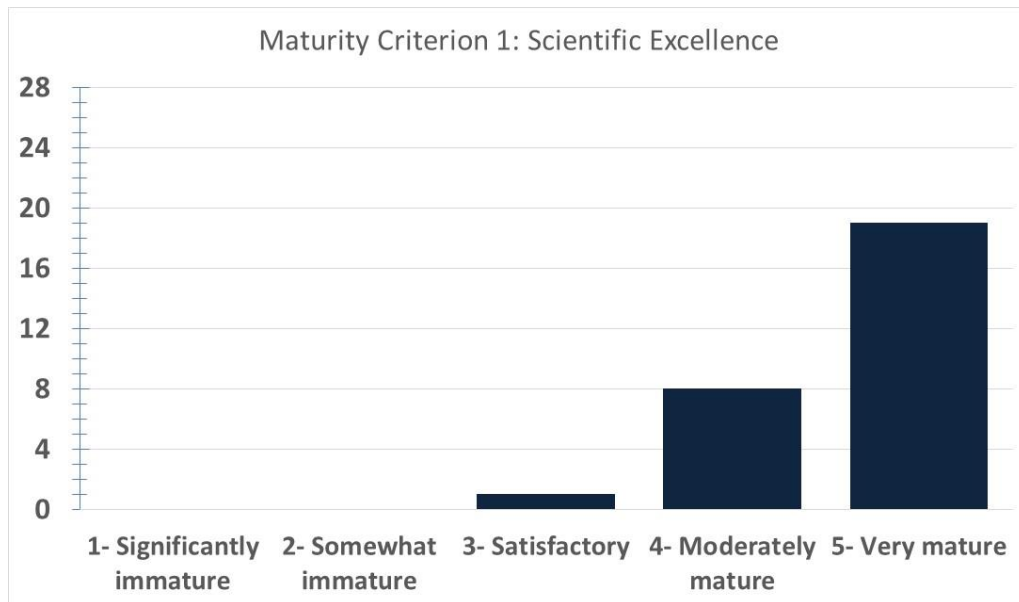


Figure 33: Number of NRIs per rating of maturity level criterion 1 "Scientific, technological potential - Scientific excellence, degree of interdisciplinarity, prospects for scientific and technological discoveries" [24]

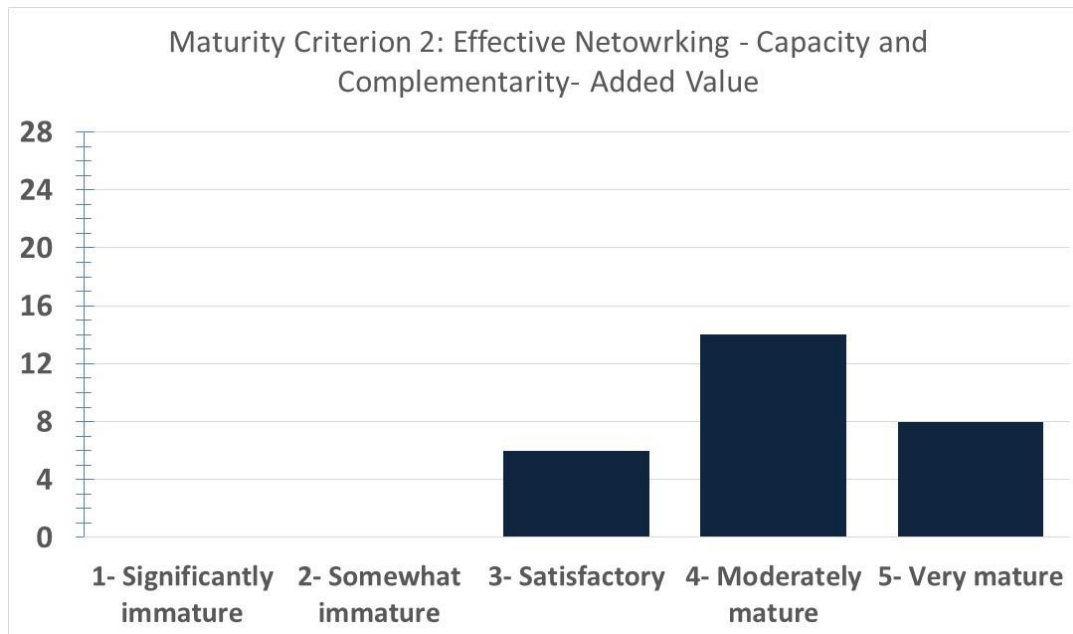


Figure 34: Number of NRIs per rating of maturity level criterion 2 "Effective networking, synergies in the knowledge triangle and international promotion - Capacity and complementarity of the partners, added value at regional, national and international level, synergies, networking, critical mass, recognition, transparency" [24]

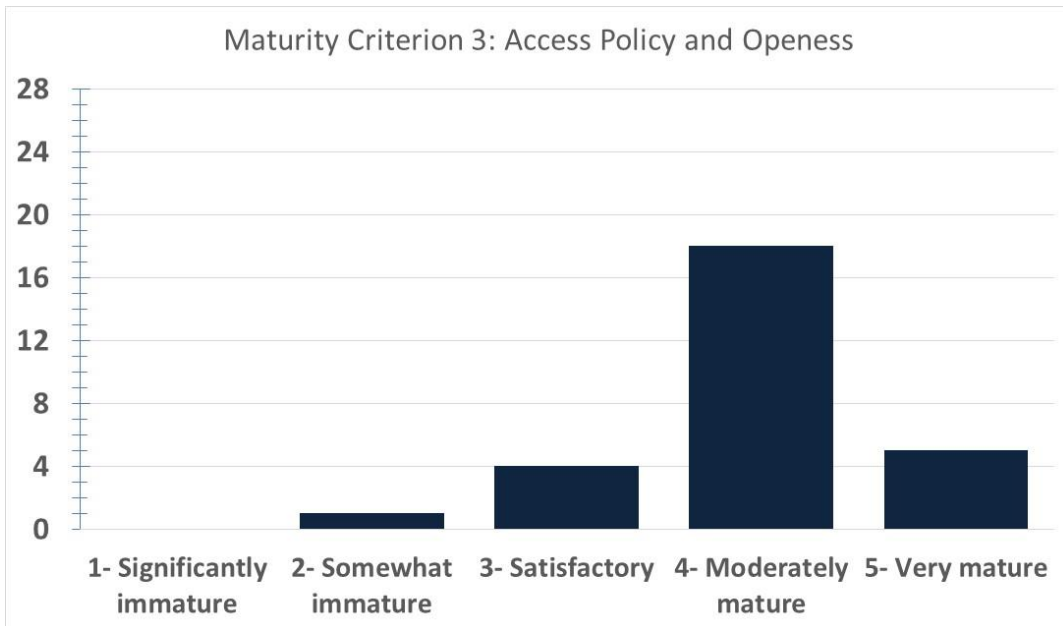


Figure 35 Number of NRIs per rating of maturity level criterion 3 "Access policy for researchers, industry, business and international users through openness to international markets" [24]

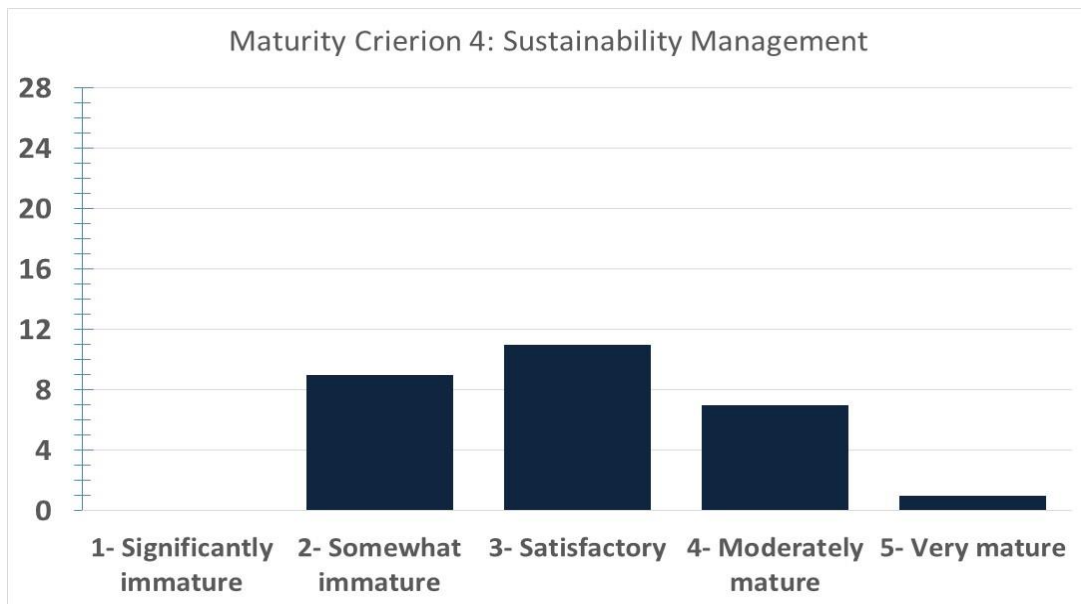


Figure 36: Number of NRIs per rating of maturity level criterion 4 "Sustainability Management structure, human resources, cost-effectiveness, long-term viability, clear investment plan" [24]

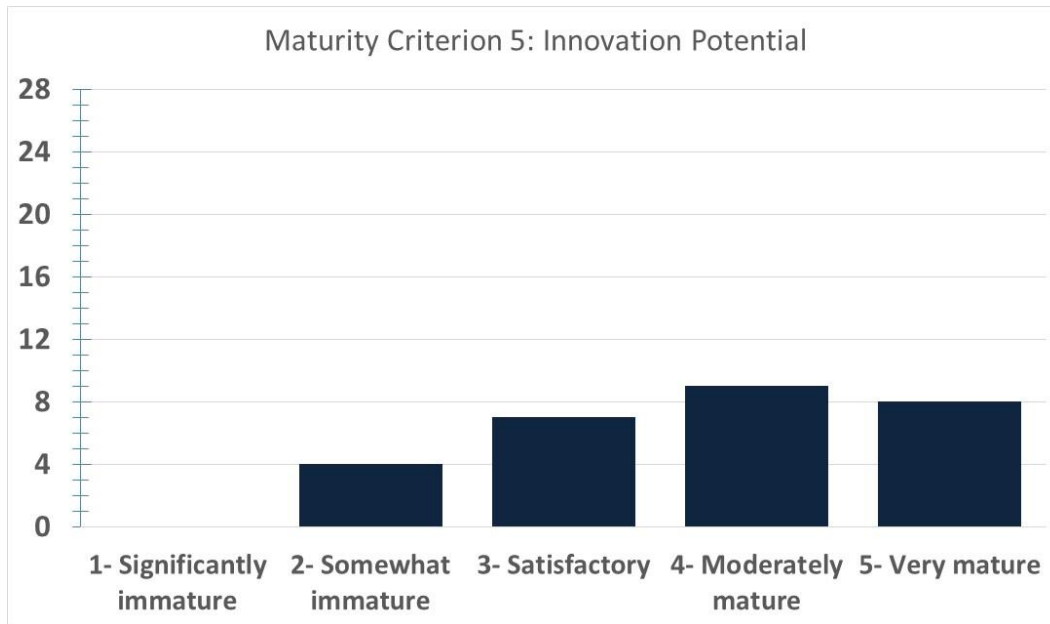


Figure 37: Number of NRIs per rating of maturity level criterion 5 "Innovation potential and contribution to private sector - Contribution to: innovation and technology transfer, creation of knowledge and innovative ideas, creation of high growth SMEs, green supply chain and circular economy" [24]

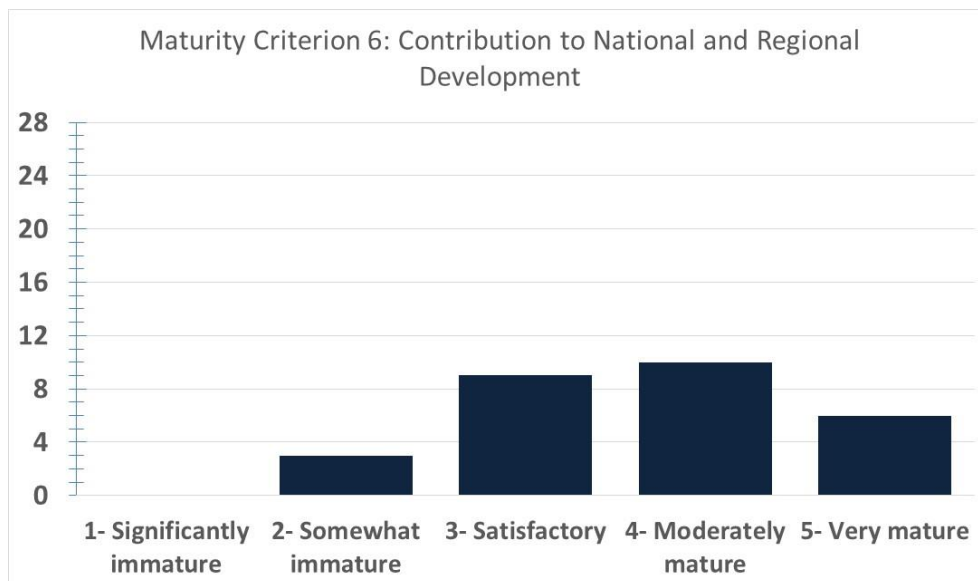


Figure 38: Number of NRIs per rating of maturity level criterion 6 "Contribution to National and Regional Development & Socio-Economic Benefits -Contribution to: private sector R&D, knowledge/employment-intensive activities, economic and social benefits and the impact of IPs on socio-economic issues" [24]



Figure 39: Average (blue bars) and median (red bars) values for the six maturity level criteria [24]

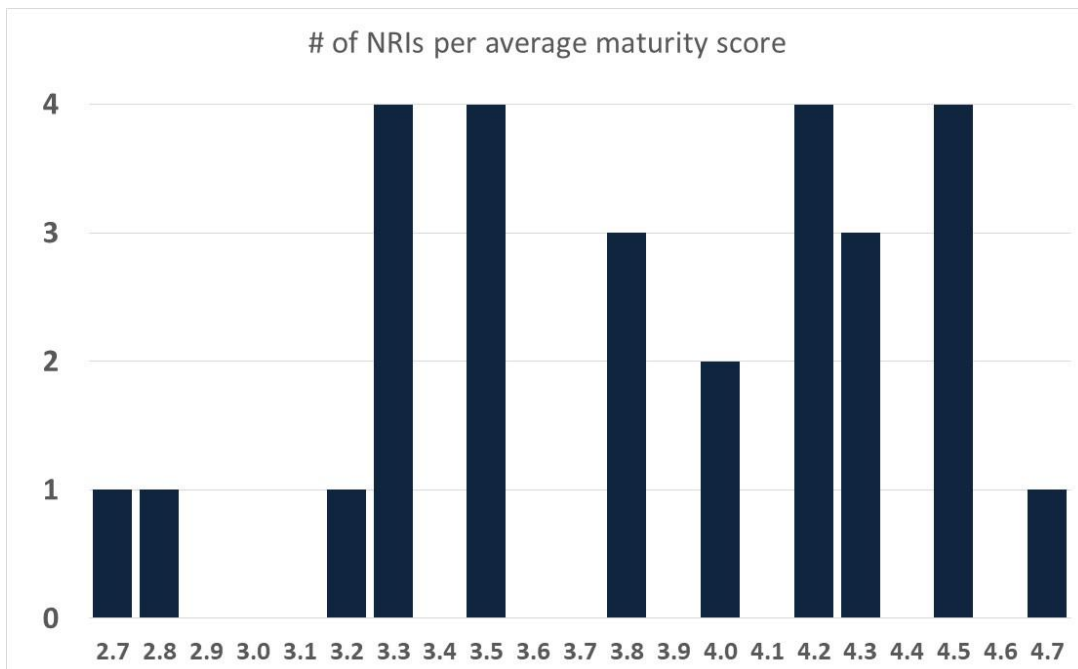


Figure 40: Distribution of average maturity level scores (number of NRIs with the same score) [24]

The main findings from the statistical analysis are the following:

- Exactly 50% (14 out of 28) position themselves as **“Moderately mature”** with an average maturity score ranging from 4.0 to 4.7. 43% (12 out of 28) view themselves as “Satisfactory” with an average maturity score between 3.0 and 3.9. Only 2 NRIs, “HELPOS” and “FuVEP”, rated themselves as “Somewhat immature” with an average score of 2.8 and 2.7, respectively.
- **Almost all NRIs position themselves as scientifically** (Criterion 1) **“Very mature”** (68% or else 19/28) or “Moderately mature” (29% or 8/28) with only “HiMIOFoTs” considering scientific maturity as “Satisfactory”.
- All other criteria—with the exception of criterion 4 “Sustainability management”—are mostly described as “Moderately mature” as seen by the average and median values.
- With respect to the level of “Effective networking, synergies in the knowledge triangle and international promotion” 50% of the NRIs consider it to be “Moderately Mature”, 29% rate it as “Very Mature” and 21% as “Satisfactory”.
- With regards to the **“Access policy and openness the vast majority** (82%) of the NRIs consider their “Access Policy” as being “Very Mature” or “Moderately Mature”, while only one (“FuVEP”) rates it as “Somewhat immature” and other four (“HELPOS”, “ARCHIMEDES”, “PROMETHEUS” and “So.Da.Net”) as “Satisfactory”.
- As far as the maturity level of the “Sustainability management” only “DeTAnet” believes it to be “Very mature”, while the opinion of the remaining 27 NRIs is more or less equally divided among “Somewhat immature” (32%), “Satisfactory (39%) and “Moderately mature” (25%).
- The last two criteria of “Innovation potential” and “Contribution to national and regional development” follow the same trend with about a quarter of the NRIs considering them as “Very mature”, one third as “Moderately mature” and another third as “Satisfactory”. In terms of “Innovation potential”, “HELPOS”, “HiMIOFoTs”, “INSPIRED” and “INVALOR” regard themselves as “Somewhat immature”. In terms of the “Contribution to national and regional development” “HELPOS”, “OMIC-ENGINE” and “FuVEP” regard themselves as “Somewhat immature”.

An integral part of the self-assessment -and the perceived degree of maturation the NRIs may have reached- was what each NRI considers as important results. The NRIs were asked to describe in a free-text format their major achievements including important issues they may have encountered so far in their effort to achieve these results or reasons for failing to do so (Question 16). The answers were compressed for brevity and are compiled in ANNEX V in a summarized form. Compressing further the information gathered from Question 16, the main findings are:

- The **major achievements** that the NRIs listed are (with descending frequency of appearance):
 - (1) **The development of new tools, services facilities and platforms** (21 out of 28)

- (2) **The purchase, maintenance and upgrade of equipment and infrastructure** (13 out of 21)
- (3) **The number of scientific publications and conference presentations** (11 out of 28)
- (4) Education, training and consulting activities (9 out of 28)
- (5) The establishment of new European and International collaborations and/or the participation in other European RIs and platforms (9 out of 28)
- (6) The strengthening of collaborations among the NRI partners and the importance in the successful completion of the Joint Research Activities (JRAs), which led to the new services and tools (6 out of 28)
- (7) Networking and connection with similar societies/entities (6 out of 28)
- (8) The new collaboration with the private sector and in particular start-ups and SMEs (6 out of 28)
- (9) The collaboration of the NRI with public bodies and national and/or European authorities (6 out of 28)
- (10) The attraction of new grants because of the NRI creation (3 out of 28)
- (11) One NRI considered the recruitment of young researchers as one of its major achievements

With regards to the level of satisfaction, almost all the NRIs that provided an answer considered the results “satisfactory”, but not in relation to the participating bodies, but in relation to the circumstances and challenges they faced during the implementation of their actions. One (1) NRI (“CALIBRA”) stated that “We consider these results very satisfactory taking into account the comparatively small group engaged in the implementation of the project”.

Finally, from the answers provided in Question 16, four (4) challenges were identified by the 10 NRIs that commented on the challenges:

- (1) The **bureaucracy of public procurements** and the stifling and rigid legal framework (5 out of 10)
- (2) Delays and **restrictions** due to the COVID-19 pandemic (5 out of 10)
- (3) **Inadequate funding** (3 out of 10)
- (4) 2 NRIs (“EN.I.R.I.S.S.T.” and “SoDaNet”) which depend on data collection mentioned limited data availability and low data quality

More detailed information on the specific answers received can be found in **Annex V**

4.4 Competition

Another important aspect of the NRI development and maturation level is how their development is self-assessed with respect to the national and international

competition. It is a fact that the NRIs were conceived and developed during the period between 2014-2019 and they have just started trying to operate as envisioned for practically one year (2020-2021). This is a very short time to fully assess how they might actually fare in comparison to more mature and longer-operating RIs, however it is critical to identify what the main competition might be at the national and international level as well as which competitors can serve as role models upon which the future operation of the NRIs can draw valuable lessons and adopt already established good practices and policies. With this in mind, the Questionnaire included two specific question (Questions 21 and 22) so that each NRI can pinpoint both their *competitors* (Question 21) and their *role models* (Question 22), not necessarily from their own technological field, the operation of which they may aim to follow and/or surpass.

These findings are to be used in conjunction with the findings of Chapter 5 (and specifically 5.2 and 5.3) in order to form a comprehensive overview of the positioning of the NRIs within the global RI scene, which type of international collaborations may be useful in terms of their sustainability and successful operation, and which routes may be followed for further internationalization actions.

Analysing the free-text answers to Questions 21, it was observed that the majority of the NRIs (21 out of 28) consider as competitors the large European Infrastructures, mainly ESFRI (European Strategy Forum on Research Infrastructures)- and ERIC (European Research Infrastructure Consortium)-type or other types of large infrastructures pertinent to their field of expertise (such as large accelerator infrastructures). In some cases other European entities and international distributed RIs were also listed as competitors, such as EU-IBISBA (Industrial Biotechnology Innovation and Synthetic Biology Accelerator), a distributed RI aiming at supporting research in industrial biotechnology (which was mentioned by 2 NRIs working on synthetic biology, "FoodOmics-GR" and "OMIC-Engine"), the Netherlands X-omics Initiative, a new facility part of the National Roadmap for Large-Scale Research Infrastructures, the National Phenome Centre, NPC Imperial College, founded in 2012 and co-funded by the MRC and the NIHR, and the US National Renewable Energy Laboratory. In general, the NRIs consider as main competitors the large pan-European RIs or other large national RIs from other countries, which have received significant funding from their respective governments and related authorities. In selected cases, NRIs view as potential competitors the European RIs they are affiliated/linked with (e.g., "ELIXIR" and "OPENSREEN-GR") should they do not manage to become full members.

Four (4) NRIs related to synthetic biology mentioned as potential competitors other Greek NRIs working in similar fields, since in some cases they might be an overlap. However, all three recognized that they could be working with good complementarity rather than antagonistically. Specifically: (i) "EATRIS-GR" perceives "OPENSREEN-GR" "Not necessarily a competitor, but "OPENSREEN-GR" is a bit complementary to "EATRIS-GR". Members of EATRIS-GR participate in "OPENSREEN-GR" as well"; (ii) "FOOD INNOVATION" RI noted that "No direct competitors were determined. Most of the research infrastructures of the Agri-food sector show complementarity with "FOOD INNOVATION" RI and some of them show some degree of overlap. These are the national infrastructures "OMIC-ENGINE", "FOODOMICS", "PlantUp" and "OPENSREEN-GR"; (iii) "FoodOmics" stated "There are RIs in adjacent scientific

fields, such as the “Plant Up” or the “Omic Engine”. However, there is no real competition.”; (iv) “PlantUp” views as potential competitors “EATRIS-GR”, “INVALOR” and “OPENSREEN-GR” alongside the center of the study and sustainable exploitation of Marine Biological Resources (“CMBR”).

Finally, there were 8 NRIs that due to their specific nature and missions identified very different entities besides other RIs as potential competitors. In detail:

(i) “E.NI.R.I.S.S.T.”, the only logistics NRI, views as main competitors, but also possible collaborators “Entities offering consultation and producing transportation studies present in the national market”

(ii) “HELPOS”, which deals with geodetic data, identifies as competitors “other entities who collect data, as for example HEPOS (<https://www.ktimatologio.gr/el/e-services/elliniko-systima-entopismoy-hepos>) alongside a number of private companies that run their own geodetic networks (e.g. <https://www.metrice.gr/>, <https://www.treecomp.gr/>)”

(iii) “HiMIOFOTs” stated that “competition is limited to particular products/services and for the marine products the large scale private sector R&Ds such as the DHI group (<https://www.dhigroup.com/>) could be included together with small companies which provide high-end visualisation forecasts such as the windy (<https://www.windy.com>) Regarding the surface waters component, the main competitors are large private companies that provide, install and maintain hydrological and meteorological stations. In many cases, these companies have been also developed web platforms for data management where access is permitted only to the station owners for the handling of their data.

(iv) “Infrafrontier-GR” is mainly concerned by “emerging infrastructures from Asia that may pose a threat” and does not see no competitors in Greece or Europe

(v) “INVALOR” believes that it does not face any competition since “there is no RI at EU level in the area of Circular Economy and Materials Recycling”

(vi) “PHILIA”, which in essence is based on a research vessel, faces competition from other research vessels in European Mediterranean countries and other HCMR research vessels

(vii) “pMED-GR” sees no competition stating that “pMedGR” is a research-focused infrastructure (unlike other local RIs with a more diagnostic focus), and as such it is unique in Greece in the field of precision medicine”

(viii) “So.Da.Net.”, apart from ERIC-type RIs, faces competition from libraries (like universities’ libraries or the National Library), which “are entering into the data landscape” and data repositories. Even the National Documentation Centre (EKT) could eventually be a “partial” competitor in the future”.

With regards to the **role models** (free-text answers to Question 22), all NRIs, which listed the large pan-European/international RIs as competitors, view them as their role models and put an effort to learn and apply good practices from them. They all look up to their organizational structure, access policies, networking efficiency and quality of services.

Again, some of the NRIs due to their specific nature and mission indicated some additional types of role models, independent of the large RIs. These were:

- (i) "InfrafrontierGR" "has been modelled based on the European infrastructure and the International Mouse Phenotyping Consortium (IMPC)"
- (ii) "PHILIA" uses Eurofleets (www.eurofleets.eu) as a role model
- (iii) "So.Da.Net" considers as its role models the American Inter-university Consortium for Political and Social Research (ICPSR) Australian Consortium for Social and Political Research Incorporated (ACSPRI)

4.5. Current Sources of Financing

The final step of the mapping of the development of the NRIs is to have an overview of their current funding source. The related information is to be used in conjunction with Chapter 7, and specifically with Sections 7.3 and 7.4 pertaining to the future needs and sustainability issues related to financing of the NRIs.

The various sources of *current financing* were extracted from Question 25, which was of open type. By analysing the free-text answers several common categories of financing sources were identified, while others were specific for the type of NRI (collectively named "other"). Table 16 compiles the common types of current sources of financing and demonstrates which have been employed by each NRI. Whenever, an "other" type of financing was found its description has been added to the last column of the table. Figure 41 depicts the number of NRIs that currently depend on each type of financing source.

The main observations are the following:

- All NRIs have been primarily supported by the initial EPAnEK fund (100%)
- The other main source of support for 61% of the NRIs comes from allocation of funds obtained European projects individually obtained by the participating partners
- 50% of the NRIs have managed to secure other types of funding, such as donations, service contracts with authorities or entities, contracts with private companies or institutions (e.g., hospitals)
- 43% of the NRIs re-route money from nationally funded projects
- 32% have explicitly stated that they rely on allocation from the partners' regular state budgets, which cover the salaries of permanent staff, operational and maintenance expenses of the infrastructure.
- 6 NRIs (21%) are using services as an additional source. However, these services are offered individually by the participating partners and not through the NRI
- Only 4 NRIs (14%), namely "Innovation-EL", "EATRIS-GR", "HELLAS-CH" and "PlantUp" have managed to create income through services offered by the NRI (albeit relatively small compared to the other funding sources)

A recurrent comment in most answers was the fact that apart from the initial EPAnEK funding the NRIs are trying to allocate funds from various sources in order to maintain their operation.

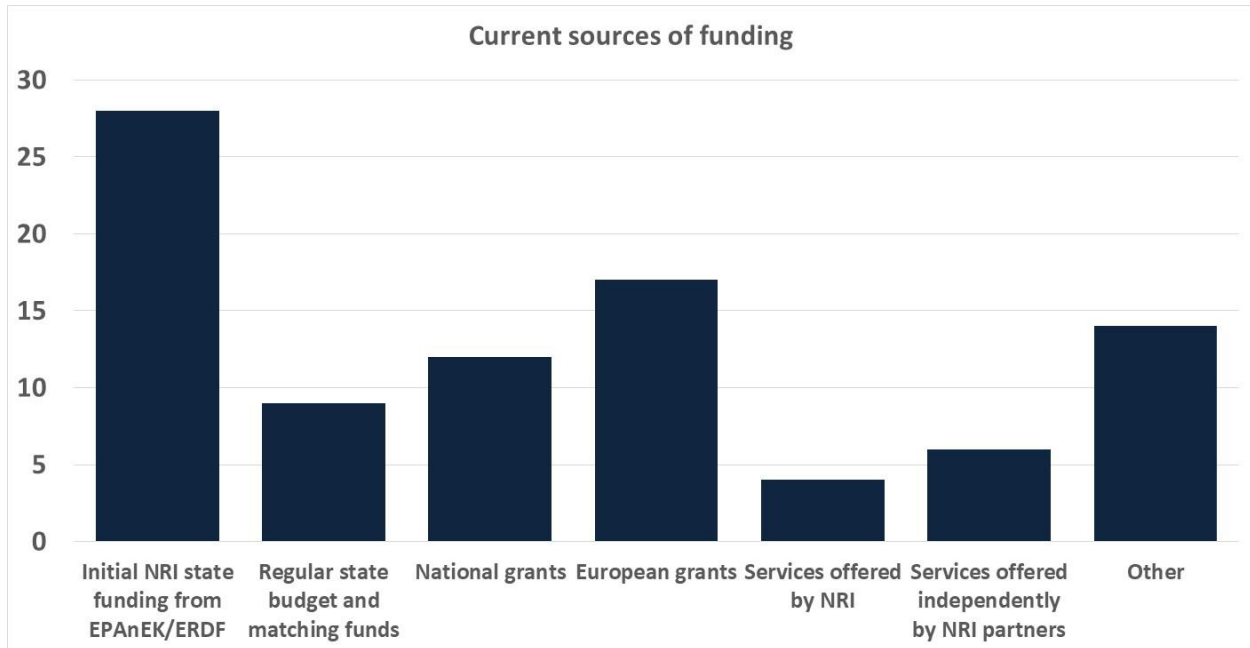


Figure 41: Number of NRIs per category of current funding source [24]

Table 16: Common Types of Current Sources of Financing per NRI [24]

NRI Name	Initial NRI state funding from EPAnEK/ERDF (04/2017-10/2021)	Partial allocation of regular state budget ²⁵ and matching funds from NRI partner(s)	Allocation of funds coming from <i>national grants</i> obtained by partners (e.g. HFRI, GSRI,)	Allocation of funds coming from <i>European grants</i> obtained by partners	Services offered by the NRI	Services provided by NRI partner independently of NRI operation	Other types of financing
APPOLONIS	X	X	X	X			<ul style="list-style-type: none"> EU projects in which ILSP participates as a LTP to CLARIN ERIC a small CLARIN ERIC financed internal project
ARCHIMEDES	X					X	
BBMRI-GR	X		X	X			
BIOIMAGING-GR	X						
CALIBRA	X	X			NB ²⁶	X	
CMBR	X			X		X	
DeTAnet	X						Small research grants
EATRIS-GR	X		X	X	X		Contracts with national hospitals and institutions
ELIXIR-GR	X			X			ELIXIR Commissioned Service Projects
EN.I.R.I.S.S.T.	X						
Food Innovation RI	X						
FoodOmicsGR	X						
FuVEP	X						member-labs managed to attract additional financing for complementary action
HELLAS-CH	X	X		X	X		
HELPOS	X		X	X			Commissioned studies
HiMIOFoTs	X			X			
Infrafrontier – GR / Phenotypos	X		X	X		X	Private donors (e.g., Stavros Niarchos Foundation)
Innovation.EL	X	X	X	X	X		Regional entities
INSPIRED	X	X	X	X			implementation studies from ESFRIs in selected cases Regional Funds from European Union (Epirus and West Greece)

²⁵ e.g. permanent staff salaries (scientist, technician and administrative personnel), operational costs (power, water)

²⁶ It is worth noting that it is not foreseen in the CALIBRA project, which is state funded, to charge fees for beam time to CALIBRA users

INVALOR	X						Regional funds (Western Greece and Attica)
OMIC-ENGINE	X		X	X			
OPENSREEN-GR	X	X	X	X		X	
PANACEA	X	X	X	X		X	<ul style="list-style-type: none"> • Other International Contracts (ESA: NEWTON, CORAL, ASKOS, MPC, MPC-2, DOMOS, QA4EO, GAUSS / EUMETSAT: ADD-CROSS, CDOP-3, CDOP-4 / CAMS contracts/) • Contract services from the International Atomic Energy Agency (IAEA) and the Environmental European Agency (EEA) • Stavros Niarchos Foundation Industrial fellowships program • Donations (Stavros Niarchos Foundation-SNF-PANGEA)
PHILIA	X	X		X			Rental revenues from third parties
PlantUp	X		X	X	X		
pMED-GR	X						some research funds for specific projects, provided through collaborations with companies
PROMETHEUS	X						
So.Da.Net	X	X	X	X			<ul style="list-style-type: none"> • CESSDA Internal Projects • Seminars on Research Methodology • Data Management • Use of Tools (SPSS, R, Limesurvey, Jamovi, Dataverse, NVivo)

4.6. Importance of specific cost categories for NRIs – Needs for Future Financing

NRIs consider as most important for their viability, funding for the acquisition of new research equipment and maintenance of the existing ones. As technology is rapidly evolving, they need not only to maintain but also to increase their efficiency. Thus, financing conducting R&D for the development of new services is indicated as important.

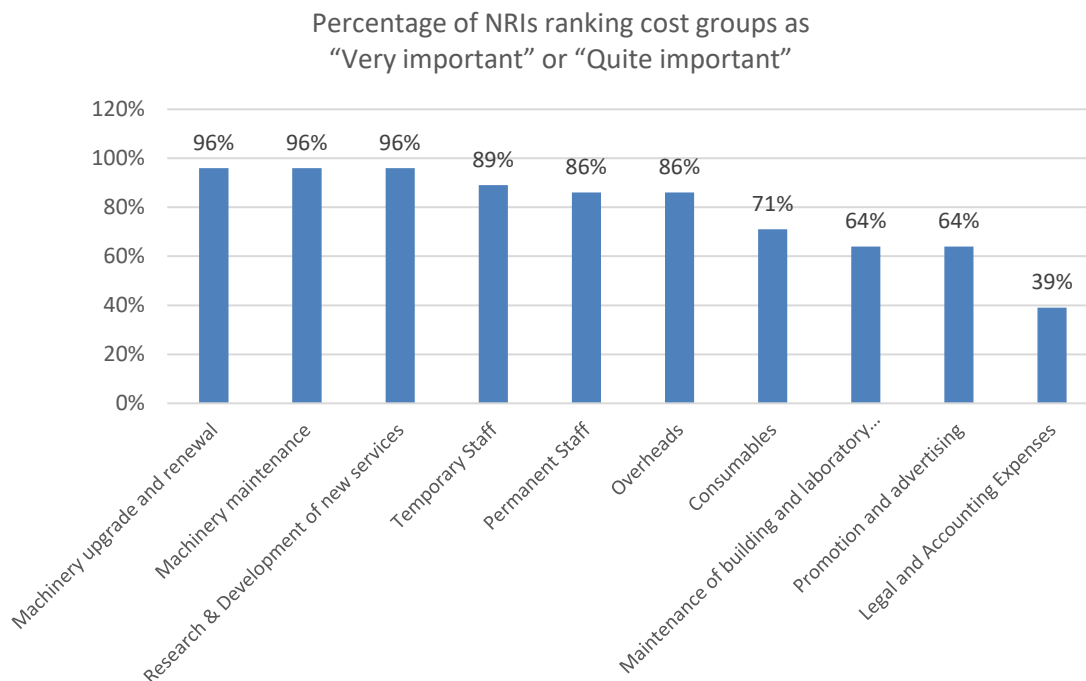


Figure 42: Importance of funding of specific cost groups in relation to the total cost of infrastructure support [24]

Main observations:

- Most NRIs mention that their long-term sustainability, smooth and competitive operation is directly related to the employment of permanent staff (although temporary staff is considered equally important). This is a known problem in Greece, since new permanent or tenure positions are very limited. Overheads are also considered an important cost category.
- Some critical cost groups (e.g., administrative, operational and building maintenance costs) involve expenses that cannot be attributed to specific cost categories in question 26 and are mostly covered by overheads.
- All NRIs consider promotion important, however most of them, do not rate it as most important. Nevertheless, participation in international networks and

networking with European and other National RIs and innovative SMEs is considered critical for their development.

- Most NRIs don't consider funding for legal and accounting expenses a priority, although some identify as important the aspects of filing for patents or expenses for external auditors. A specific problem of legal nature is mentioned by from BBMRI-GR, which is a network of biobanks. Specifically, this NRI states that *'the exchange of samples (from donors or patients), although relatively easy within the country, faces important legal problems when borders are crossed. A related issue is that of securing a signed, informed consent from the patient or individual that contributes the sample. This issue is important and in Greece and should be solved by educating all professionals involved on how to approach prospective donors'*.

4.7. Legal & Administrative Constraints

This section compiles the assessment and opinions of the 28 NRIs with respect to the legal and administrative constraints that they have been up against and that they have limited or hindered their development and operation. The identified constraints were mainly extracted from answers to Questions 28-29.

Sixteen (16) questionnaires included answers commenting on purely legal constraints. Thirteen (13) out of 16 NRIs identified as the main constraint the lack of legal status and the fact that the NRIs are not separate legal entities with their own VAT and PIC numbers, a fact that does not allow them to participate in European projects nor larger European and international RIs.

Other legal constraints that were also found were the need for costing policies (6 out of 16) and the need for ISO certification and quality assurance of the services (5 out of 16).

From an administrative point-of-view almost all NRIs (23 out of 27) stressed the need for hiring dedicated personnel with long-term contracts not only for the scientific and technical operations of the infrastructures (23/27), but also for managerial, financial and administrative tasks as well as marketing, networking and promotional activities (20/27).

Tables 17- 18 summarize the findings.

Table 17: Legal constraints identified by most of the NRIs [24]

Constraint No	Description of Constraint	Occurrence
1	Lack of legal status and related legislation	13/16
2	Need for costing policies	6/16
3	Need for ISO certification and quality assurance procedures	5/16

Table 18: Administrative constraints identified by some of the NRIs [24]

Constraint No	Description of Constraint	% Occurrence
1	Lack of dedicated scientific and technical personnel for operation and maintenance of infrastructure	23/27
2	Lack of dedicated personnel for management, administration, marketing, promotion, networking and communication	20/27

4.8 Human Resources

Human capital is an integral of any organization, absolutely necessary for its operation and creative capacity. For that reason, the issue of human resources is examined in this separate and dedicated section, which on the one hand identifies the challenges the NRIs faced in recruiting or retaining skilled staff including attracting (returning) researchers from abroad, and on the other hand it records the current and future needs of the NRIs in terms of human capital.

As far as the challenges encountered so far in recruiting or retaining the required skilled personnel, these were described a free-text format answer to Question 17. The main challenges identified by the NRIs are summarized in Table 19. It is noteworthy that most of the challenges were common amongst the NRIs regardless of the NRIs' thematic area or services provided.

Table 19: Challenges in recruiting/retaining skilled staff as identified by most of the NRIs [24]

Challenge No	Description of Challenge	% of Answer Occurrence
1	Low, non-competitive salaries compared to the private sector or other European countries and RIs (the Greek legislation imposes an upper limit on salaries given by nationally-funded projects)/ heavy taxation and unappealing contracts forcing the researchers to work as freelancers	64%
2	Short-term contracts (most of the time shorter than the duration of the projects)- lack of continuance- extremely limited prospects for career advancement (linked to irregular funding and lack of tenured-track positions; see also challenge no 4) - insecurity	86%
3	Complicated, cumbersome and time-consuming hiring procedures further encumbered by the recognition of working experience and degrees obtained from non-Greek institutions – deliverables must be submitted in the Greek language → Unappealing procedure for Greek expatriates and not at all appealing for foreigners	54%
4	Intermittent/irregular funding – long gaps between funding periods – lack of concrete planning for next funding periods for	71%

	NRIs –lack of bridge funding –lack of regular openings of tenured-track positions	
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Main observations from 4.7 & 4.8:

- In short, all NRIs are facing the same 4 challenges that hinder the recruiting and retaining skilled staff. The answers provided stated the same factors to a lesser or higher degree, but as bluntly put “it is a struggle to keep skilled staff” and “early-career researchers found better opportunities abroad, with higher salaries and longer contracts”.
- When it comes to the future needs in terms of human resources, the data were extracted from Question 32, which collectively interrogated about the future needs of the NRIs.
- All but two NRIs (EN.I.R.I.S.S.T. and FuVEP) have listed the recruitment of highly-skilled scientific and technical personnel as one of the top priority needs (if not the most important need). Special emphasis was given to the creation of permanent or at least long-term positions in order to secure the viability of the NRIs. For the specific case of NRIs offering specialized high-tech services it was also emphasized that each node should be able to have dedicated scientific personnel working exclusively for the NRI.
- Another important finding derived from the answers to Questions 32 was that half of the NRIs recognized the importance of hiring alongside the scientific/technical personnel dedicated personnel for administrative and managerial positions as well as experts for business development, for effective networking, dissemination and communication activities, the creation of legal and quality departments and marketing and public relations offices.

5. NRIs Networking and Internationalization

According to recent studies^{27,28}RI outreach is recognized as a key driver for long-term sustainability. The nature and complexity of the societal challenges relating to RIs require a transnational or even global approach to efficiently address them. International cooperation is highly strategic when pooling of resources and is necessary for construction and operation of RIs and for achieving scientific excellence. Moreover, visibility and optimal communication of the services provided is a crucial point in establishing strategic partnerships.

²⁷Sustainable European Research Infrastructures – A call for action, COMMISSION STAFF WORKING DOCUMENT – Long-term sustainability of Research Infrastructures, SWD(2017) 323 final; https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/swd-infrastructures_323-2017.pdf

²⁸Report on the Consultation on Long Term Sustainability of Research Infrastructures (2016), https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/lts_report_062_016_final.pdf

Chapter 5 compiles the data gathered from the Questionnaire (*Questions 18, 19b*) with respect to the complementary organizations the 28 NRIs are collaborating with (*Question 18*) and the level of networking and international collaborations they may have achieved (*Questions 18 and 19b*). The Chapter concludes with a summary of the main findings concerning the level of networking and internationalization of the RIs.

5.1 Complementary Organizations

As already mentioned, collaborations and networking with complementary structures (such as technology parks, networks, other academic or research institutes, European or International partners, ESFRI projects etc.) is a key element of an RI operation and a pivotal contributor to its long-term sustainability. Question 18 collected the complementary structures that the 28 NRIs have started collaborating with (if) and added value provided to the NRIs. The data are presented in Table 20. In case a NRI does not collaborate with other structures and organizations the table entry is "N/A". Question 18 provisioned for an answer in free-text format that would lay the factors that have affected the lack of collaboration. The submitted factors are examined in the next section (5.2) alongside and in correlation to the answers of 19b (self-assessment of NRIs in terms of "Effective networking, synergies in the knowledge triangle and international promotion").

NRIs can either be located on one **single** site or **distributed** to other infrastructures that have complementary nodes.

The majority of the 28 infrastructures of the Greek Multiannual Budgeting Plan for Research Infrastructures of the 2014-2020 Programming Period is **distributed** networks. Based on the questionnaires results several NRIs have established various agreements and memoranda of cooperation with both public and private bodies.

Table 20: Complementary structures that NRIs collaborate with [24]

Acronym & Title	Complementary Structures
ELIXIR-GR Managing and Analyzing Biological Data	Several ESFRI infrastructures; other Greek NRIs and Networks; The Greek Bio-informatics Networks/Societies; Greek bioinformatics SMEs
So.Da.Net_CESSDA_GR: the Greek RI for social sciences	Social Science university departments all over Greece; other ESFRI infrastructures and ERIC; several Greek authorities and associations; other Greek NRIs; Ministries
DeTAnet Detector Development and Technologies for High Energy Physics	European and International Institutions (CERN, IMPERIAL COLLEGE LONDON - High Energy Physics, UCLA, BNL)
PROMETHEUS A Research Infrastructure for the Integrated Energy Chain	Local and national users to a European and global wide research area; relevant networks and associations (such as Hydrogen Europe, the CSP Joint Programme of EERA, the European Automotive Research Partners Association (EARPA) and others); international energy and transport related companies, Greek key energy stakeholders and many others; industrial and academic-research partners; companies (such as Global Sol Energy, CYRUS)

	start-up company); Technology Parks; national Universities and Research Centres;
FuVEP Centre of Excellence for Future Vehicle Environmental Performance	Long list of front- line sponsors, collaborators and clients (vehicle industry, different European networks and associations in the transport sector (e.g. Toyota Motor Europe, Honda, PSA Peugeot Citroen, FTP – Fiat Powertrain, Renault Suppliers); international Fuels and Lubricants companies; European Commission; a huge number of European Associations; Universities and Research Centres)
OMIC-ENGINE Synthetic Biology: from omics technologies to genomic engineering	Laboratories from European Universities and research centres; non-governmental organisations and initiatives
PlantUp Upgrading the Plant Capital	A huge number of collaborations with research centres, universities and technology parks in Greece and abroad (European and international level); spin off companies
FoodOmicsGR A consortium for comprehensive molecular characterisation of food products	European research infrastructures; Other complementary organizations (Food Periodic Table Initiative); European Research Foundations; Shandong International Biotechnology
Food Innovation RI Research Infrastructure on Food Bioprocessing Development and Innovation Exploitation	Research organisations worldwide (institutions, research, centres, universities); public bodies (regional authorities, such as of Epirus and Western Greece); Society of Microbial Ecology & Disease; Greek regional RIs; European research infrastructures; companies from the agri-food sector
CMBR Centre for the study and sustainable exploitation of Marine Biological Resources	Node of European RI (ERIC); other Greek NRIs; other ERIC infrastructures; Commercial partners; European universities
INVALOR Research Infrastructure for Waste Valorization and Sustainable Management of Resources	Other Greek NRIs; companies as partners in in research projects that developing innovative technologies for material recycling and utilization
HiMIOFoTs Hellenic Integrated Marine and Inland Water Observing, Forecasting and Offshore Technology System	Participation in 2 ERIC RIs; European Copernicus Marine Service; Ministries
HELPOS Hellenic Plate Observing System	EPOS ERIC
PHILIA Research Fleet/reconstruction of the research vessel – PHILIA	Universities, Research Institutes, the Aquaculture sector, SMEs, Producers organizations, fishermen associations and individuals
PANACEA Panhellenic infrastructure for atmospheric composition and climate change	Interactions with complementary organizations in academia and industry; ESFRI RIs, international agencies and initiatives, governmental and regional authorities; several agencies and administrations in the space sectors (ESA, NASA etc.); International Organisations (GEO, WMO Sand and Dust Storm – Warning Advisory System, International Atomic Energy Agency etc.); International Networks; partners from the industrial sector (mostly Greek companies); numerous EU Academic Institutions

<p>Infrafrontier – GR / Phenotypes The Greek Research Infrastructure for Molecular and Behavioral Phenotyping of biological model organisms for chronic degenerative diseases</p>	<p>Participation in ESFRI related RI; European Mouse Mutant Archive; other national RIs; Interactions with international networks for mouse production and phenotyping</p>
<p>pMED-GR The Greek Research Infrastructure for Personalised Medicine</p>	<p>Other Greek NRIs; international networks (such as ICPemed, SAPHIRE and others)</p>
<p>INSPIRED The National Research Infrastructures on Integrated Structural Biology, Drug Screening Efforts and Drug target functional characterization</p>	<p>ESFRI RIs and ERICs; other Greek NRIs; Greek Regional Technological Parks and other Greek flagship initiatives; other Greek Research Centres and Universities; European and international academic/research institutes; the European Spallation Source; the partners of the NRI are users of the European Synchrotrons and the Free Electron Laser User Organization</p>
<p>OPENSREEN-GR An Open-Access Research Infrastructure of Target-Based Screening Technologies and Chemical Biology for Human and Animal Health, Agriculture and the Environment</p>	<p>The European high-capacity screening network EU-OPENSREEN; several Greek regional Technology Parks, National Institutes of Research organisations</p>
<p>BIOIMAGING-GR A Greek Research Infrastructure for Visualizing and Monitoring Fundamental Biological Processes.</p>	<p>European research infrastructures; European Society for Molecular Imaging; national technology transfer network; Science and Technology Park of Crete; national, European and international Research and Academic Institutions</p>
<p>EATRIS-GR Infrastructure for preclinical and early-phase clinical development of drugs, therapeutics and biomedical devices</p>	<p>Other Greek Institutes; Universities and research centres</p>
<p>BBMRI-GR Strategic expansion of the Greek Biobanking Infrastructure</p>	<p>National Network of Precision Medicine on Oncology, Cardiology and Neurodegenerative diseases; Greek Genome Center; other NRIs; Ministry of Health</p>
<p>INNOVATION-EL National Infrastructure in Nanotechnology, Advanced Materials and Micro/Nanoelectronics</p>	<p>Several regional Technology Parks, technology Transfer networks, national and European Research Centres and Universities; Companies (such as Greek Defence Industry; and companies from Pharmaceutical, Construction, Nanotechnology / Nanofabrication and Agrofood Sector)</p>
<p>HELLAS-CH The HiPER, ELI and LASERLAB Europe Synergy & IPERIONCH.gr</p>	<p>Large number of Research and Academic institutions worldwide; ESFRI related RIs; European Laboratories and facilities</p>
<p>CALIBRA Nuclear Science, Technology and Applications Research</p>	<p>Nuclear Physics European Collaboration Committee; collaboration agreements with leading laboratories in the world engaged in research with ion beams; European Infrastructures; European</p>

Infrastructure (only for the CALIBRA part – Cluster of Accelerator Laboratories for Ion Beam Research).	Network of Small-Scale Accelerator Facilities ENSAF; collaborate actively and participate in CERN experiments; International Atomic Energy Agency; accelerator laboratory of the Louvre Museum; several European and international institutes and Labs; other Greek NRIs
APOLLONIS Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation	Node of 2 ESFRI Infrastructures; relevant organisations and European networks; academic and research organisations; other European Infrastructures; several National archives and museums
EN.I.R.I.S.S.T. Intelligent Research Infrastructure for Shipping, Supply chain, Transport and Logistics	Large number of organisations at both national and European/international level with similar interests; MoUs and Associate Partnership Agreements/Letter of Interest with several organisations (3 ministries, foundations, municipalities etc.); regional authorities, museums, banks, associations; national parks; enterprises; collaboration via MoUs with several European/international institutions (Research institutes, universities, associations and actions)

The complementary structures that NRIs collaborate with fall into 20 general categories that are presented in Table 21.

Table 21: General Categories of Complementary Structures NRIs are collaborating with [24]

National / regional Technology Parks
European Technology Parks
Greek Universities
European Universities
Non-European Universities
Greek Research Centres / Research Institutes / Research Laboratories
European Research Centres / Research Institutes / Research Laboratories
Non-European Research Centres / Research Institutes / Research Laboratories
National Networks
European Networks
European and International Associations
National Clusters
European Clusters and Platforms
Other NRIs
European RIs
ESFRI Projects
EU-funded Research Projects
Industrial Partners (Large companies, SMEs, spin-off and start-up companies)
Industrial national, European and international associations
Authorities (ministries, agencies, regional authorities, municipalities etc.)

Other (e.g., museums, banks, non-governmental organisations and initiatives etc.)

Figure 43 shows the overall density of collaborations with complementary structures, based questionnaire results.

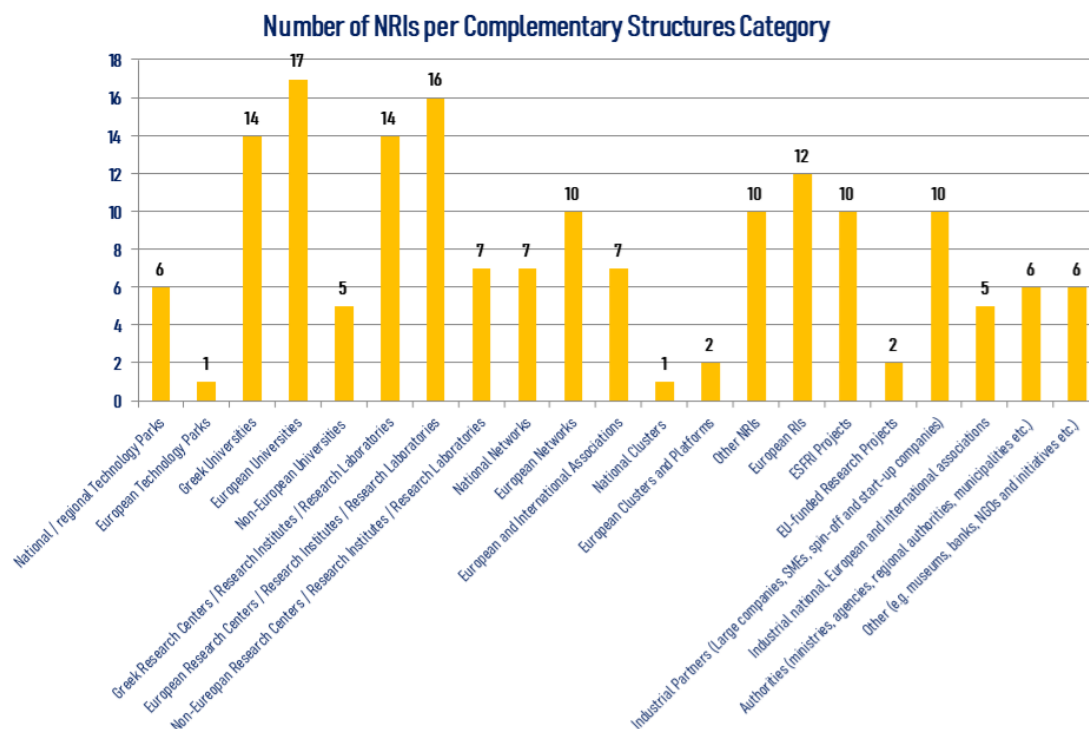


Figure 43: Number of NRI's collaborations with Complementary Structures per Category [24]

5.2 Networking and International Collaborations

This section focuses on the networking maturity level of the NRIs based on the answers to Question 19b (self-assessment relating to the efficiency of networking, synergies in the knowledge triangle and international promotion (Figure 44). Table 5.2.1 compiles the answers extracted from Question 18 detailing the factors that have prevented some of the NRIs not to use/collaborate with complementary structures.

8 NRIs are presented declare a very mature networking efficiency. These are: i) CALIBRA; ii) DeTAnet; iii) EN.I.R.I.S.S.T.; iv) HELLAS-CH; v) Infrafrontier – GR / Phenotypos; vi) Innovation.EL; vii) INSPIRED and viii) PANACEA

14 NRIs declare moderately mature. These are:

i) APOLLONIS; ii) BBMRI-GR; iii) BIOIMAGING-GR; iv) EATRIS-GR; v) ELIXIR-GR; vi) Food Innovation RI; vii) FoodOmicsGR; viii) INVALIDOR; ix) OMIC-ENGINE; x) OPENSREEN-GR; xi) PHILIA; xii) PlantUp; xiii) pMED-GR; xiv) So.Da.Net

5 NRIs state that they show satisfactory networking efficiency. Among them are the infrastructures: i) CMBR; ii) FuVEP; iii) HELPOS; iv) HiMIOFoTs nad v) PROMETHEUS.

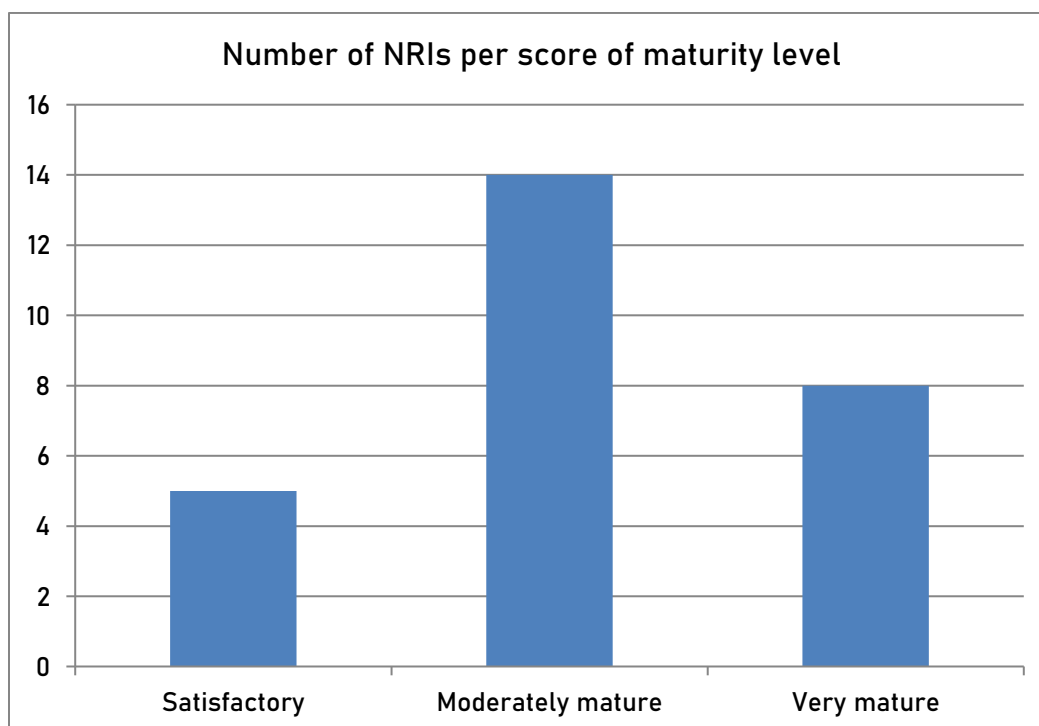


Figure 44: Number of NRIs per score of maturity level with respect to networking, synergies in the knowledge triangle and international promotion [24]

The main observations from both 5.1 and 5.2 are:

- There are a number of variations related to the thematic area in which an infrastructure operates, whether it is part of a larger infrastructure of the European Roadmap for Research Infrastructures (ESFRI), the added value of pre-existing synergies of partners with European or international networks, universities, research centres etc.
- Main collaborations are with Greek and European research organisations and universities as well as other NRIs
- 10 out of 27 NRIs declare collaboration with industrial partners.
- 10 out of 27 NRIs declare collaborations with ESFRI networks although 17 out of 28 NRIs are related to ESFRI infrastructures.
- Issues related to the "open access" also arise, e.g., External access to certain scientific data or confidentiality to open innovation projects is a set of obstacles that may need to be addressed as part of the promotion of new collaborations.

- In matters concerning their internationalization, most of the 28 NRIs agree that their potential competitors abroad are respective research organizations with the same or similar research object. However, many of them identify complementarities with infrastructures abroad and state that either there are already collaborations with them, or they intend to cooperate with these infrastructures in the near future.

6. Science vs. Markets

The mapping of the Greek RI landscape could not omit an essential and inherent element that of the user groups each NRI is targeting for and the level of importance each assigns per target group. The clear definition of the targeted users is significant for their own identity formulation and long-term operation. In addition, and in the same context, it is important to identify the Key Performance Indicators (KPIs) that the NRIs should employ to monitor their progress and assist in formulating their longer-term operation, governance and risk management plans based on the experience gained so far from their short-term (2020-2021) pilot operation. Each KPI was rated in terms of its importance. Sections 6.1 and 6.2 present the findings on these two aspects, respectively. The data were gathered from Questions 10 (Section 6.1) and Questions 23 and 24 (Section 6.2).

6.1 Targeted Users for Current and Future Operation

Depending in the individual mission as set by each NRI and the thematic area they belong, not all NRIs aspire to serve the public and private sector on an equal footing. Each NRI is targeting at different user target groups and probably puts different weight of importance per target group. Therefore, it was essential for a mapping to be created with the target user groups and the allocated importance the NRIs give.

This was attempted through Question 10, where 5 major categories of target users (Researchers from the NRI partners, Researchers from other universities, Start-ups, SMEs, Large Companies) and one additional free category of "Other", to be described by each NRI if and when applicable) were given a score from 1 to 5 was given to demonstrate the level of importance for each NRI (with 1 being "most important" and 5 "least important"). The data are collectively demonstrated in Figures 45 – 49. Figure 50 concentrates all data for comparison. 10 NRIs (43%) identified other types of targeted end-users collected in Table 22.

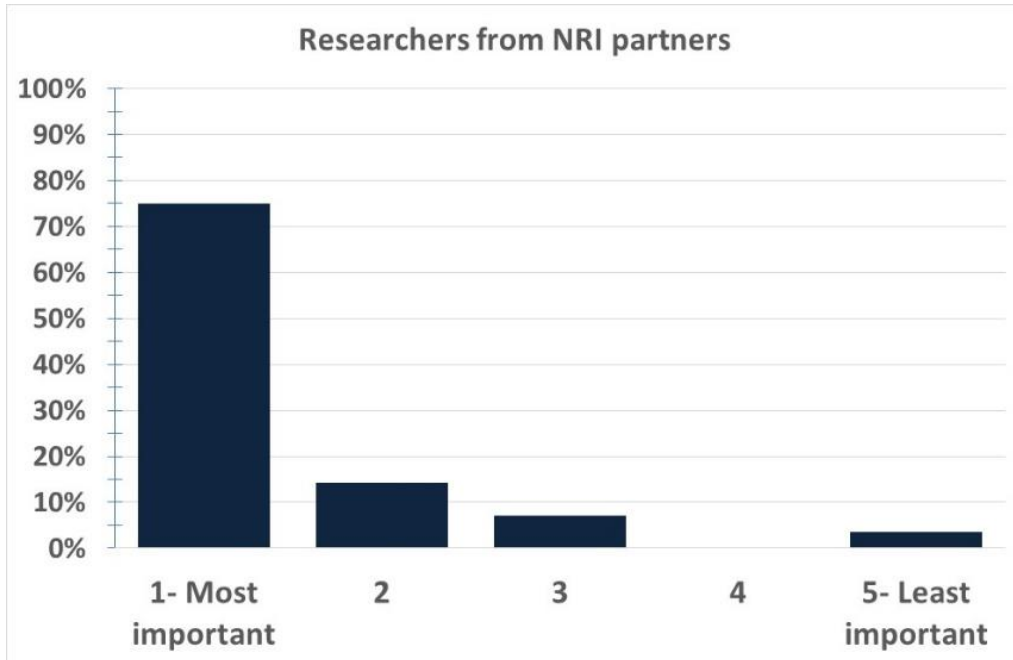


Figure 45: Percentage of NRIs per level importance for the user target group "Researchers from the NRI Partners" [24]

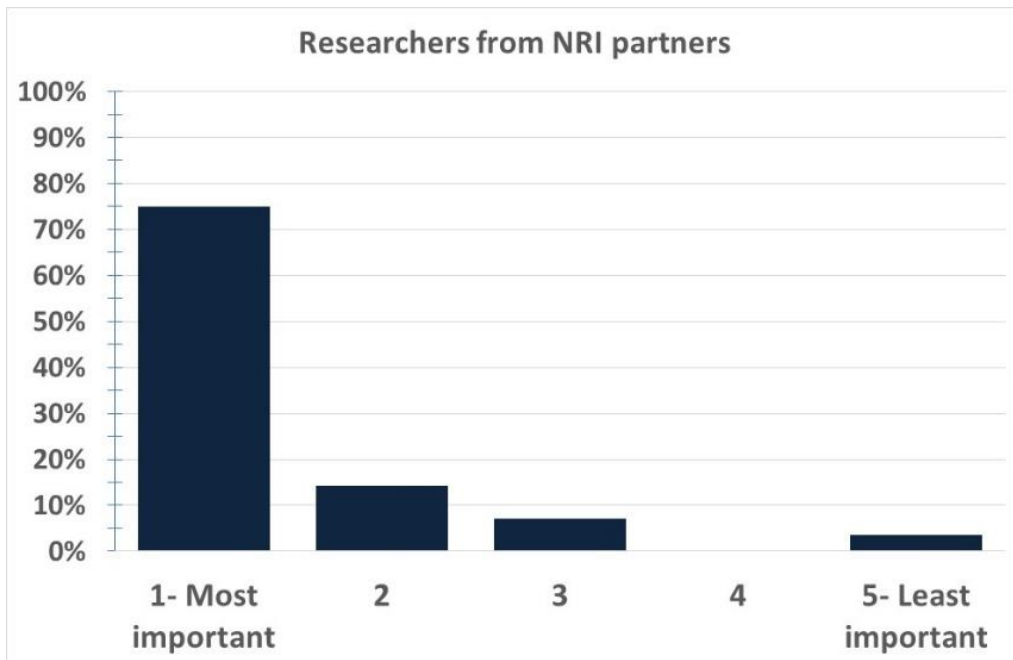


Figure 46: Percentage of NRIs per importance level for the user target group "Researchers from other universities" [24]

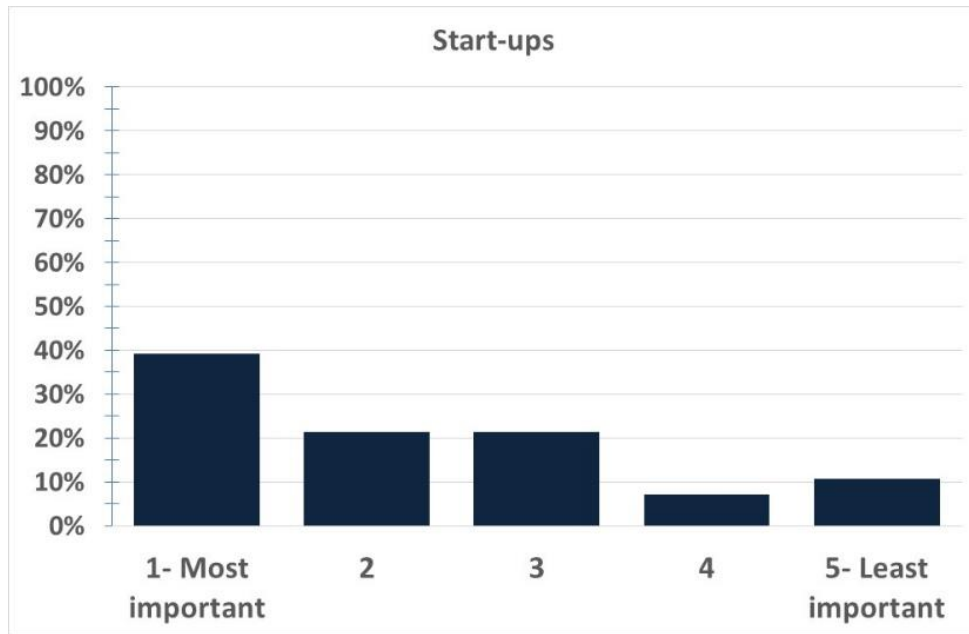


Figure 47: Percentage of NRIs per importance level for the user target group "Start-ups" [24]

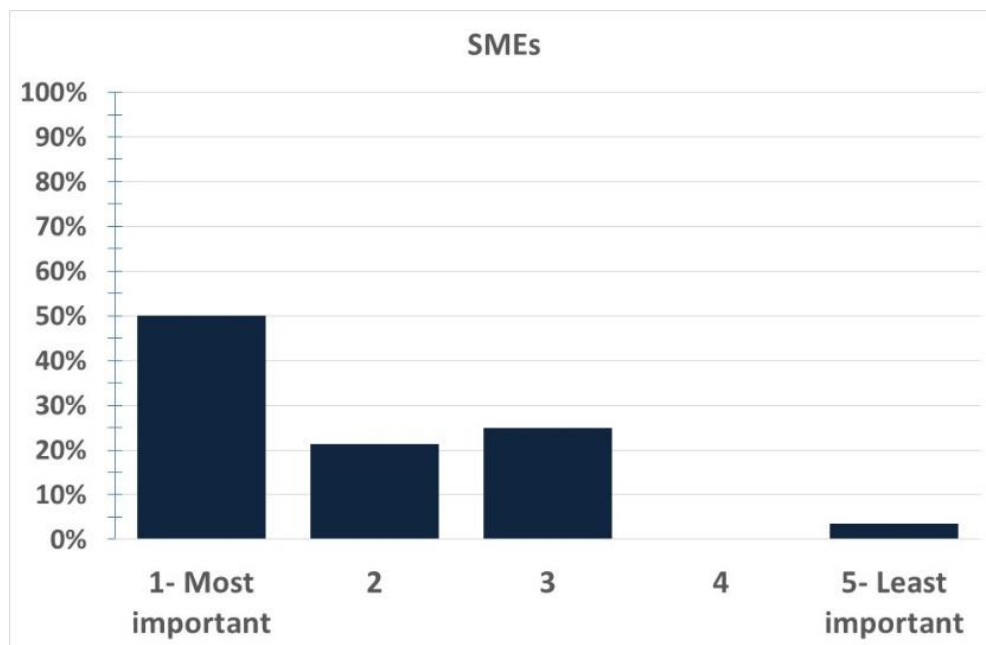


Figure 48: Percentage of NRIs per level importance for the user target group "SMEs" [24]

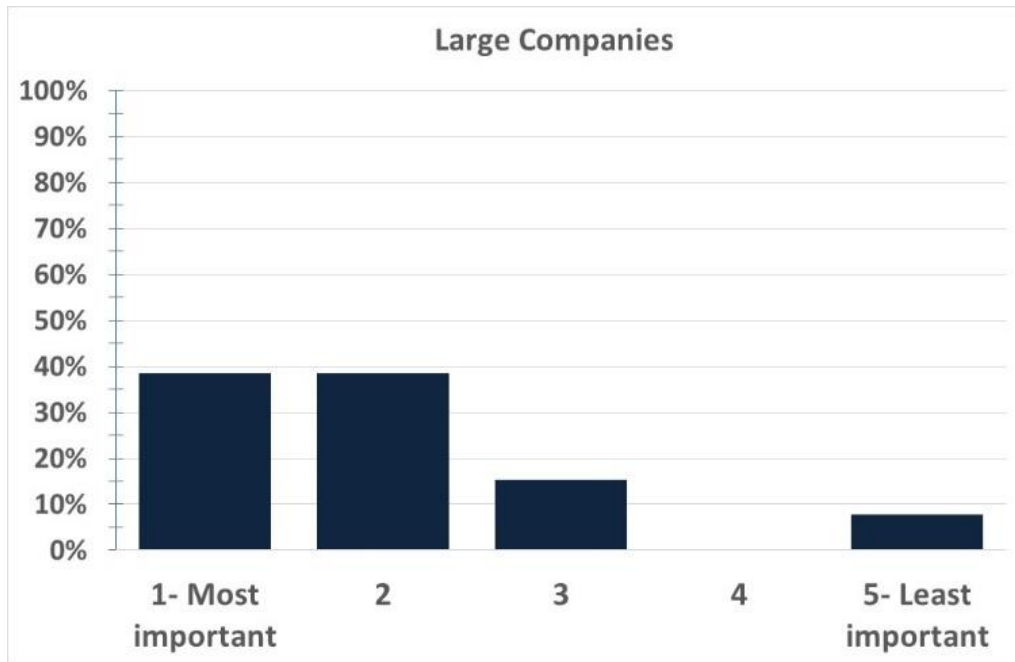


Figure 49: Percentage of NRIs per importance level for the user target group "Large Companies" [24]

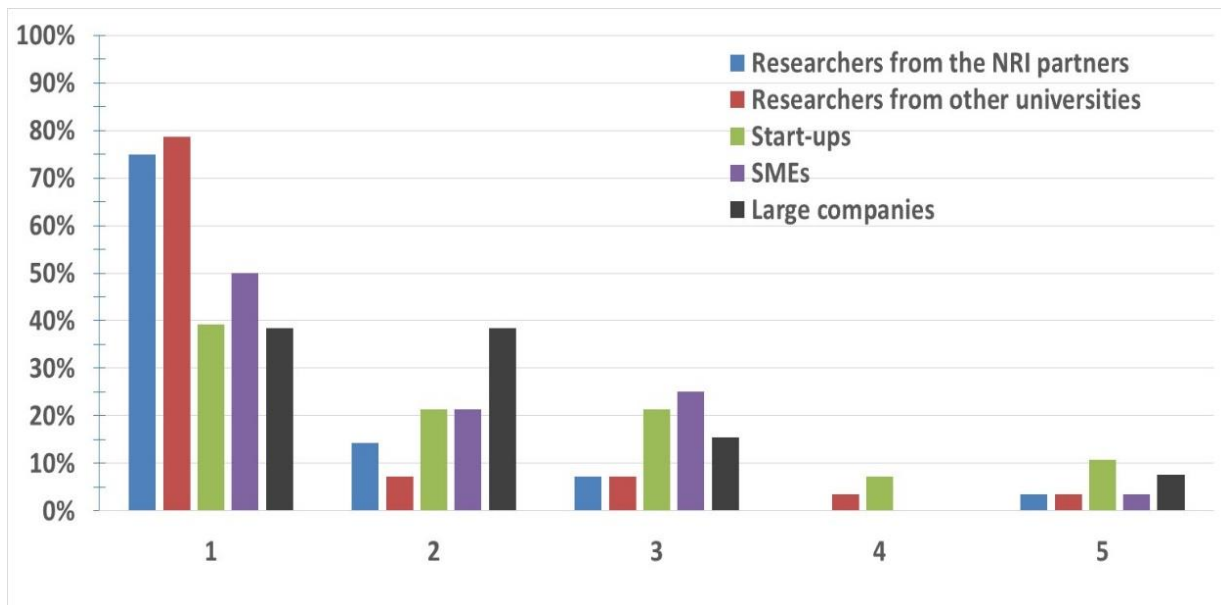


Figure 50: Percentage of NRIs per importance level for all target groups [24]

Table 22: Other types of users as identified by the NRIs [24]

NRI	Type of user identified (score)²⁹
CALIBRA	National authorities (for analytical services)
EN.I.R.I.S.S.T.	Public authorities (national and local authorities) (1); European Commission (1) European Investment Bank (1) OECD (2) UNECE and other international organisations (2) Research projects in need of relevant data (1)
FuVEP	National and/or International Organisations (1) Public Bodies (1) Policy makers, etc (1)
HiMIOFoTs	Governmental authorities which deal with the marine environment and surface waters State agencies that handle emergency cases (pollution accidents in the sea, floods) such as the Coast Guard and/or the Civil protection agency National Meteorological Service General public
Innovation-EL	Students of all levels and junior researchers: (2) Public bodies (2)
INSPIRED	Hospitals, diagnostic centres, state general laboratory (1) Other RIs in Greece and abroad in Health and Food sector (1)
OPENSREEN-GR	Farmers Regional Administration of Epirus (UoI)
PHILIA	Students (3)
pMED-GR	Clinicians/Clinical researchers from hospitals and clinics
So.Da.Net.	Students Press/Journalists Political Bodies Government NGOs Citizens

As can be seen:

- “Researchers from NRI partners” and “Researchers from other universities” are considered as most important (1)/very important (2) end-users by 75%/14% and 79%/7% of the NRIs. Only 1 NRI (“OMIC-ENGINE”) views “Researchers from NRI partners” as least important, while only 1 NRI (“ARCHIMEDES”) considers “Researchers from other universities” as least important.
- Start-ups are viewed as most important end-user by 40% of the NRIs, while 21% consider them as very important and another 21% as of medium

²⁹ Score when indicated by the NRI

importance. 5 NRIs do not include them as end-users of significant importance ("FoodInnovation RI", "FoodOmics", "FuVEP", "ARCHIMEDES" and "HELPOS").

- SMEs are highly important end-users for 50% of the NRIs and very important for another 21%. 25% of the NRIs view them as end-users of medium importance. Only 1 NRI ("ARCHIMEDES") views them as least important end-users.
- Large companies as most important for almost 40% of the NRIs and very important for an equal percentage of NRIs. 4 NRIs target them as end-users of medium importance and 2 as least important.
- In general, the NRIs seem to put a strong focus on promoting research activities within academia/research and to a slightly lesser degree on promoting innovation through services to SMEs. Start-ups and large companies are deemed as significantly important users by only half of the NRIs.
- Among the other important types of users identified 3 types stood out being mentioned by most of the 10 NRIs: (1) national authorities and public bodies, (2) European/international organizations and (3) students.

6.2 KPIs and RI Operation

In conjunction with the prioritization and level of importance of the NRI user target groups, it is of equal significance for each NRI to choose a set of Key Performance Indicators (KPIs). Apart from the fact that these KPIs will serve as the basis for any future monitoring of progress and assist in defining the NRI operation, sustainability and risk management plans, they are pivotal in carving in a more solid way the NRI identity and in prioritizing their goals. Questions 23 and 24 were formulated in order for the NRIs to describe their own self-assessment feeling on where they belong and to more clearly define their orientation that may range from pure market services to pure science activities. KPIs are mainly based on ESFRI KPIs.

Towards that purpose a set of 20 KPIs were selected (Question 23) and each NRI rated the importance of each KPI in a scale from 1 to 5 with 1 being "not at all important", 2 "Less important", 3 "Quite important", 4 "Important" and 5 "Very Important". Figure 52 shows the distribution of rating (percentage of NRIs giving a specific rating score) for all KPIs. The results in terms of average and median rating per KPI are summarized in Table 23 (in descending order of average score) alongside the percentage of NRIs rating each KPI as "very important" or "Important". The data of the table are depicted in Figures 53 and Figures 54. Table 24 compiles other KPIs that some of the NRIs indicated.

Table 23: Average and Median Ratings of KPIs [24]

KPI	Average Rating	Median Rating	Percentage of NRIs rating as "Very important" or "Important"
Number of postgraduate and doctoral students using NRI	4.7	5	96%
Total NRI revenue (including grants and research project revenue)	4.7	5	93%
Utilization of new knowledge produced through its use in new services of NRI	4.6	5	93%
Number of Scientific publications	4.6	5	93%
Number of users served	4.6	5	89%
Number of user access requests	4.5	5	86%
Size of NRI resources available	4.3	5	82%
Training of non-NRI staff	4.2	5	71%
Customer approach achieved through direct contact with NRI	4.2	4	82%
Percentage of top (10%) reported publications	4.1	4	75%
Reaching customers through the NRI Website and social media	4.1	4	75%
Collaborations of NRI members with countries outside ESFRI	4.0	4	75%
Industry-related users share	4.0	4	79%
Share of infrastructure users outside Greece	3.9	4	71%
Participation of NRI in activities related to technology policy	3.9	4	71%
Reaching customers using the media (internet, media, etc.)	3.9	4	64%
Revenues from the provision of NRI services	3.8	4	64%
Number of publicly available data sets used externally	3.6	4	61%
Number of patents filed by NRI members	3.1	3	39%

Table 24: Other KPIs identified by the NRIs [24]

Other KPIS
Number of hits on NRI webpages
Number of public-private sector collaborations
Number of students and non-NRI staff trained
Participation in policy related activities or citations in policy related publications
Number and quality of publications, citations and invitations
Number of successful start-ups created
Outreach of media and communication channels

Question 24 allowed the NRIs to comment on the reasoning for their ratings and to provide additional comments on the performance monitoring. The answers may be found in the individual questionnaires of the NRIs.

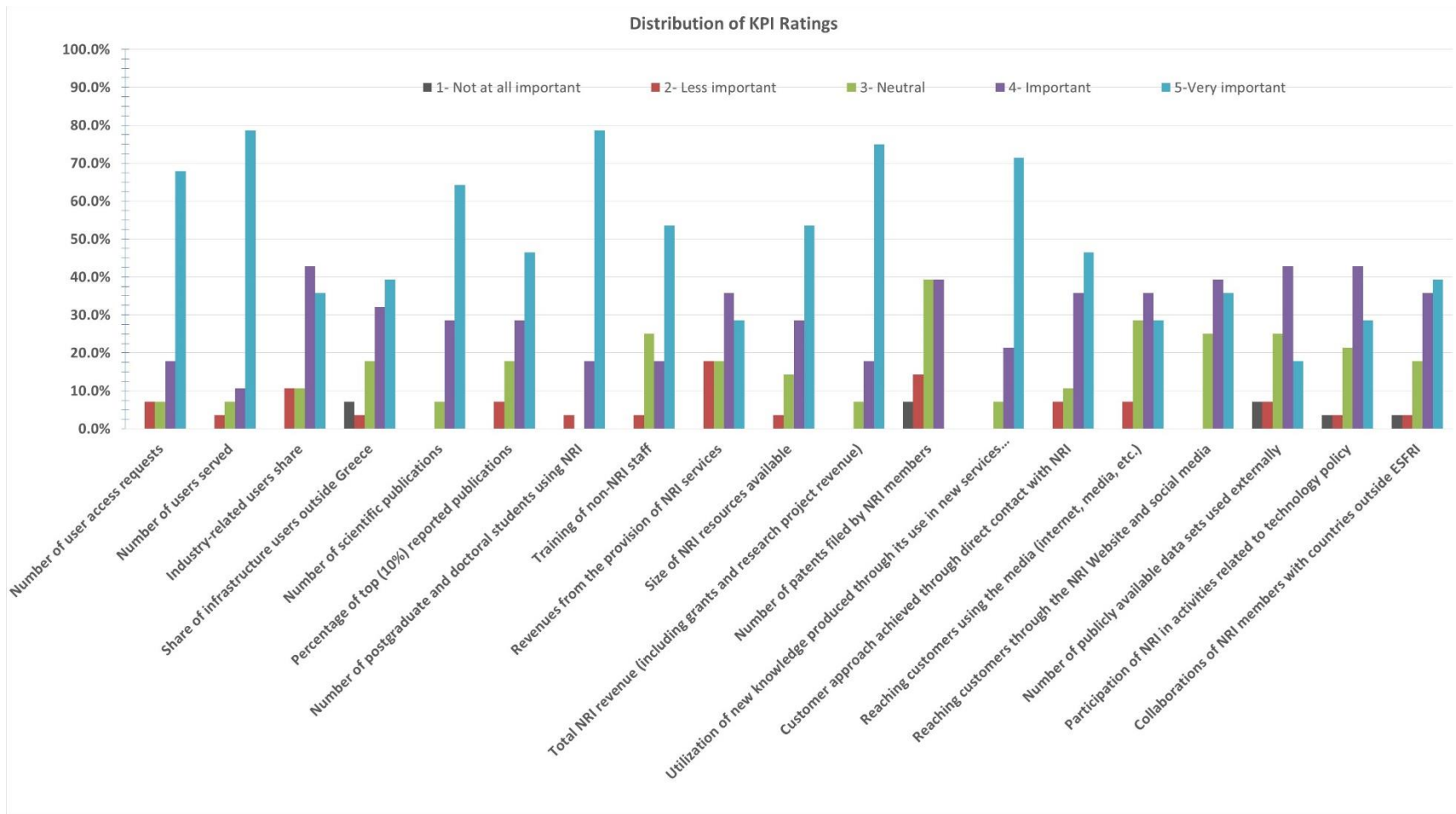


Figure 51: Distribution of rating (percentage of NRIs providing a specific rating) for all KPIs [24]

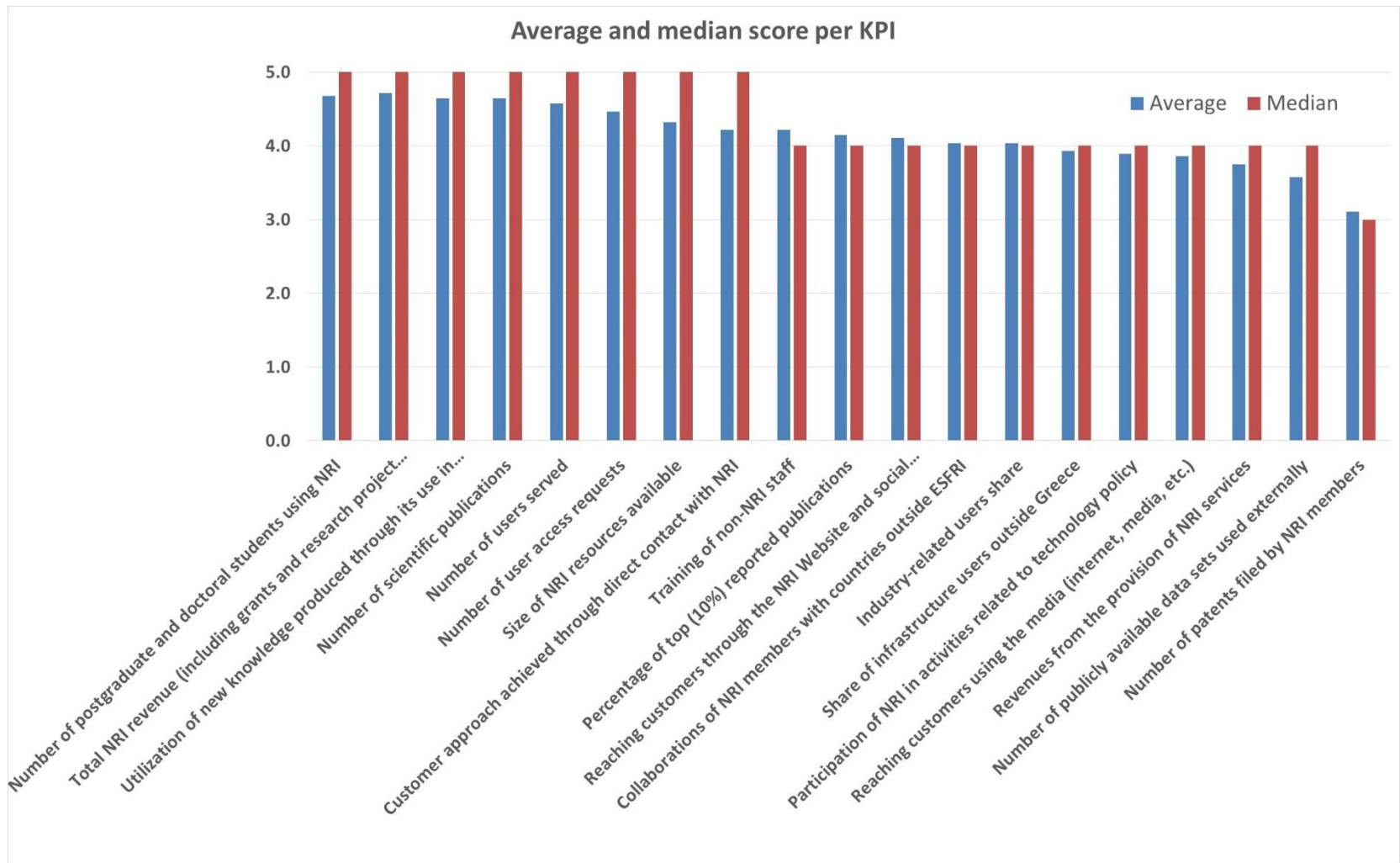


Figure 52: Average (red bar) and Median (blue bar) Rating of KPI Importance in descending order [24]

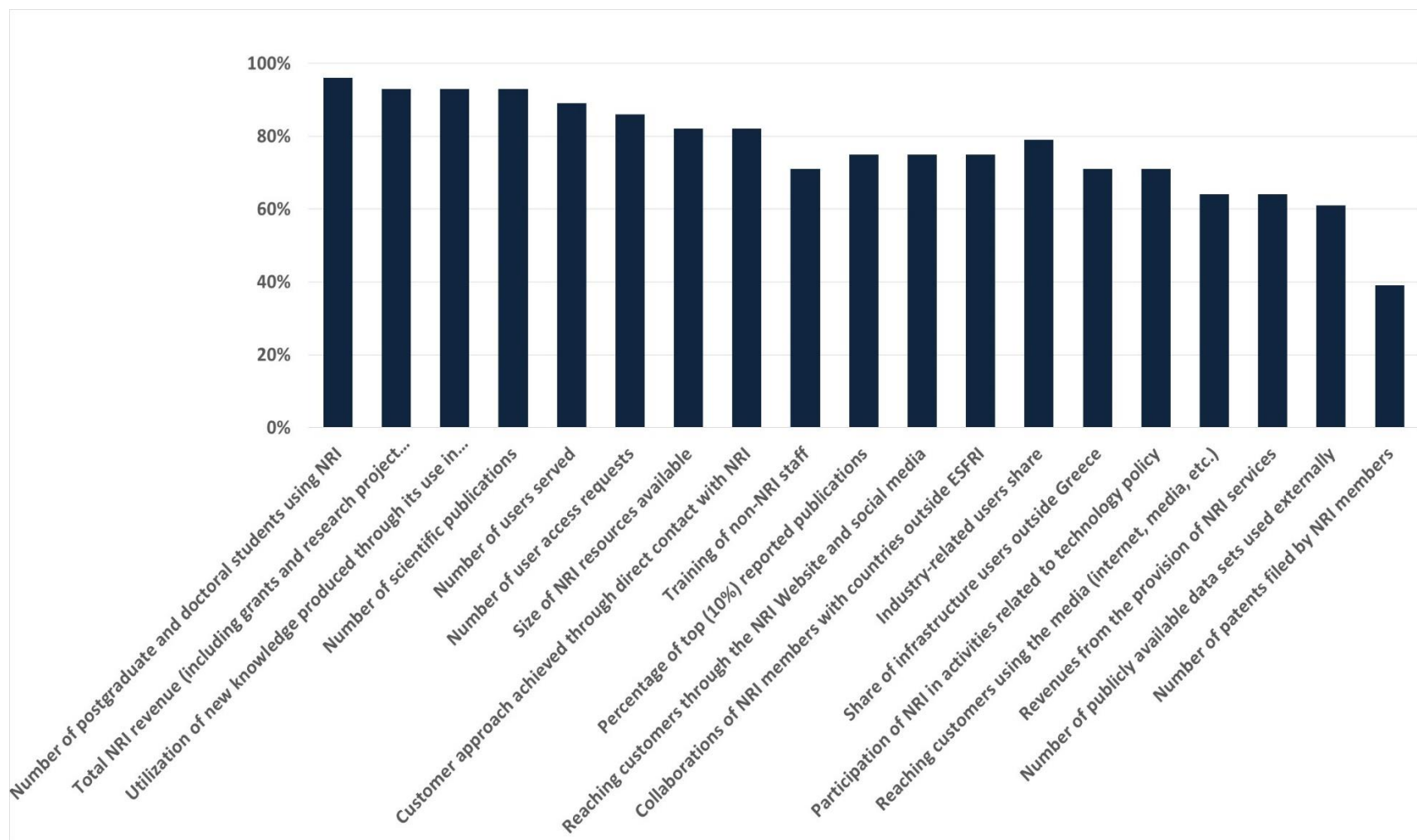


Figure 53: Percentage of NRIs evaluating each KPI as "very important" or "Important" (order based on descending average scores of Figure 52) [24]

The main observations are:

- It is clear the most NRIs regard their contribution to the scientific community as the most important giving to the relevant KPIs, such as the number of Postdoc and PhDs collaborating with the NRI and the number of scientific publications published by the NRI's researchers, the highest scores.
- Utilization of the new knowledge through services receives an equally high score underlying the importance of scientific advancement. Training users outside the NRI also receives a high importance rating with an average of 4.2 but a median of 5 and 71% of the NRIS considering it as very important/important.
- The number of users (requesting services and served) is of significant importance, but still fare somewhat lower to the production of scientific knowledge. Still, almost 80% of the NRIs believe that the industry-related users share is a very important KPI. Quite interestingly, the related revenues from offered services receive a moderate score of importance of 3.9 with about 2/3 of the NRIs considering as a very important/important KPI.
- Collaborations with other ESFRI RIs is viewed as very important/important by 75% of the NRIs, while attracting users outside Greece is important to 70% of the NRIs
- Participation of NRI in activities related to technology policy fares moderately with an average score of 3.9 even though 71% of the NRIs are interested in participating in policy making
- Reaching customers using the media (internet, media, etc.) received a score of 3.9 with 2/3 of NRIs believing it is an important KPI
- Production of externally available data is viewed as moderately important (score 3.6), which is partly controversial to the high importance attributed to the generation of knowledge and the importance of FAIR data management (see Section 4.2)
- Notably, none of the NRIs have evaluated the KPI "Number of patents filed by NRI members" as "Very important", but rather almost 40% of them rated this aspect as quite important and 40% as "neutral".

7. S4-Greek RDTI policy 2021-2027 options-connections with NRIS

7.1 Main features of the Greek Economy in 2021

1. Three global trends are expected to affect the Greek economy in the coming decades: a) **climate change**, b) **digital transformation and automation** and c) a **new structure of world trade**.

2. Although Greece, due to its size, does not affect global gas emissions significantly, it is important that the country complies with existing international agreements and should adequately prepare the following: (i) addressing transition risks, (ii) development opportunities arising from climate change mitigation policies (iii) tackling the effects of climate change in its geographical area.

3. During the period 2021-2027, the dual ecological and digital transition of the EU is expected to affect every aspect of the country's economy, society and industry and will require both new technologies and investment in innovation. However, about 40% of the Gross Value Added of the Greek economy in the two years 2018-2019 comes from sectors that do not present such high specialization, production of innovations, Research and Development activities, use of new technologies and internationalization (Real Estate, Public Sector, Wholesale). However, the sectors following present some of the above

characteristics such as e.g., Manufacturing, Tourism, Transport-Storage, Health-Social Welfare, the Primary sector, etc. Some of these sectors are showing an increase in their share of Gross Value Added in recent years (Tourism, Transport-Storage, Primary sector).

4. A small part of FDI (Foreign Direct Investments) in Greece is directed to sectors that are characterized to some extent by innovation, high specialization and use of new technologies (e.g., Petroleum Products, Pharmaceuticals, Plastics-Chemicals).

5. The largest share of goods' exports concerns food, chemicals, industrial and agricultural products, while in the case of services 83% of exports (on average in the period 2002-2020), concern Tourism and Shipping.

6. Especially Tourism is a field that does not independently lead technology specialization, however, as an area of innovative applications (test bed) in relation to culture and creative industries.

7. Regarding to publications of the Greek Academia & Research institutions the areas of excellence (data for the period 2014-2018) are "Engineering and Technology" (1.36), "Medical and Health Sciences" (1.35) and "Natural Sciences" (1.34) exceeding for the first time the world average (1.00). Although these fields do not necessarily reflect in business activities, they signify specialization and creation of new ideas.

8. The contribution of innovative companies in strategic areas of smart specialization is a critical issue. According to a relevant publication of the NDC (National Documentation Center) in 2019, the largest contribution of the innovative activities of Greek innovative companies is in the "Agro-Nutrition & Food Industry" (21.7% of companies with product and / or process innovation). It is followed by the "Information & Communication Technologies" with 19.3%, the "Materials - Constructions" with 17.7% and "Transport & Supply Chain" with 16.1%.

9. Greek start-ups, despite the severe effects of the COVID-19 pandemic and the financial crisis (2009-2017), show a dynamic growth, contributing significantly to various sectors of the Greek economy. According to a study by EIT Digital Foundation, the most active field is that of Health and related applications, (growth of 16.16% in the last two years (2018-2020)). They are followed by the sectors of Retail and E-Commerce, the sector of Entertainment (sports, fashion, social networks, etc.), Energy and Infrastructure, Tourism, Agri-Food, ICT and Transport.

10. In the Elevate Greece database, which is an initiative of the Greek Government for the support the Greek start-ups ecosystem, 473 start-ups are registered. Investments amount to € 2,400 million in 301 of them. Out of the 473 start-ups 55 are active in Natural Sciences (MedTech, HealthTech, BioTech), 35 in Environment and Energy, 35 active in Tourism, 28 in the Food and Agri-Food sector, 18 in Shipping and Supply Chain and Transport and 18 in Manufacturing. Other sectors of activity are Advertising, Marketing, e-commerce, retail, financial services as shown in the diagram. (Source: Elevate Greece, www.elevategreece.gov.gr)



Figure 54: Greek Start-ups³⁰

11. The table below highlights the strategic areas that are the visible "players" in the national system of entrepreneurship, research and innovation.

Table 25: Main strategic areas and sectors in the Greek Economy³¹

	GVA Sectoral	GVA (Public Sector)	Exports	R&D	FDI	Innovation in Businesses	Start-ups
Primary – Food	X		X	X		X	X
Tourism	X		X				X
Health - Medicine		X		X	X		X
Maritime transport - supply chain	X		X			X	X
Engineering			X	X			X
ICT –Digital Economy				X		X	X
Materials/ Constructions			X	X		X	X
Energy							X
Wholesale and Retail		X					

³⁰ Elevate Greece

³¹ National RIS3 2021-27

7.2 Vision and Intervention Logic of the new RIS3 for the period 2021-27 in brief

The economic crisis of the last decade has strongly affected Greece, and has caused a recession in investment and economic activities, as well as in the business sector. Greek economy is characterized by very low public and private investments in innovation, except the areas of Attica and Thessaloniki, and a low ranking in the global competitiveness index (IMD 2021). At the same time, the health crisis resulting from the Covid-19 pandemic affected further the Greek economy, highlighting the need for drastic changes and immediate decision-making to adapt both public and private systems and operating models in such a way as to support Greek society facing the new reality. In addition, the outbreak of the 4th Industrial Revolution in conjunction with an aging population, globalization, the effects of the greenhouse effect and the depletion of available resources, require the adaptation of international and national strategies and directions.

This direction requires investments in innovation and research, with a simultaneous orientation towards digitization, standards and new technologies, with the aim of increasing productivity, ensuring competitive high value-added products, efficiency and security of credit markets and flexible labor markets. These elements are basic prerequisites in the planning of the National Smart Specialization Strategy (ESEE) for the Programming Period 2021 - 2027.

In Greece, the largest percentage of companies is very small or small in size with limited technological specialization that determines the level of innovation in the country. Also, many start-ups show up without growing ambitions, limiting themselves to small business schemes. Given the small size of companies the resources invested in innovation (either human or financial) are limited, fragmented and often insufficient to improve the competitive position companies.

The education system needs to reorient its activities in terms of training the competitive workforce, in order to connect higher education with the modern needs of the market and the adaptation of lifelong learning. In addition, the low salaries that exist in the market have as a result the inability to attract or retain "talents" who can develop / adopt innovation within organizations and businesses. In terms of funding, while there is an increase in public investment in Research and Development, the increasing competition in European co-financed Research and Innovation programs makes it difficult to access European funds. Nevertheless, the private sector contributes a lot to the country's R&D expenditure, as a fairly high percentage of total expenditure comes from private companies.

The main challenge of linking Research with Innovation is the limited cooperation between the private sector and the research community, which leads to a reduction of innovation outputs and in general to innovations development that probably do not solve existing market problems.

"The vision of the Smart Specialization Strategy is the transition to a new development model that is socially, economically and environmentally sustainable, based on its knowledge and utilization through the production of high value-added products and services, with the prospect of integration into International Value Chains."

Investment in research and innovation supports the main choices of the country's development strategy, providing the necessary innovative background to increase the competitiveness of the Greek economy and to solve important social challenges such as:

- the increased signal knowledge, as well as its management
- the successful utilization and Dissemination of New Knowledge
- the need for a systemic approach to the integration of innovation (product / process, etc.) and the strengthening of technological modernization
- the internationalization through intensifying international competition and emerging technologies
- the participation in International Value Chains.

Meeting the above challenges is a continuous process of modernization and evolution, of an "innovation journey" that intervenes in the various stages of innovation and business practices in order to develop sustainable and competitive ventures starting in Greece and with an international orientation. The intervention logic of RIS3 2021-27 is based on a combination Strategic Objectives which are in line with the directions of Policy Objective 1 of the NSRF 2021-2027 and the corresponding Enabling Condition 1, and are the following:

Strategic Objective 1: Increase the production of new knowledge

Strategic Objective 2: Effective utilization and dissemination of new knowledge

Strategic Objective 3: Technological modernization - adoption of innovations

Strategic Objective 4: Development, Networking & Internationalization of Greek companies

Strategic Objective 5: Increasing Extroversion - Participation in Research, Technological and Business Global Value Chains

Table 26: National RIS3- Intervention Logic [31]

Strategic Goals	Increasing the production of new knowledge	Effective utilization and dissemination of new knowledge	Technological modernization - adoption of innovations	Development, Networking & Internationalization of Greek companies	Increasing Extroversion - Participation in Research, Technological and Business Global Value Chains
Priority Fields					
Human Resources (Research & production)	XXXX	X	XXX	XXX	XX
Research Infrastructure & Innovation Infrastructures	XXX	XX	XXX	XXX	XX
Mechanisms, Services & Support Structures	X	XX	XXX	XX	XX
Connection of Research and Production	XXXX	XXXX	XXXXX	XXXX	XXXX
Digital Transformation	XXX	XXX	XXXXX	XXX	XXX
Regulatory Framework (Legislation, Administration, Taxation)	XXXX	XXXX	XXXX	XXXX	XXXX
Public Procurement	X	X	XX	X	X
Promotion - Publicity	X	X	X	XX	XX

The above Strategic Objectives are the key distinct stages of the aforementioned "innovation journey" recognizing that innovation is produced, further disseminated, adopted by companies enhancing their growth and competitiveness, and supports their extroversion and internationalization in the global economy.

In more detail:

- Production of New Knowledge: The most important asset that the country has and on which innovation is based, are the people, the research potential and especially the young scientists. With the utilization of the new scientific potential, the aim is to strengthen the innovative effort, by upgrading the respective investment of the private sector, in order to function as a "locomotive of growth". In this direction, a simple network of innovation support mechanisms is designed through the development of new skills and research results, especially by young researchers and scientists, thus releasing a series of bottlenecks of innovation.
- Utilization and Dissemination of New Knowledge: The classic linear model of technology transfer (where research results are transferred from the research

laboratory to the R&D departments of companies in order to produce new products and services) has now been replaced by a two-way model of cooperation, according to which Research organizations and companies interact in various ways, aiming at the co-creation of new knowledge and technology. The country's productive fabric and the R&T system do not always meet in terms of objectives, which lead to several occasional collaborations and limited use of research results. It is necessary to design enhanced forms of cooperation that include not only collaborative projects between companies and research institutions on the basis of demand (as emerging through new business discovery cycles) but also co-creation structures and a medium-long-term cooperation strategy to bridge the gap that often exists between supply and demand.

- Business Innovation & Technological Modernization: Greece's performance in knowledge-based innovation remains low, despite the improvement that is observed in the last years. The support of the innovation production by the existing companies is sought by strengthening the creation of research and development departments in them through the financing of industrial research and experimental development projects in the specific thematic priorities that interest the productive fabric of the country, which contribute to the production of new or improved products / services and help the penetration in new markets or lead to the production of new knowledge that can be utilized.
- Development, Networking & Internationalization: At the level of support, it has already been identified during the study of the country's challenges, that there is a support gap for innovative projects corresponding to advanced technological maturity as well as the process of growth and / or networking of companies and research organizations in order to acquire the necessary critical mass that makes them internationally competitive. Greece's participation in the actions of European Value Chains, Horizon Europe and the New European Research Area in general (Partnerships, Missions, ESFRI infrastructures, etc.) is expected to be important during P.P. 2021-27, while the expansion of the network of bilateral multilateral cooperation (bilateral cooperation with China, Russia, Germany, Israel, USA, Cyprus, Turkey, Great Britain, etc., multilateral cooperation Greece - Cyprus - Israel & USA) can create new opportunities for a stronger international network for Greek research institutions and companies.
- Participation in Research, Technology and Business Global Value Chains: The importance of global innovation networks requires an innovation policy that transcends regional and national boundaries. International cooperation is a key element of RIS3 and includes knowledge exchange, coordination and exploitation of synergies with RIS3 initiatives in other countries and regions. Cooperation and extroversion promote the understanding of the competitive position of the country / region in relation to others and in particular in relation to the Global Value Chains (GVCs) so that companies and research organizations can have access to wider business and knowledge networks, gain the necessary research capacity, penetrate in new markets, to expand business opportunities, to combine complementary advantages and to integrate into international systems.
- Achieving the above objectives in the strategic priority areas that the RIS3 2021-2027 focuses on, requires a series of interventions grouped into eight key areas of intervention. These areas are the asset and the framework of the country, which

needs to be strengthened in order to achieve the expected results based on the goals and vision of RIS3. The areas of intervention that are identified are:

- Human Resources (Research & Production) - The main goal of the investments in the field of intervention is the strengthening of the Targeted Research Strategy through the training and / or retraining of the human resources of the country either in technical or business matters and the strengthening of the skills for its innovation management and staff specialization to support business development and internationalization.
- Research Infrastructures and Innovation Infrastructures - The main goal of the investments in the field of intervention is to support the National Research Infrastructures and the Research Infrastructures in general through the modernization and the strengthening of the extroversion at national, European and international level. The measures identified to strengthen the infrastructures are expected to contribute to all stages of the innovation journey of rational intervention.
- Mechanisms, Services & Support Structures (including collaborative mechanisms) - The main aim of the investments in the field of intervention is to support the development of businesses and to facilitate the technology transfer and knowledge through the continuation of the existing infrastructures and the assistance creation of new.
- Linking Research and Production (State Aid & Other Financial Instruments) - The main aim of intervention investments is to further link research and innovation with entrepreneurship and to strengthen competitiveness, productivity and extroversion of companies to international markets in order to transition to quality innovative entrepreneurship and increasing domestic added value with the aim of economic development based on knowledge and sustainable specialization, the integration of new knowledge and innovation in existing but also in new products, services, production systems and chains value, and linking academic research to market needs and the economy. A prerequisite for achieving the objectives of the action is the concentration of resources and efforts in the selected areas of economic activity and in areas of intervention, where potentials of research excellence and entrepreneurship are detected according to the national research and innovation strategy for smart specialization at national and regional level with the aim of modernizing, diversifying and exploiting new opportunities in the Greek economy.
- Digital Transformation - The main goal of investments in the field of intervention is the modernization and upgrading of companies and others with the aim of creating added value by exploiting the advantages of digital transformation technologies which is a horizontal vehicle in all stages of the innovation path provided by the intervention logic of NS3 21-27, in relation to the specific objective b of the policy objective 1 of Cohesion Policy 2021-2027, which RIS3 serves. A key factor in promoting these investments is the successful implementation of the 'accelerators' of the 'Digital Transformation Book 2020-2025' through interventions that are the 'backbone' for the digital transformation of the Public Administration and its transformation into a service provider, actively oriented to the needs of citizens and businesses.
- Regulatory Framework (Legislation, Administration, Taxation) - The main aim of the proposed measures in the field of intervention is to form a favorable framework for the creation of knowledge & innovation, their utilization and in general the development of business initiatives at national and international level, important

reforms and legislative acts to homogenize the renewed system of research, innovation and entrepreneurship that is emerging.

- Public Procurement - The main aim of the proposed measures in the field of intervention is the promotion of new technologies and innovations, in SMEs, but also in the assistance of their participation in Internationalization and Global Value Chains through systems and processes that promote greater transparency and speed of implementation of public works and supplies.
- Promotion - Publicity - The main goal of investments in the field of intervention is the dissemination of research results & innovations at national and international level to facilitate access to action results, the connection of researchers in public and private institutions with international developments in the field but also the strengthening of collaborations for the further utilization of results (e.g., schemes of open innovation).

8. Main findings from the questionnaire results

Collected questionnaires highlighted the challenges raised during the development and operation of the 28 National Research Infrastructures of the Multiannual Research Infrastructure Financial Plan of the Programming Period 2014-2020. In summary these are:

1. Most NRIs (25/28) provide access to their facilities and equipment in accordance with their mission. The most common type of services with at least 50% of the NRIs offering them fall within four major categories: 1. Access service, 3. Expertise (consultancy) service, 6. Support service, 7. Education and training.
2. The strongest focus of most NRIs is in the generation of new knowledge and providing services to the academic sector (within and outside the NRIs). Education and training play a prominent role in their missions. Most NRIs position themselves highly in terms of scientific excellence which needs to be challenged.
3. The majority of the NRIs (22/28 or 79%) consider Researchers from both the NRI partners and other universities as the most important target groups. Approximately 50% of the NRIs acknowledge the private sector (start-ups, SMEs and Large companies) as of top importance and place it at an equal footing to the academic. However, only 10 out of 28 NRIs (36%) have increased the time allocated to the non-academic sector during the pilot phase.
4. Only four NRIs namely Innovation-EL, EATRIS-GR, HELLAS-CH and PlantUp have managed to start creating income through services offered by the NRI (albeit relatively small compared to the other funding sources). It should be pointed out that service fees can be collected only through the individual partners (see point 8).
5. Despite the importance on the generation of new knowledge and their perception of the maturity level in terms of "innovation potential" and "knowledge management" which they believe as being largely, "mature", IP management has scored the lowest in importance as a KPI.

6. Funding has mostly come from the EPAnEK program. A lot of the NRIs strive to allocate funds from the state budget of the participating institutes to maintain their operation. The correlation between funding from other sources or projects in favour of NRIs development during 2019-21 is a grey area.
7. Human resources are a major issue. Most NRIs recognize the need to hire dedicated highly skilled personnel for the NRI node daily operation, administration and management, however (i) funding is non-adequate, (ii) salaries are not attractive so as to maintain highly-skilled personnel, and (iii) large bureaucracy does not allow for swift hiring complicating procedures unnecessarily.
8. Most NRIs identified as their main constraint in operation the lack of legal status and the fact that the NRIs are not separate legal entities with their own VAT and PIC numbers. Governance structure of most of NRIs is like the governance of a none-profit network. This fact does not allow them to participate in European projects nor larger European and international RIs and as a corollary cannot profit from the respective European calls of Pillar I acquiring funds that could contribute to their sustainability. In addition, this has implications in applying costing policies and distributing the generated income in the NRI.
9. Networking and promotional activities are considerably limited. Nonetheless, a large percentage of the NRIs have recognized the need to create dedicated departments or at least hire specialized personnel to increase such activities. This has not been possible though because of the constraints in funding and hiring/retaining personnel (see above).
10. Most NRIs tried to model themselves according to large European infrastructures (ERIC or ESFRI), however the different legal status, the related registration and the level of state funding was prohibitive for them to be built or operate as such.
11. Large European infrastructures (ERIC and ESFRI) are obviously the main competitors. Several Greek NRIs are associated to them to a lesser or larger degree and aspire to become full members in order for them to continue to exist.
12. All NRIs are concerned about their sustainability. In addition to the problem of retaining personnel, most NRIs stretched the need of renewing/maintaining aging equipment or acquiring new to align themselves to the scientific developments. Maintenance cost is possibly the most important cost category since there is no programme or financing scheme that is eligible.
13. Numerous NRIs pointed out the need to have their services certified in order to become competitive and trustworthy service providers. However, this is an issue that is challenged since certification of procedures implies restrictions in R&D activities of the certified laboratories.
14. NRIs were not supported by any horizontal activity although a number of them was planned in the multiannual plan. Some issues may have been eliminated if this had happened. Especially on issues relating to internationalisation and maybe purchase of equipment and consumables.

Annexes

ANNEX I. QUESTIONNAIRE

The Questionnaire given to the NRIs is presented below. It was created using Survey Monkey and was active from 12/22/2021 until 15/1/2022. Two important remarks should be made. Firstly, that the NRI HELIX did not provide with any answers and secondly that the NRI PROMETHEUS received two responses, one from partner CERTH- Hellas and one from partner NCSR. In the analysis provided throughout this Report both answers have been taken into account, since the activities of the two bodies have become distinct. In this context, it is considered that we are dealing with two separate single-partner infrastructures, one managed by CERTH- Hellas (PROMETHEUS) and one managed by the NCSR, which is called ARCHIMEDES. Thus, until HELIX responds, 28 NRIs are presented and analyzed.

1. Contact details of NRI respondent

Please complete the contact details of the person who is responsible for completing or coordinating the completion of this survey on behalf of your NRI

* 1. First name

* 2. Family name

* 3. Organisation

* 4. Email

* 5. Mobile number

2. NRI Identity

* 6. Name of NRI

* 7. Mission and Scope

Please describe the mission and scope of activities **as defined in the original proposal** and highlight any changes made since the proposal was accepted

* 8. Types of services provided by the NRI

Please tick all relevant boxes for which you provide service

- 1. Access service
 - 1a. access to data
 - 1b. access to software
 - 1c. access to central infrastructure for IT resources and digital services
 - 1d. access to aggregators
 - 1e. access to facilities
 - 1f. access to equipment
- 2. Analysis service
 - 2a. data analysis service
 - 2b. sample analysis service
- 3. Expertise (consultancy) service
- 4. Data management
 - 4a. maintenance service
 - 4b. data storage service
- 5. Material processing service
 - 5a. material maintenance and modification
 - 5b. material production service
 - 5c. material storage service
- 6. Support service
 - 6a. project development
 - 6b. development of models and tools
 - 6c. development of solutions
 - 6d. certification and benchmarking
 - 6e. knowledge and technology transfer
- 7. Training and education service
- 8. Logistics service
 - 8a. financial service
 - 8b. transport service

9. Please indicate any other services the NRI provides (Optional)

* 10. Who are the targeted users of the NRI's services?

Score according to the priority the NRI has set according to its mission (different categories may receive the same score in terms of importance)

	1 (most important)	2	3	4	5 (less important)
Researchers from the NRI partners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Researchers from other universities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Start-ups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SMEs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Large companies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify and rate)

* 11. What percentage of the **operational time of the NRI equipment per annum** is made available to internal and external users for the **period 2021** (NRI operation period).

Academic/

Reresearch sector

Non-academic sector

* 12. What percentage of the **operational time of the NRI equipment per annum** is made available to internal and external users for the **period 2011-2020** (period before the operation of the NRI, therefore the data will correspond to sum of time allocated to services annually by each of the partners as individual entities).

Academic/

Research sector

Non- academic sector

3. Governance - Maturity Level - Competition

* 13. How would you evaluate the following **governance** aspects of your NRI?

	Non applicable	1– Requires significant improvement	2 – Requires some improvement	3–Satisfactory	4 – Good	5–Very good
Representation of partners in the NRI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Administrative and financial practices of the partners organisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Project management and coordination of partners activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Human resources (including gender/diversity) policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(FAIR) data management policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge management / intellectual property policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ethics policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Please provide any comments regarding the previous question (Optional)

* 15. Describe the **governance structure** of your NRI and provide links to relevant documents supporting it (e.g., internal regulation, interfaces with internal regulations of the parent organizations, development plan, marketing and/ or feasibility studies of the NRI or its partners). Please describe any existing legal, administrative and regulatory issues that hamper the governance of your NRI.

* 16. What do you consider to be the most important **results** produced by your NRI so far? Do you consider these results satisfactory in relation to the level of the participating bodies? If not, what are the most important issues you have encountered so far?

* 17. Describe the challenges you face in recruiting or retaining skilled staff including attracting (returning) researchers from abroad

* 18. What are the **complementary organisations** (e.g., technology parks, networks, other academic or research institutes, European or International partners, ESFRI projects, etc.) with which you collaborate and give added value to your NRI? If you are not collaborating, please mention the factors that led to this.

* 19. What is your self-assessment concerning your NRI with respect to international level standards of **excellence and quality**? Please rate and comment on the following parameters

1- Significantly immature 2- Somewhat immature 3- Satisfactory 4- Moderately mature 5- Very mature

	1- Significantly immature	2- Somewhat immature	3- Satisfactory	4- Moderately mature	5- Very mature
Scientific, technological potential <i>Scientific excellence, degree of interdisciplinarity, prospects for scientific and technological discoveries</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Effective networking, synergies in the knowledge triangle and international promotion <i>Capacity and complementarity of the partners, added value at regional, national and international level, synergies, networking, critical mass, recognition, transparency</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access policy <i>Access policy for researchers, industry, business and international users through openness to international markets</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sustainability <i>Management structure, human resources, cost-effectiveness, long-term viability, clear investment plan</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1- Significantly immature 2- Somewhat immature 3- Satisfactory 4- Moderately mature 5- Very mature

Innovation potential and contribution to private sector innovation

Contribution to: innovation and technology transfer, creation of knowledge and innovative ideas, creation of high growth SMEs, green supply chain and circular economy

Contribution to National and Regional Development & Socio-Economic Benefits

Contribution to: private sector R&D, knowledge/employment-intensive activities, economic and social benefits and the impact of IPs on socio-economic issues

20. Please comment on your rating

* 21. In your assessment, who are the main **competitors** (other research infrastructures) of your NRI nationally and internationally (please list the name and website)?

* 22. What research infrastructures could serve as **role models** for your NRI? You can also refer to international research infrastructures of other technology areas (please list the name and website).

* 23. How important do you consider the following **Key Performance Indicators (KPIs)** to examine the level of operation of the NRI research infrastructure? (This question provides a self-assessment feeling on where the NRI belongs - from pure market services to pure science activities)

1- Not at all important 2- Less important 3- Neutral 4- Quite important 5 – Very important

Number of user access requests

Number of users served

	1- Not at all important	2- Less important	3- Neutral	4- Quite important	5 – Very important
Industry-related users share	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Share of infrastructure users outside Greece	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of scientific publications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Percentage of top (10%) reported publications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of postgraduate and doctoral students using NRI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Training of non-NRI staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Revenues from the provision of NRI services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Size of NRI resources available	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Total NRI revenue (including grants and research project revenue)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of patents filed by NRI members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utilization of new knowledge produced through its use in new services of NRI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer approach achieved through direct contact with NRI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reaching customers using the media (internet, media, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reaching customers through the NRI Website and social media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of publicly available data sets used externally	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Participation of NRI in activities related to technology policy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collaborations of NRI members with countries outside ESFRI	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify and rate)

24. Please comment on your rating

* 25. Please describe the current sources of financing of your NRI

* 26. **Sustainable funding** is an important part of the **viability** of a research infrastructure. How important do you consider funding for each of the following cost groups in relation to the total cost of infrastructure support and development. Please fill in other costs that may be omitted.

	1-Not at all important	2 - Less important	3- Quite important	4- Important	5-Very Important
Machinery upgrade and renewal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Machinery maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintenance of building and laboratory infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Research & Development of new services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Permanent Staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Temporary Staff	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promotion and advertising	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Legal and Accounting Expenses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consumables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overheads	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify and rate)

27. Please comment on your rating

4. Future Development of your NRI

* 28. What additions and enhancements should be made for the future development of your NRI (organisation, facilities, governance, human resources policy, financing & project management, promotion & marketing)

* 29. How do you think these services can be improved/ enriched for the next implementation phase of the structure?

* 30. Should additional technologies or capabilities could be integrated into your NRI research infrastructure to enhance its future development?

* 31. What complementary structures (e.g. technology parks, networks, other academic and research bodies, etc.) would your NRI like to collaborate with or further develop co-operation? And why?

* 32. What do you think will be the main future needs (equipment, maintenance, human resources, etc.) of your research infrastructure?

* 33. What existing and new sources are the most important for your NRI to generate external revenue in the future? Please refer to each partner (if applicable) and justify.

* 34. What changes do you think need to be made in the way potential customers access / attract the structure to help further the development of your NRI?

35. Please enter any other suggestions and comments that are not covered by all of the above

ANNEX II. RESEARCH INFRASTRUCTURES FICHES