

EIROforum Position Paper on the Next Framework Programme “FP9”

Executive Summary

Europe needs to extend its investment in research, technology and innovation in order not to lag behind global competitors. Fundamental research drives knowledge creation, expands the frontiers of science and technology, and leads to both incremental and breakthrough innovation as well as societal applications. The next EU Framework Programme can help secure Europe's future, by providing solid support for fundamental research.

The three core programmes funded by the Excellent Science pillar of H2020—Research Infrastructures, Marie Skłodowska-Curie Actions, and the European Research Council—are essential for the advancement of European science and technology. These programmes are unique; they have no equivalents at national level and should be further developed and extended in FP9.

Research infrastructures are cornerstones for European science and play a pivotal role in sustaining the world-class excellence of European research. Fundamental breakthroughs made in, and cutting-edge technologies developed for, research infrastructures in Europe can be successfully used in other pillars of FP9 focused on innovation and large-scale impact-driven missions.

The EIROforum organisations:

- Call for a new Framework Programme that recognises the critical role of fundamental research to society and advocates a clear vision for science, with substantial funding.
- Underline that Research Infrastructures are by their very nature established to achieve extraordinarily challenging scientific goals, and should thus play a key role in the 'missions' proposed for FP9 by the Pascal Lamy expert group.
- Support the development of the European Open Science Cloud (EOSC) and offer their expertise for its implementation.
- Welcome a European Innovation Council as a spearhead in fostering a strong innovation ecosystem in Europe.
- Call for increased funding for the Research Infrastructures and Marie Skłodowska-Curie Actions instruments, and for European Research Council grants.
- Recommend the introduction of new robustly-funded instruments for support to novel technology development and innovation at European Research Infrastructures.

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1. Introduction

Not long ago, one of the worst economic crises ever shook the world. Europe was not spared and in many EU countries upturn is slow and the economic situation is still fragile. Nonetheless, countries that continued to invest in science and technology faced the crisis on solid ground and made a faster recovery, a reason why global competitors with powerful economies have continued to invest heavily in R&D^{1,2,3,4}. Europe needs to invest more than ever in science, research and innovation, in order not to lag behind and to secure its prosperity and future^{5,6}.

While increased investment in science and technology at a national level is critical, the investment made on a European scale in the Framework Programmes accomplishes goals that cannot be achieved by individual nations alone. The impact assessments of FP6⁷ and FP7⁸, and the interim evaluation of H2020⁹, demonstrate convincingly the European added value of these programmes in terms of: pooling resources and achieving a critical mass of excellence, sharing expertise and enabling cross-border collaboration, enhancing the skills and international mobility of researchers, improving the capacity of and access to research infrastructures, creating jobs and growth, augmenting the competitive edge of European industry and SMEs in particular, as well as addressing common societal and pan-European challenges.

In 2021, the EU will launch the next Framework Programme for research and innovation, referred to herein as FP9. With this position paper, the eight European intergovernmental research organisations, speaking collectively as EIROforum¹⁰, call upon the European Commission, Parliament and Council to extend funding in the next Framework Programme to further build on the successful programmes and experience of FP7 and H2020. A strong level of support for fundamental research guarantees the excellence of European science and European technology.

In this paper, the EIROforum organizations (EIROs) stress the importance of the Framework Programmes' role in maintaining the excellence of fundamental scientific research, focusing on the three following observations:

Firstly, Europe's core scientific strengths lie in the ability to design, construct, and operate world-class Research Infrastructures (RIs), which serve as focal points for scientific communities and provide unique tools to conduct world-leading science.

Secondly, programmes such as the Marie-Sklodowska Curie Actions (MSCA) and the European Research Council (ERC) are essential to the development of a pool of skilled and mobile scientists, engineers and technicians, and to the expansion of the frontiers of science and technology, respectively.

Thirdly, the development of innovative technologies and the industries that harness them would not be possible without the input and support of fundamental research and frontier science.

¹ *Basic Science in Knowledge-Based Society*, Intervention of President Se-Jung Oh (Institute of Basic Science), preparatory Conference for Daejeon Global Innovation Forum, Daejeon City, Republic of Korea, 25-26 September 2013.

² J. Qiu, China goes back to basics on research funding, *Nature*, vol. 507, March 2014; W. Yang, Boost basic research in China, *Nature*, vol. 534., June 2016; H. Wang et al, An Explanation for China's Economic Growth: Expenditure on R&D Promotes Economic Growth, *Journal of Service Science and Management*, vol. 8, 2015.

³ The Cabinet Office translation of the 5th S&T Basic Plan <http://www8.cao.go.jp/cstp/english/basic/5thbasicplan.pdf>

⁴ The President's Budget for Fiscal Year 2017, <https://obamawhitehouse.archives.gov/omb/budget> ; S. Reardon et al., *Nature News*, 14 December 2014

⁵ Reflection paper on the future of EU finances, European Commission June 2017

https://ec.europa.eu/commission/publications/reflection-paper-future-eu-finances_en

⁶ Why fund Research?, Science Business Report, June 2017, <https://sciencebusiness.net/>

⁷ https://ec.europa.eu/research/evaluations/index_en.cfm?pg=fp6

⁸ https://ec.europa.eu/research/evaluations/index_en.cfm?pg=fp7

⁹ https://ec.europa.eu/research/evaluations/index_en.cfm?pg=h2020evaluation

¹⁰ <https://www.eiroforum.org/> (CERN, EMBL ESA, ESO, ESRF, EUROfusion, European XFEL, ILL)

2. Support to the European Science Base in FP9

The value of fundamental research

Many world-changing technologies and applications such as satellite and wireless communications, mobile phones, MRI scanners and cancer treatments, all come from developments and breakthroughs in fundamental research, such as the general theory of relativity, electromagnetism, and the human genome. One of the main features and values of fundamental research is the advancement of the frontiers of scientific knowledge and the achievement of outstanding, sometimes unexpected, breakthroughs, often without concrete applications in mind. Nobel-prize winning discoveries such as Giant Magnetic Resistance sometimes lead to industrial applications in just a few years. More often, however, Nobel-prize discoveries, such as DNA and lasers, find their way into everyday life decades later. These are just two examples of the numerous outstanding achievements of European scientists¹¹.

Basic research drives knowledge creation and thus fosters technology breakthroughs with novel societal and industrial applications. Starting with moderate support to fundamental research, mainly through Marie-Curie fellowships back in the 1990s (FP3), the EU supports today the excellence science pillar of H2020 including the MSCA, Research Infrastructures, and ERC programmes, which are all of utmost importance for the continued progress of the European Research Area. Without a programme for the training and mobility of researchers, the skilled human resources of European science and technology would be diminished; without a programme for support to RIs, including e-infrastructures, the integration of scientific communities, joint development of cutting edge technologies, and open access to research facilities and computing resources in Europe would be undermined; and without a programme for funding frontier research, Europe will not be able to achieve and/or maintain leadership in many fields of science and technology.

This is why, with the next EU Framework Programme, Europe needs to support unconditionally its science and research base, upon which the major societal and industrial challenges of today and tomorrow can be faced.

Beyond H2020

The EIROs call for a solid continuation and encourage the expansion of the core of the Excellent Science pillar of H2020, notably the Research Infrastructures (including e-infrastructures) programme, the MSCA, and the ERC. These programmes are unique and have no equivalents at national level. They provide significant and necessary resources for enhancing research and innovation capacities throughout Europe, developing and stimulating mobility and researchers' careers within Europe, and supporting the excellence of European frontier research and technology development.

Research Infrastructures

RIs remain essential in advancing and maintaining Europe's global leadership in ground-breaking research and innovation. They play a key role in extending the frontiers of knowledge and developing new technologies, in turn leading to innovation, and they provide excellent training opportunities for young technicians, engineers, and scientists in Europe. The EIROs thus encourage a further expansion of the RI programme in FP9.

Developing New Research Infrastructures in Europe

The EIROs view positively the development of new world-class RIs in Europe, notably through the ESFRI process, and have provided advice and expertise¹² to ESFRI over the years. The Design Studies and other dedicated instruments for support to the preparatory and implementation phase of ESFRI projects, landmarks

¹¹ https://www.nobelprize.org/nobel_prizes/lists/countries.html

¹² EIROforum (2010) Establishing New Research Infrastructures in Europe – The EIROforum Experience
EIROforum (2015) EIROforum discussion paper: Long-term sustainability of Research Infrastructures
(<https://www.eiroforum.org/science-policy/publications/>)

and other world-class infrastructures, have provided a significant boost to the said projects, with a positive impact on many scientific communities. As such, this support should be continued and strengthened in FP9.

With regards to the current set of funding instruments for major upgrades and for the furtherance of a balanced development of RIs in Europe, the EIROs view these as highly effective and essential to ensuring that European RIs remain at the technological forefront.

Further Integration of Scientific Communities

The EIROs support the goal of providing Europe with world-class research facilities that are accessible to all researchers in Europe and beyond, according to scientific merit, which has been one of the objectives of the Research Infrastructure programmes in FP7 and H2020. The Integrating Activity (IA) projects under FP7 and H2020 have proven to be a very useful tool in this regard, and have resulted in a significant European added value in all scientific fields which use RIs. The IA instrument is very successful in structuring and consolidating large scientific communities and in fostering collaboration between RIs across Europe. Under FP9, continued funding for such actions should be foreseen, with the aim of ensuring the sustained and efficient access of researchers to, as well as the optimal use and the enhancement of services at, state-of-the-art facilities in Europe.

New instruments could be introduced to provide support and leverage for the implementation of joint R&D programmes and the development of novel cutting-edge technologies for clusters of RIs which have achieved an advanced level of integration over FP7 and H2020. The EIROs remain committed to explore solutions for the creation of sustainable structures and longer-term funding for such advanced communities.

Technology development at Research Infrastructures

In order to maintain excellence in their respective scientific domains, RIs act as hubs of innovative and cutting-edge technology development. These new technologies often have spill over applications in other domains and industrial sectors that cover a whole spectrum ranging from cancer treatment and new medicines, to aerospace and automotive industries. This technology development in RIs feeds a cycle of innovation in their respective areas and beyond.

The funding allocated to support technology transfer and spin-off applications from RIs has not been sufficient in FP7 and H2020, and as a result the innovation potential of European RIs has not been well exploited. The innovation pilots foreseen in the last part of H2020 need to be extended and deployed on a larger scale in FP9 in order to develop RIs that contribute to the European Innovation Union goals. The ATTRACT initiative¹³ is a step in the right direction. This action, supported by the EU and driven by a number of EIROs, is a pan-European action which aims to accelerate the development of detector and imaging technologies for the market through a process of co-innovation among European research institutes, small and medium enterprises (SMEs), companies and universities.

E-infrastructures for Research and the European Open Science Cloud

The European Open Science Cloud in FP9

Maintaining a competitive advantage in cloud computing and big data analysis must remain a top priority in FP9 and the European Open Science Cloud (EOSC) pilot represents a good first step. In view thereof, the EIROs proclaimed their support of the EOSC Declaration and remain available to offer their guidance and recommendations to ensure the rapid creation, uptake and long-term viability of the EOSC¹⁴.

Through recently approved H2020 projects, the 'PCP' and 'virtual access' funding instruments are being applied to e-infrastructure services. Our experience to-date shows that these instruments need significant adjustments in order to accommodate the realities of digital services and the single digital market.¹⁵

¹³ <http://www.attract-eu.org/>

¹⁴ EIROforum IT Working Group (2017) 'Federated Scientific Data Hub' <https://www.eiroforum.org/science-policy/publications/>
EIROforum (2015) 'A European Open Science Cloud' <https://www.eiroforum.org/science-policy/publications/>

¹⁵ <https://ec.europa.eu/digital-single-market>

For the EOSC to be successful, measures to integrate innovation from commercial cloud providers will also be crucial, as highlighted by the work in Helix Nebula¹⁶. EIROforum therefore recommends that the governance model is formed around end-users and procurers. Further action is also needed to fund outstanding exemplars in the scientific community. This could be accomplished by stimulating the use of the EOSC through a voucher scheme, and by exploring hybrid models involving private and public cloud resources that are linked with trusted community repository and service capacities of cloud “fast runners”¹⁴. In addition to this, EIROforum recommends that:

- it should be recognised that High Performance Computing (HPC) has a wider scope, which includes public and commercial cloud-based HPC services in addition to supercomputers of top range capabilities, and that these capacities need to be integrated in the EOSC to be made available to user communities on-demand;
- the engagement of *advanced research communities* and commercial cloud service providers should be accelerated by bringing the results of path finder procurements activities, such as Helix Nebula Science Cloud, into production use and expanding the platform to include higher-level services;
- the means by which ERC grantees (of which there are almost 7,000 researchers and a total of more than 40,000 team members over the last ten years) could make use of the EOSC to accelerate their research and share their results should be given due consideration.

Making EOSC a key theme in FP9 will ensure that research communities and commercial service providers continue to build trust and to invest in initiatives for the future.

Research Infrastructures as Models of International Cooperation in Science

Science is one of the most developed form of international cooperation and the EIROs represent a successful model of organizing scientific cooperation, networking, setting of standards and the building of lasting partnerships between Europe and the rest of the world. The acceleration of such scientific collaboration is particularly worthwhile when the goals will deliver universal benefits: the mitigation of climate change, the curing of epidemic disease and cancer, development of fusion energy or the exploration of space.

European science benefits tremendously from international cooperation, and we believe this also applies to the European Union Framework Programme. Allowing researchers from all over the globe to take part in H2020 projects, by, for example, “promoting R&I staff mobility at an international level through the Marie Skłodowska Curie actions (MSCA)”¹⁷, is a positive element of the current programme and should be continued in FP9. Strengthening the role of international cooperation in science in FP9 will necessitate additional measures to, for example, counter the decline of third-country participation witnessed in the first three years of H2020. Targeted opening of Calls to third country participants, joint / coordinated Calls with third countries, and international cooperation flagships in priority areas agreed with the third countries concerned are possibilities that the programme could explore.

Marie Skłodowska-Curie Actions in FP9

The MSCA, which remain amongst the most useful and popular EU instruments due to their focus on interdisciplinarity, international mobility and a bottom-up approach to research topics, must be strengthened in FP9. In addition to enhancing the careers and mobility of scientists and engineers, the MSCA also address other important areas such as innovation and international and inter-sectorial knowledge exchange. Due to the increasingly high number of proposals rejected, despite their excellence, there is a real danger that world-class researchers will be discouraged from submitting applications. To counter this, the budget of MSCA in FP9 should be significantly raised.

With regards to specific MSCA such as the ‘European Fellowships’, the EIROs wish to highlight that very few ambitious scientific projects can be realised in a timespan of two years. Extending the duration of European

¹⁶ <https://helix-nebula.eu/>

¹⁷ EC SWD(2017) 221 final INTERIM EVALUATION of HORIZON 2020 Annex 1

Fellowships in FP9 to cover up to three years would help address this issue and would be in line with the typical duration of post-doctoral appointments in industry and academia.

In addition to the investigator-driven actions, host-driven actions should also be continued and extended. Both COFUND and RISE (Research and Innovation Staff Exchange) are important tools to strengthen the science base. COFUND, on the one hand, creates the environment for valuable synergies between regional, national and international mobility programmes at both PhD and post-doctoral levels, and fosters in-coming, out-going and re-integration mobility.

The RISE action, on the other hand, has proven to be a useful instrument for strengthening international and/or inter-sectorial cooperation through knowledge exchange. However, the current RISE scheme is limited by its restriction to secondments of researchers, engineers and managerial staff. A potential way to expand the impact of this scheme would be for it to encompass local recruitment of early stage researchers, who then take mandatory secondments to other participating institutions.

The Innovative Training Networks (ITN) have become one of the most competitive EU-funded instruments, with persistent success rates below 10% for many years. These networks are a unique tool allowing academic and industrial participants to collaborate on common inter-disciplinary research topics, addressing all objectives of the programme in terms of innovation, knowledge circulation, cross-border cooperation, mobility and career development. All scientific communities in Europe have benefited from the ITNs and the EIROs support a substantial increase in ITN funding in FP9.

Finally, a word of caution concerning the compulsory involvement of industry in host-driven actions. It must be taken into account that in some scientific fields meaningful industrial involvement might be difficult to establish due to lack of collaboration-opportunities with industry, as well as the particular nature of the subject matter. Evaluation schemes should be flexible with respect to the scientific discipline to account for such entry barriers in forming industry-academic partnerships.

The European Research Council

The European Research Council (ERC) is now a global reference for excellence and should undoubtedly continue to be strongly supported under FP9. In addition to positive structuring effects across all scientific fields in Europe, the ERC's three-tier structure of grants (starting, consolidator and advanced) and its peer-review process have proven to be highly effective.

Concerning supplementary types of grants to the abovementioned three-tier structure, the EIROs consider Proof-of-Concept (PoC) Grants, which allow ERC grantees to explore the innovation potential and the path to marketable products of the results of their research, to be a very useful addition to the ERC portfolio.

Similarly, the EIROs support the reintroduction of Synergy Grants, as carrying out frontier research in manifold scientific fields requires large, international, and multi-disciplinary collaborations, which often do not fit into the grant schemes currently available. The very high over-subscription rate, and consequently low success rate, for Synergy Grants is clearly an issue, thus a significant increase in funding is needed for this instrument. Furthermore, streamlining and shortening the review process of ERC grants would be welcome, since their evaluation timeframe is nearly twice the H2020 time-to-grant target of five months.

3. Fundamental Research and the Innovation Cycle

In order to nourish the “European Research and Innovation Engine”, Europe needs to continue to strengthen investment in fundamental research with the next EU framework programme¹⁸. Fundamental research underpins many areas of our economic system¹⁹. Take, for example, the research in geometry of the 19th century German mathematician Bernhard Riemann whose studies helped Albert Einstein to formulate his Relativity Theory. The latter is now essential for the Global Navigation Satellite Systems used today in drones, cars, aeroplanes, and ships. At present, the European transport industry directly employs around ten million people and accounts for about 5% of Europe's GDP. Effective transport systems are fundamental for

¹⁸ Why fund Research?, Science Business Report, June 2017, <https://sciencebusiness.net/>

¹⁹ Value of Research, Policy Paper by the Research, Innovation, and Science Policy Experts (RISE). June 2015.

European companies' ability to compete in the world economy, accounting for 10-15% of the cost of a finished product²⁰.

Similar examples range from drug discovery originating in the understanding of basic biological functions, to patient treatment with technologies like Nuclear Magnetic Resonance (NMR) or Magnetic Resonance Imaging (MRI), which originated in fundamental physics. The translation into economic wealth is staggering: the global pharmaceutical market is estimated to reach nearly 70 billion Euros in 2019, and the MRI market five billion Euros by the year 2020²¹.

Fundamental research contributes highly to economic growth, as a recent EU-commissioned study demonstrates²². The European Research Council (ERC) has analysed the wider societal impact of funded projects. The results of this analysis show that more than 40% of the projects have already had an impact on the economy and society, for example, via the creation of spin-off companies (existing, new or planned) to bring the results to the market²³. Other studies highlight the multiplication factor of the direct economic and industrial benefits generated by investment in European RIs²⁴. Outside of Europe, a recent analysis in the US demonstrates that the patents with the most impact tend to be the most science-intensive, relying more directly on scientific advances than other patents did²⁵.

The conclusion is clear – economic growth via industrial innovation requires ideas, knowledge, highly skilled people, and networks of collaboration that are generated from fundamental research.

4. The Role of Research Infrastructures in FP9

European RIs have an essential and pivotal role in sustaining the world-class excellence of European research. They can also play an important role in other core elements of the expected configuration of the next EU Framework Programme, oriented towards innovation (the European Innovation Council²⁶) and addressing global challenges through strategic, impact-focused “missions”²⁷.

In the context of the European Innovation Council (EIC), EIROforum wishes to emphasise that the interaction of RIs with high technology innovators generates a mutual benefit, which in many cases can be an important asset to young companies in strengthening their competitiveness, thus paving the way to scale up²⁸. Moreover, it reinforces the capacity of RIs to achieve their goals and increase their innovation potential. RIs are ideal testbeds where breakthrough technologies can acquire a readiness level suitable for becoming future products of industrial value.

The collaboration between RIs with industry is driven by the requirement for the cutting-edge instrumentation needed for fundamental science. This ranges from breakthrough detection and imaging technologies to novel accelerators, data acquisition systems and high performance computing and communication networks. It will

²⁰ European Commission, *Transport Sector Economic Analysis*, <https://ec.europa.eu/jrc/en/research-topic/transport-sector-economic-analysis>

²¹ <https://www.bccresearch.com/market-research/biotechnology/drug-discovery-technologies-report-bio020e.html> and <http://www.axisimagingnews.com/2015/07/analysis-global-mri-market-reach-5-8-billion-year-2020/>

²² The economic rationale for public R&I funding and its impact. Directorate-General for Research and Innovation, March 2017

²³ *Qualitative Evaluation of completed projects funded by the European Research Council, European Research Council Report*, July 2016.

²⁴ The impact of the ESRF and its Upgrade Programme, Report European Synchrotron Radiation Facility (ESRF), June 2013; The Value and Impact of the European Bioinformatics Institute, Report European Molecular Biology Laboratory (EMBL) and European Bioinformatics Institute (EBI), 2016; A. Fernandes et al., Does astronomy generate economic benefits? Technological innovation seen through the lens of the European Southern Observatory's Very Large Telescope, *International Journal of Technology, Policy and Management*, vol. 14, 2014; The Impacts of Large Research Infrastructures on Economic Innovation and on Society: Case Studies at CERN, Report OECD, 2014; M. Florio, et al. Cost-Benefit Analysis of the Large Hadron Collider to 2025 and Beyond, 2015, <http://arxiv.org/pdf/1507.05638v1.pdf>; Final Report on the Space Economy 2016, ESA Studies, http://www.esa.int/About_Us/Business_with_ESA/Space_economy/ESA_Studies

²⁵ Mohammad Ahmadpoor, Benjamin F. Jones. *Science*, Vol. 357, No. 6351. (11 August 2017).

²⁶ <https://ec.europa.eu/research/eic/index.cfm>

²⁷ <https://sciencebusiness.net/highlights/eu-shoot-moon-next-research-programme>

²⁸ Autio E, Hameri AP, Vuola O, A framework of industrial knowledge spillovers in big-science centers, *Research Policy*, Vol: 33, 2004, Pages: 107-126; Autio E, Hameri AP, Nordberg M, A framework of motivations for industry big science collaboration: A case study, *Journal of Engineering and Technology Management*, Vol: 13, (1996) Pages: 301-314.

be of strategic importance for Europe to exploit this innovation ecosystem within the framework of the EIC in FP9.

One proposed novelty of FP9 is the implementation of a number of large-scale research and innovation “missions” with significant societal impact, capable of mobilising all actors in the research and innovation cycle and capturing public engagement and involvement²⁹. Should a top-down mission-orientation be adopted in FP9, the EIROs would like to highlight that such missions must remain compatible with curiosity-driven fundamental research and leave sufficient room for researchers to experiment and take unbeaten paths in contributing to solving them.

Given their core mandates to explore and expand the edges of fundamental science, and their steadfast role as a source of inspiration for European citizens³⁰, large European RIs, such as the EIROforum organisations, should play a key role in such missions. Equally important is the long experience of the EIROs in successfully structuring strategic mechanisms, setting-up and managing worldwide open collaborations, and steering the passion of specialised and non-specialised communities to achieve goals *a priori* unattainable. Examples abound, ranging from the discovery of the Higgs Boson to the decoding of the human genome all the way to space exploration and the expansion of our knowledge of the most distant corners of our universe.

European RIs, along with the resourcefulness and creativity of their scientific communities, have the capacity to contribute as drivers of new technology development, providing pathways for both incremental and breakthrough innovation.

5. Concluding Comments

The EIROs have demonstrated over the years the importance of fundamental research in leading to today’s societal advances, as well as responding to the grand challenges of our time.

The EIROs, on the basis of their collective experience and expertise, look forward to the opportunity to establish a sustained and productive dialogue with all relevant actors to discuss the implementation of the next Framework Programme, in particular the continuous support of fundamental science, the potential implementation of the EOSC, the EIC and the proposed large-scale research and “mission-oriented” projects in FP9.

²⁹ LAB-FAB-APP, *Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes*, European Commission, Brussels, 2017, https://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf

³⁰ For example, in 2017 CERN hosted some 7,500 visits for more than 150,000 visitors from more than 100 countries.