Next EU framework programme

INFN

Istituto Nazionale di Fisica Nucleare

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Position paper

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1. Introduction

EU Framework programs are among the biggest research funding initiative in the world, leading them to the heart of European competitiveness far beyond the next future. Its formulation, starting with fundamental research and then walking up to the market through applied research and experimental development must come along with the efforts in research to a sustainable creation of value and benefits for European society. A working research ecosystem must be based on principles of non-discrimination, equality, scientific and technological developments. The basis for improving and accelerating scientific progress is international collaboration, a unique opportunity for keeping dialogue alive and fostering peace, even in the most difficult geopolitical crisis. Against this backdrop, it is essential that the EU keeps encouraging international scientific collaboration, balancing security policies, strengthening the role of European research agencies and bodies in coordination and cooperation in science.

In the last decades Europe has experienced an innovation gap with the United States and China, especially in advanced technologies, that now must be overcome. Digital technology has been the key driver of the rising productivity gap between EU and US and Europe currently looks set to fall further behind. We must reverse the wheel and the way to do it is investing in frontier research and innovation much more funding – at least doubling it - than in the past decades as well set out in Draghi report "The future of European competitiveness".

2. Context

The National Institute for Nuclear Physics (INFN) is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them and to the exploration of the mistery of the Universe to answer fundamental questions about the cosmos.

Operating under the supervision of the Ministry of Universities and Research, the INFN engages both in theoretical and experimental research in subnuclear, nuclear, and astroparticle physics. Over time, applied physics has also emerged as a vital research field for the INFN, with contributions ranging from detector design to biomedicine and cultural heritage preservation. As a key player in international collaborations, INFN is a member of prominent institutions, laboratories and committees all over the world and has significant participation in EU FP since many years.

3. The INFN position

Europe faces several key technological challenges as it navigates a complex landscape of digital transformation, sustainability goals, and global competition. The Draghi Report identifies the need for a robust foundation of fundamental research as crucial to driving Europe's innovation capacity. Curiosity-driven research, aimed at understanding basic scientific principles without immediate commercial applications, is a core component of advancing technologies that are competitive globally.

Strong support and investments in fundamental research (**excellence science**) and **coordinated efforts** between governments, industries, and academic institutions are needed for Europe to secure its position in the global economy, address strategic vulnerabilities, and become a leader in the next generation of technologies.

Young researchers must be supported by offering dedicated networking and skills development opportunities. **Administrative simplification** is mandatory to reduce the workload for participants and simplify procedures, as recalled in President Ursula von der Leyen "Political guidelines" and in each Commissioner-designated "Mission letter"

EU public sector support for R&I is inefficient due to a lack of focus on disruptive innovation and fragmented financing, limiting the EU's potential to reach scale in high-risk breakthrough technologies. Moreover, once companies reach the growth stage, they encounter regulatory and jurisdictional hurdles that prevent them from scaling-up into mature, profitable companies in Europe. Finally, the EU is falling behind in providing state-of-the-art infrastructures necessary to enable the digitalisation of the economy.

Poor intra-EU coordination hinders the broader innovation ecosystem. **Most Member States lack the scale for world-class research and technology infrastructure**, limiting their R&I capacity. However, CERN and EuroHPC are successful examples of coordinated efforts in large R&I projects. The following analysis is organised by pillars with key actions proposed.

CROSS-PILLAR ACTIONS

FOCUS AREAS:

- **Coordination Framework**: Establish a Competitiveness Coordination Framework to align Member States' policies with EU strategic priorities.
- **Regulatory Simplification**: Reduce the regulatory burden and harmonize regulations across Member States.
- **Increasing the budget**, that should be doubled, particularly for EIC (European Innovation Council) and its Pathfinder instrument.

ACTIONS:

- **Competitiveness Action Plans**: Develop detailed action plans for each strategic priority, with clear objectives, governance structures, and financing mechanisms focusing on a smaller number of common priorities, encompassing groundbreaking fundamental research, disruptive innovation and scientific excellence
- **Enhanced Cooperation**: Use enhanced cooperation mechanisms to allow willing Member States to move forward on key initiatives even if unanimity cannot be achieved. Improve the coordination of public R&I among Member States and consolidating European academic institutions of excellence. Draghi Report recent idea on establishing an excellence-based, highly competitive "ERC for Institutions" programme to provide the required resources for research and academic institutions and simpler associative formats is extremely commendable. This action could contribute to the onset of a strong European network. Regulatory simplification should be introduced to facilitate and improve collaboration among networks.
- **Streamlined and simplified administrative procedures**: to achieve better results in the research and innovation fields it would be of paramount importance that the EU reduces all the administrative burdens and hindrances, e.g. to receive funding and to report it, and a revision of the Public Procurement Directive for strategic sectors, e.g. research and technological innovation.
- **A bridge from ERC to EIC**: A key factor for the systematic exploitation of fundamental research programmes' results is the capacity to discover, highlight and link up synergies and opportunities for groundbreaking line of research, disruptive innovations and new technologies. This, leveraging open science through structured agents and matching tools, can build a bridge between fundamental and applied research, from ERC to EIC, to accelerate the creation of added value for society.

PILLAR I: EXCELLENT SCIENCE

FOCUS AREAS:

- **Disruptive Innovation**: Prioritize funding for high-risk, high-reward projects that have the potential to lead to breakthrough technologies.
- **Talent Attraction and Retention**: Implement programs to attract and retain top global talent in research and innovation
- **Public-Private Partnerships**: Foster collaborations between public research institutions and private companies to drive innovation and commercialization.

ACTIONS:

- **Increase Budget for European Research Council (ERC)**: Allocate a larger portion of the budget to support frontier research and high-risk projects. Excellence-driven initiatives are key to advancing knowledge, addressing societal challenges, and maintaining Europe's leadership in science and innovation. As we move forward, it is crucial to ensure balanced support for both curiosity-driven research and application-focused programs. Fundamental research, often driven by curiosity, lays the foundation for breakthrough innovations, while applied research addresses immediate technological and societal needs.
- **Marie Skłodowska-Curie Actions (MSCA)**: Expand fellowship programs to attract and retain top researchers globally and, at the same time, fostering collaborations among universities and other research institution to set up attractive academic career development schemes.
- **EU Chair position:** As proposed in Draghi report, a new regime for world-class researchers can attract and retain the best academic scholars by hiring them as European officials. This regime should be supported by a new EU framework for privatise funding to enable public universities and research centres to design more competitive compensation policies for top talents and to provide additional support for research.
- **Investing in research infrastructure** is equally critical. Well-resourced and accessible infrastructures are vital for enabling excellent science. Improving transnational access to these infrastructures will foster greater collaboration and enhance Europe's competitiveness. Emergent social needs/technologies, such as decarbonisation, artificial intelligence, quantum technologies, advanced health care, etc, can be fully exploited in Large European Research Infrastructures. Therefore, next EU programs should reinforce the RI network, through support to their long-term sustainability, and to trans-national access. Projects dedicated at the development of low environmental impact solutions could

be perfectly in line with European objectives to reduce the carbon footprint that research infrastructures should pursue. This strategic step needs huge investments: the outcomes could be of extreme importance not only for the point of view of the energy saved but also to implements cutting edge solutions thanks to the high level of expertise available in research infrastructures.

- **Innovation Clusters**: Establish and fund innovation clusters that bring together universities, research institutions, startups, and large companies. Furthermore, a pan-European program toward strategic materials should be launched. ESFRI activity plays a pivotal and independent role in the RI panorama and its action should be thoroughly supported by EU Commission. ERIC model of RI has shown in these years several limitations and difficulties, mainly linked to the high level of bureaucracy: new simpler associative formats to support Infrastructure initiatives should be foreseen. Next EU program should also foster an increased capability of transferring and developing **new technologies from research to the industrial ecosystem.**

  Regulation of Technological Infrastructures, where companies play an essential role in association with Research Institutions, should be implemented, while respecting each other's institutional role and prerogatives.

PILLAR II: GLOBAL CHALLENGES AND EUROPEAN INDUSTRIAL COMPETITIVENESS

FOCUS AREAS:

- **Open science**: to facilitate all these goals, the transition towards open science must be prioritized.
- **Clean Tech Manufacturing**: Support the development and scaling of clean technologies where Europe has a competitive edge. The EU strategy on low carbon emissions is one of the most challenging programs that has to be implemented during the next decade. The implementation of renewable energy must be complemented with other sources of energy that could guarantee electrical grid stability and minimize greenhouse gas emissions. The current revitalized discussion concerning nuclear energy should consider proper investments in research and developments and important technologies that could be transferred from advanced research laboratories to industrial applications, such as the development of high-field magnets, the production of intense neutron beams for material testing and/or as injection systems (for plasma heating), advanced and innovative plasma sources. All these approaches have large applications in nuclear experiments and, namely, in the realization of high-performance accelerators for nuclear and particles physics. European projects that could create direct connection between fundamental research and industrial stakeholders in these various fields could be extremely important to obtain a new generation of nuclear reactors based on a fusion process.
- **Critical Raw Materials**: Secure supply chains for critical raw materials through strategic partnerships and domestic production as well as promoting research and innovation in alternative materials.
- **Digital Technologies**: Reduce dependencies on non-EU countries for critical digital technologies like semiconductors and cloud services. AI – and particularly generative AI – is an opportunity in which EU research institution and companies still can play an important role. An important case of valuable societal impact is the exchange of biomedical images (while respecting privacy protection) to generate large image databases that can be used for training AI algorithms, thus increasing the ability to detect tumors and other diseases/dysfunctions in advance. Furthermore, AI assists researchers in operating complex infrastructures like accelerator complexes and data centres, while also automating data acquisition and processing in the field of Digital Cultural Heritage, for tasks such as the inspection of artworks.

On another side, Quantum Computing, establishing connections and synergies between classical and quantum machines (integration of quantum simulators/emulators in classical machines) is very important. For this aspect, the creation of dedicated hubs is strategic for Europe, and they can be focused on three "dimensions":

- "use cases" (for example, quantum algorithms for High Energy Physics, Quantum Machine Learning applications, etc.);
- infrastructures a key aspect in view of a European hub in Quantum Computing;
- "enabling technologies": Superconductivity, Cryogenics, Qubit readout and control, Test facilities and Photonics.

ACTIONS:

- **Dedicated Funding for Clean Tech**: Establish specific funding streams within the Framework Programme for clean technology R&D and manufacturing.
- **Digital Sovereignty**: Support projects aimed at developing EU capabilities in semiconductors and critical digital technologies. Even if the gap in cloud services appears unbridgeable, it is important that EU research institutions and companies maintain a foothold in areas where technological sovereignty is required, such as security and encryption. In addition, must be considered that a weak tech sector will hinder innovation performance in a wide range of adjacent fields, such as pharma, energy, and materials. The chip design facilities operating inside fundamental science institutions can thus play a key role in the build-up of highly specialized human capital for microelectronics, which is one of the major points addressed by the EU regulation n. 1781/2023, the so called "Chips Act". The tight budgets and very small volume production typical of fundamental science make today impossible to use the most advanced chip manufacturing and packaging technologies available on the market, thus slowing down the progress in the field of microelectronics for basic research. In the medium term, this could even jeopardize the level of excellence reached so far, severely limiting the important contribution this community could give to strengthen the Italian and European performance in the strategic field of microelectronics at large. The design groups operating inside basic science institutions have acquired a unique know-how in the design and characterization of "fault-tolerant" integrated circuits operating in harsh environments, a theme which is becoming more and more vital also for the space industry. Furthermore, it is not uncommon that chips developed for basic science have found use in other fields of society, such as medical imaging instrumentation, material analysis, homeland security, etc. It must be pointed out that basic science endeavors can naturally tolerate a higher level of risk.

This offers a unique playground in which new generations of chip designers can be trained in the field, with obvious advantages for industry as well. It is thus considered of strategic importance that in future EU programs due financial resources are foreseen to:

- Allow to basic science Institutions regular access to most modern chip production and packaging technologies
- Promote full access to the most advanced Electronics Design Automation (EDA tools), duly acknowledging the role of such Institutions in training new generations of designers
- Stimulate more direct connections between basic research Institutions and top-level semiconductor companies
- Encourage more cooperation between fundamental science Institutions and the private sector, lowering the barriers that might discourage pre-competitive research, especially when small and medium enterprises are involved.

PILLAR III: INNOVATIVE EUROPE

FOCUS AREAS:

- **Commercialization**: Enhance support for the transition from research to market, ensuring that innovations can be scaled up and commercialized effectively.
- **Regulatory Environment**: Help innovative companies to grow, streamlining and harmonizing regulations to reduce barriers for innovative companies, namely SMEs, according to Letta Report so-called 28th regime
- **Public-Private Partnerships**: Leverage public funds to attract private investment in strategic projects such as extending the use of innovative radiotherapies (e.g., hadron therapy, BNCT, and hyperthermia) to provide patients with a wider range of therapeutic options that consider the specificities of the tumor (personalized medicine and combined therapies).

ACTIONS:

- **Expand European Innovation Council (EIC)**: Increase the size and scope of the EIC to support higher-risk, high-impact projects.
- **Streamline Application Processes**: Simplify the application and reporting processes for funding to make it more accessible for smaller companies and startups.

4. Conclusions

By integrating these focus areas and actions across the Horizon Europe pillars, the next EU Framework Programme can effectively address the competitiveness challenges and leverage Europe's strengths to achieve sustainable growth and innovation.

We emphasize the need for international collaboration, support to young researchers, and coordinated efforts between governments, industries, and academic institutions. Key challenges include improvement of the public sector support, reducing the regulatory hurdles, and increasing the intra-EU coordination. We believe that increased funding, regulatory simplification, and enhanced cooperation are essential to foster innovation and maintain Europe's technological leadership. Europe must invest in frontier research and innovation to overcome current challenges and secure its future competitiveness and prosperity.

In the end, we would like to recall what European Commission President, Ursula von der Leyen, wrote in Commissioner-designated for Research, Ekaterina Zaharieva "Mission letter": "(You/Your Commission) will play a critical role in this ambition, driving the EU's scientific and technological progress, from basic research to applied innovation. Research and innovation must become an ever-greater part of our competitive edge in today's global economy."

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