EARTO

IMPACT DELIVERED

European Association
of Research and Technology Organisations

EARTO RECOMMENDATIONS FOR EUROPEAN RD&I POLICY POST-2020

Founded in 1999, EARTO promotes RTOs and represents their interests in Europe. The EARTO network counts over 350 RTOs in more than 29 countries in Europe and beyond. EARTO members represent 150,000 highly-skilled researchers and engineers managing a wide range of innovation infrastructures: a significant resource in support of innovation in Europe.

EARTO VISION

A European research and innovation system without borders in which RTOs occupy nodal positions and possess the necessary resources and independence to make a major contribution to a competitive European economy and high quality of life through beneficial cooperation with all stakeholders.

EARTO MISSION

- promote and defend the interests of RTOs in Europe by reinforcing their profile and position as a key player in the minds of EU decision-makers and by seeking to ensure that European RD&I programmes are best attuned to their interests;
- provide added value services to EARTO members to help them improve their operational practices and business performance;
- provide them with information and advice to help them make the best use of European RD&I programmes funding opportunities.

Table of Contents

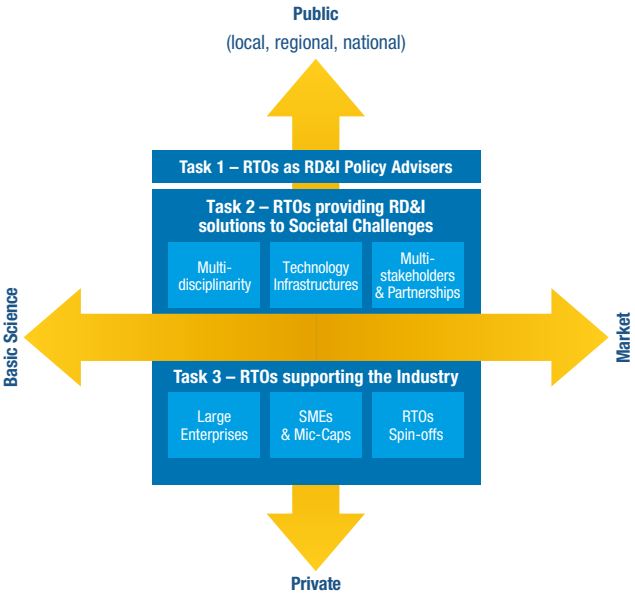
INTRODUCTION

Research, Development and Innovation (RD&I) are the key drivers of productivity and hence of prosperity and growth. Two-thirds of the EU economic growth derives from RD&I, accounting for 15% of all productivity gain in Europe[1]. In today's global context, technological capabilities are the decisive strategic factor to secure Europe's seat amongst the frontrunners of the global technology race. As stated by the European Commission (EC) High-Level Group Industry 2030, *"Europe will build its competitive advantage on cutting-edge and breakthrough technologies, respect for our environment and biodiversity, investment in our people and smart European and global alliances"*. The European Commission also underlined that RD&I *"is the only way to simultaneously and sustainably tackle low economic growth, limited job creation, and global challenges"*[2]. Indeed, RD&I investments determine Europe's technological capabilities and innovation capacity to answer society's needs. RD&I is also essential for achieving the United Nations Sustainable Development Goals (SDGs). RD&I will be key to find impactful solutions to our global challenges, such as tackling climate change, ensuring citizens' health, wellbeing, mobility and security, fighting poverty and social exclusion, boosting economic competitiveness and creating jobs.

Today, European Leaders have the opportunity to define Europe's future: delivering on our key societal, environmental, and economic challenges. The European RD&I policy post-2020 will be essential to build a prosperous, safe, inclusive and sustainable future for the next generations. Accordingly, EARTO and its members hereby put forward a key set of recommendations and priorities to support the elaboration of the European RD&I policy post-2020.

EARTO represents more than 350 Research and Technology Organisations (RTOs) from all over Europe and beyond. The core mission of RTOs is to harness science and technology in the service of innovation, to improve quality of life and build economic competitiveness. They have a public mission, supporting fundamental and close to market research, aiming to bridge the gap between basic science and market solutions. They are distinct from universities, whose main mission is education and fundamental research, and from enterprises, which produce goods and services driven by commercial interest. However, RTOs closely collaborate with both, in addition to local, regional and national governments. As innovative problem-

RTOs' business model



[1] The economic rationale for RD&I funding and its impact, EC, 2017

[2] EC Communication for a New Modern MFF, 2018

solvers, RTOs will be key actors of what many see as the next production revolution, yielding cheaper and cleaner energy, new methods transforming manufacturing and services, and novel responses to social and environmental challenges.

RTOs will be a key enabler to achieve such ambitious goals. As key actors in the European RD&I ecosystem and innovation-driven strategic value-chains, RTOs have a prominent role in EU RD&I programmes and policies. They are therefore very well positioned to provide concrete recommendations to policy makers to develop impactful post-2020 RD&I policies in Europe.

EARTO's concrete proposals for an effective post-2020 RD&I policy in Europe are structured along the four following recommendations:

1. **Boost public investments in RD&I as key driver of prosperous and sustainable growth, recognising that Europe's technological capabilities will be the decisive strategic factor to build Europe's future.** Concrete and ambitious targets of raising RD&I investments aiming to deliver impact for society need to be set at EU, national and regional levels. Effective complementarity and practical synergies between EU funded programmes should also be ensured.

2. **Foster cross-border RD&I collaboration as the solution to jointly face the global societal & industrial challenges of today, especially through the pillar II of Horizon Europe.** This includes ensuring funding for medium-term strategic pre-competitive technology development and supporting the continuity of public-private partnerships, both essential to turn promising basic research results into technologies with industrial maturity.

3. **Support a European RD&I ecosystem approach along strategic value chains, boosting technology co-creation and (large & small) industry's uptake of innovative products and services.** For this, the development and scaling-up of key enabling technologies is essential, for both breakthrough and incremental innovation, in all industrial sectors (not only digital). This will require the set-up of an ambitious EU strategy on technology infrastructures, targeted support to SMEs, and the creation of deep-tech start-ups in Europe (incl. with the European Innovation Council's support).

4. **Ensure the right framework conditions to stimulate knowledge and technology co-creation in Europe and prevent the creation of unwanted regulatory barriers hampering European innovation capacity.** Taking into account the specificities of the RD&I sector in the revised EU state aid rules for RD&I will be key. In addition, a balanced approach needs to be fostered between the EU Open Science and the Intellectual Property policies, focusing on the optimum dissemination and exploitation of research results.

EARTO and its members remain of course ready to further discuss these recommendations with the European Institutions' representatives in a continued open dialogue.

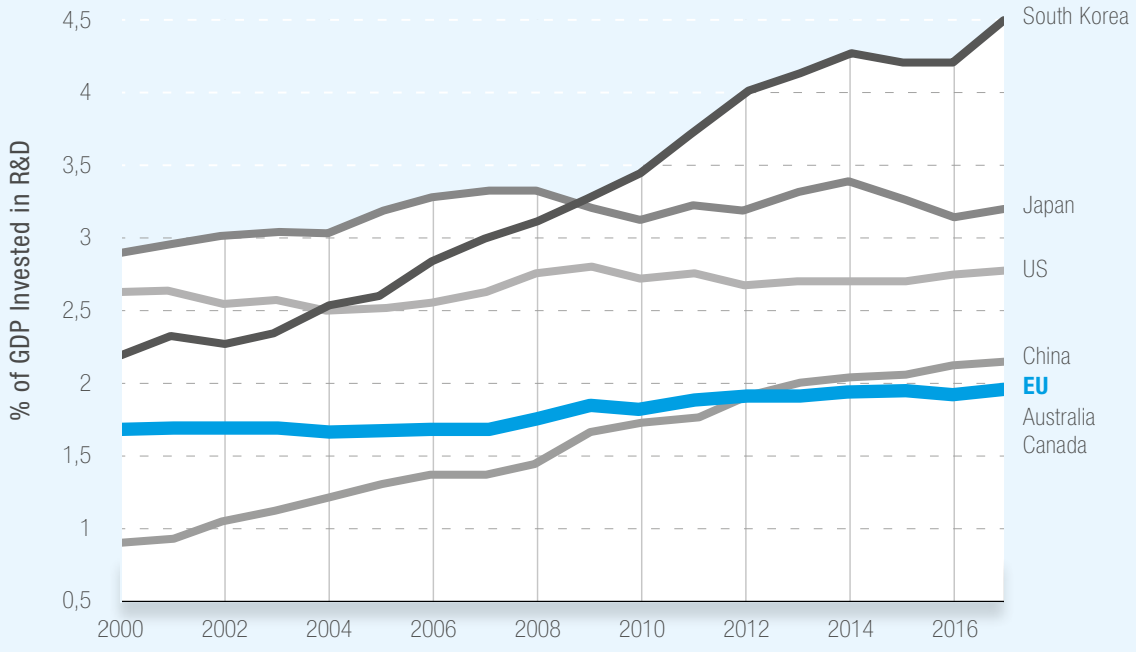
1 BOOST IMPACTFUL PUBLIC INVESTMENTS IN RD&I AS KEY DRIVER FOR PROSPEROUS AND SUSTAINABLE GROWTH

Public investments in RD&I are crucial to alleviate market failures, as well as to stimulate private RD&I investments by lowering the risks that such investments represent for industry. While the global technological race accelerates, the EU still lags behind in terms of public and private investment in RD&I, especially with regards to South Korea, Canada, Australia, Japan and China. This performance gap is expected to further increase in the coming years. Countries like China are catching up at twice the EU's innovation performance growth rate[3].

In this context of dynamic global technological race, European companies are increasingly investing in RD&I. For instance, the automobile, health and digital sectors invested 5.5% more in RD&I activities in 2017 than the year before. However, such private EU growth in RD&I investments is outpaced by countries like the US or China: the former increased its private R&D investments by 9% in 2017, the latter by 20%[4].

The Europe 2020 strategy sets the target of "improving the conditions for innovation, research and development"[5], in particular with the aim of "increasing combined public and private investment in R&D to 3% of GDP" by 2020[6]. After a period of slow but rising growth, gross domestic expenditure on R&D as a

Gross domestic public & private spending on R&D



Source: OECD data, 2017

[3] EU Innovation scoreboard 2019
[4] EU Industrial R&D Scoreboard 2018
[5] European Council conclusions 17 June 2010
[6] EC Communication on the Europe 2020 strategy, 2014

Business R&D Investments (as % of GDP)


EU 1.4%


CHINA 1.7%


USA 2.0%


JAPAN 2.5%


SOUTH KOREA 3.6%

Source: EC based on OECD data, 2017

percentage of GDP in the EU stagnated at around 2% between 2014 and 2017. As a result, the 3% target is still some distance away[7]: the gap with EU's global competitors is increasing.

This EU 3% target of GDP investment in R&D should not be questioned and should rather be increased. In any case, the 2021-2027 Multiannual Financial Framework (MFF) should aim at making it a reality. A concrete roadmap to fulfil such commitment should also be the focus of the upcoming revision of the European Research Area's strategy by the Council.

RD&I: AN INVESTMENT WITH HIGH IMPACT

The benefits of public RD&I investments can take many forms. Many RD&I impact assessments' methodologies focus today on the economic aspects, even though such methodologies are limited and fail to capture the full range of RD&I's impact. A substantial share of such impact includes non-economic aspects, such as the increase of citizens' well-being, national security, environmental protection, improved health or social cohesion, amongst others[8]. Besides, RD&I spill overs and unintended effects can lead to key scientific and technology discoveries. Research results can also find applications in areas far removed from the original goal of the research idea.

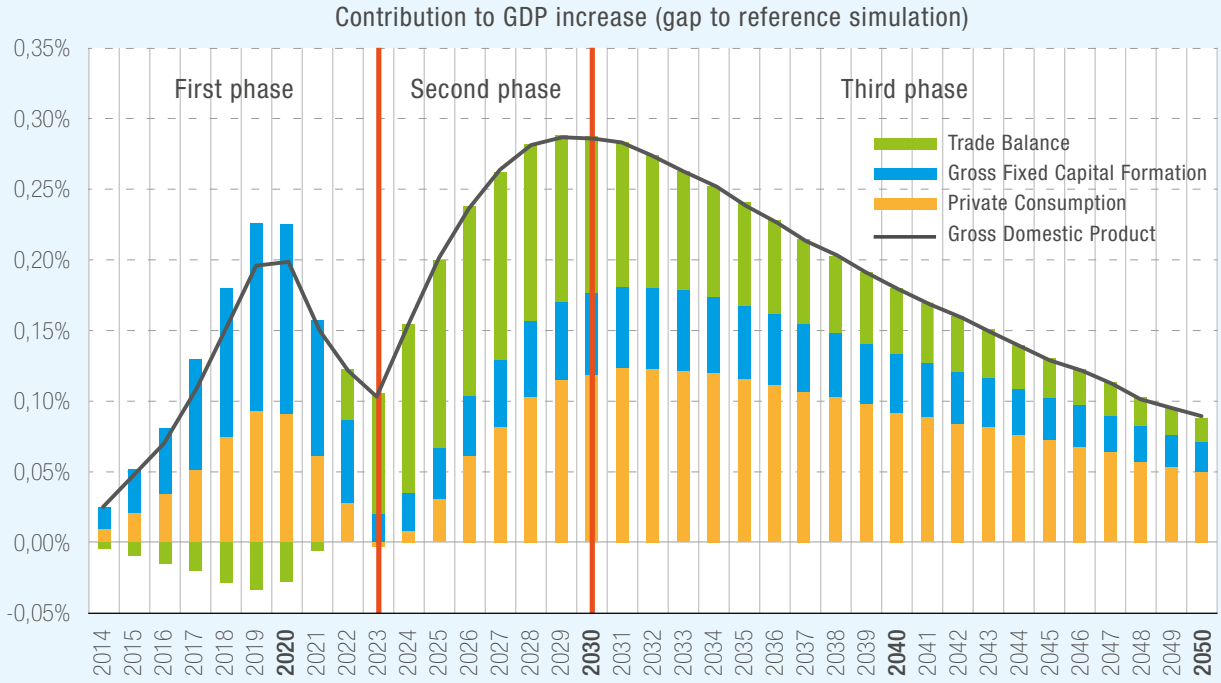
Impact of European Framework Programmes for RD&I (EU FPs)

As stated during its interim evaluation[9], macroeconomic models project the Horizon 2020 socio-economic impact to be in the order of €600 billion and 179,000 jobs by 2030. The interim evaluation also shows that H2020 would increase labour productivity by up to 0.20%, and boost EU external competitiveness by increasing net exports by up to €23 billion. Given that H2020 represents less than 5% of total public R&D spending in the EU, the full socio-economic impact of European total RD&I public investment is much larger.

[7] OECD Data, Gross domestic spending on R&D 2000-2018
[8] OECD Science, Technology and Industry Outlook, 2008
[9] EC SWD "In-depth interim evaluation of Horizon 2020", 2017

The economic impact of H2020 funding for research on EU28 GDP

(in % deviation from reference scenario)



Source: PPMI based on NEMESIS model results

Compared to the reference scenario in which H2020 would not have been implemented, H2020 is estimated to bring a GDP gain of between 0.27% and 0.34% at its peak in 2030[10]. The impact follows three main phases: 1) the maturation phase with only few innovations, 2) the innovation phase with the arrival of process and product innovations increasing the internal and external demand, and 3) the maturity and obsolescence phase. On average, the GDP gain is estimated to amount to between €24 billion and €35 billion per year (in 2014 prices) during 2014-2030. Over the same period of 17 years, the total GDP gain is between €400 billion and €600 billion. This high economic return is justified by the fact that investing in RD&I at EU level has a higher economic performance with high added value and enables to attract additional funding (public & private).

In addition, for Horizon Europe, the European Commission further analysed that a European RD&I budget of €120 billion would create an estimated additional 420,000 jobs, of which 40% will be highly skilled. EU investments in RD&I would also increase the EU GDP by around 0.33% by 2040[11], which means that each euro invested would potentially generate a return of up to €11 of GDP over 25 years[12].

Impact of Research and Technology Organisations (RTOs)

As key players in the European RD&I ecosystem, Research and Technology Organisations (RTOs) have a high impact in Europe, both from a science and technological perspective but also in social and economic terms[13]. EARTO commissioned several fact-finding studies on the impact of RTOs over the years, which clearly demonstrated RTOs' key contribution to Europe's competitiveness.

[10] Ibid.

[11] EC Communication "A new, modern Multiannual Financial Framework for a European Union that delivers efficiently on its priorities post-2020", 2018

[12] EC Proposal for a Regulation establishing Horizon Europe, 2018

[13] However, official data on RTOs have not been collected so far at OECD or Eurostat level, and are lost in various categories making it impossible to overlook and study the sector properly.

In 2018, 20 of the largest European RTOs:

directly employed more than
67,000
staff,
78 %
of which being engaged
in RD&I activities

generated more than
€ 12 billion
turnover

filed more than
2,000 patents
(first filings) and had more than
15,000
active granted patents running

published more than
14,000
peer-reviewed papers
and guided about
6,000
PhD projects

worked with more than
50,000
industrial partners,
70 %
of which being SMEs

created
61 spin-offs
in 2018 (from 10 RTOs),
for a total of
450 spin-offs
still active (from 10 RTOs)

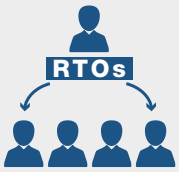
with a turnover of
€ 1.7 billion
and
8,500 jobs
created

The average survival rate
after 5 years of those spin-offs
was between **78 %**
and **90 %**

[14] EARTO, Economic Footprint of 9 European RTOs in 2015-2016, full study and brochure, 2018

In terms of impact, the Economic Footprint study[14] commissioned by EARTO to IDEA Consult is based on data collected from 9 RTOs, representing 1/3 of EARTO members in terms of employees and turnover: AIT (Austria), CEA (France), DTI (Denmark), Fraunhofer (Germany), imec (Belgium), SINTEF (Norway), Tecnalia (Spain), TNO (Netherlands) and VTT (Finland). In 2016, the aggregated effects of the core activities as well as activities generated through collaborative contract research (publicly & privately funded), the spin-offs, and the outflow of highly skilled staff of these 9 RTOs, resulted in the figures below.

The aggregated economic effect of those 9 RTOs from their core activities and generated through contract research and spin-offs resulted in 2016 in:



For
1 job
in an RTO, additional
4 jobs
were created elsewhere in Europe in 2016

For
€ 1 invested
by governments in RTOs as operational grants
€ 3 return
flew back to those governments in 2016

Source: EARTO Economic Footprint study, data 2016

These results clearly demonstrate RTOs' crucial role in the European RD&I ecosystem. It is important to note that these results are only a lower boundary of the full impact of RTOs. Indeed, this study only focuses on the short-term economic effects, and does not take into account the long-term technological and societal value of the research and technology they produce.

RTOs: impact delivered

CEA (France) and Fraunhofer (Germany) recognised
8 and 6 times
amongst the Clarivate-Derwent
Top 100 Global Innovators

Thomson Reuters' Top 100 Global Innovators

CEA (France) and Fraunhofer (Germany) have respectively been recognised eight and six times amongst the Clarivate-Derwent Top 100 Global Innovators, including in 2019[15]. In addition, many RTOs are also recognised among the world's most innovative research organisations in Thomson Reuters' Top 25 World's Most Innovative Research Institutions[16].

[15] Clarivate-Derwent, Top 100 Global Innovators, 2019
[16] Reuters, Top 25 World's Most Innovative Research Institutions, 2019

Firms collaborating with TNO gain

13 to 17%

value-added growth after 1 year of collaboration

—

TNO impact study, 2018

This study estimated the impact of the Dutch RTO, TNO, on the value-added growth of the Dutch firms collaborating with TNO. Results show that firms collaborating with TNO gain an additional growth of value added in the range of 13 to 17%, one year after the collaboration took place. Such high impact might be caused by the inclination of firms to involve TNO in more advanced RD&I projects, increasing their probability of success. TNO services therefore yield a higher impact than average firm R&D activities.

TI Institutes' industrial partners gain

13%

of additional turnover growth

—

Technopolis impact analysis of Norwegian RTOs, 2015[17]

The study estimates the impact of the Norwegian RTOs – called Technical-Industrial (TI) Institutes – on their industrial partners. It found that the additional turnover of companies due to their collaboration with the TI institutes is estimated to a total of €78.1 billion (NOK798 billion) in the period 2004–2013 (real prices 1998-fixed). This represents 13% of additional turnover growth for all TI's industrial partners.

GRANT-BASED PUBLIC RD&I FUNDING: KEY FOR LONG-TERM COMPETENCE BUILDING

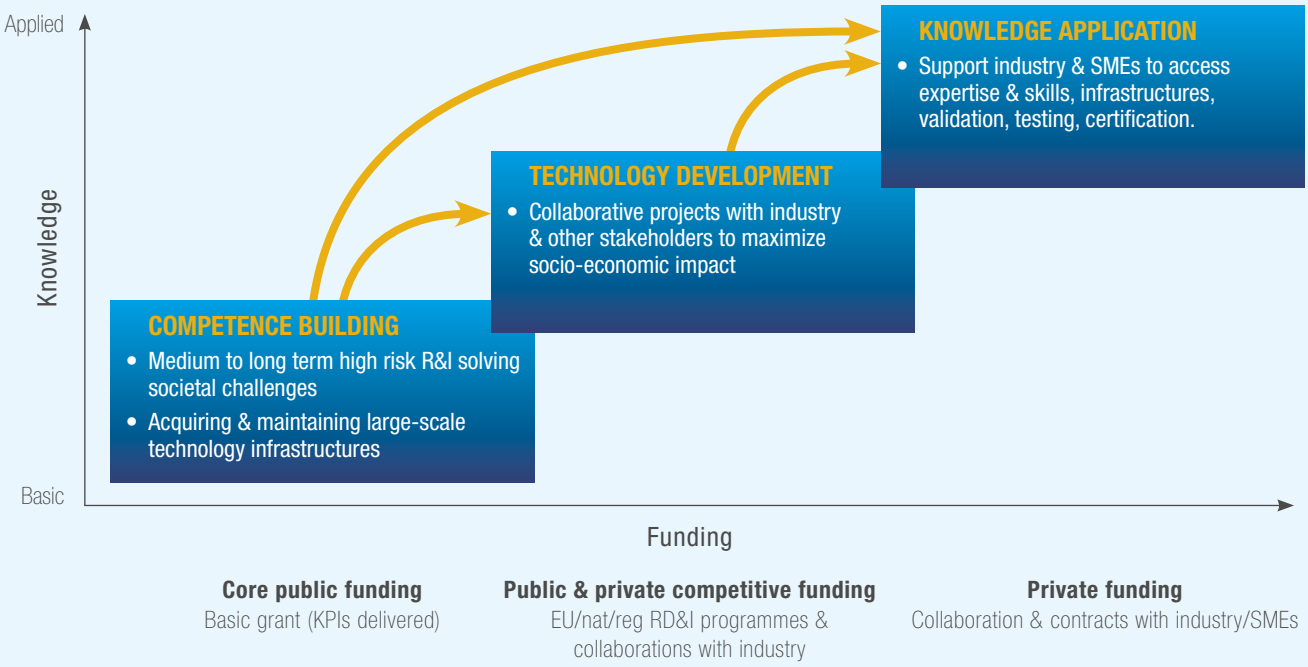
The capabilities of European RD&I actors to jointly deliver impact greatly depends on the accessibility of the right funding sources and framework conditions, along all the different steps of the innovation process.

RTOs three-stage innovation dynamic and funding model

RTOs' distinctive mission to harness science and technology in the service of innovation for the benefit of society is further reflected in their three-fold funding scheme, broadly correlated with their three-stage innovation dynamics. Different time spans and target groups imply different budgetary arrangements from different funding sources. Access to adequate finance delivered via appropriate channels is an essential condition of RTOs' successful impact, like it is for industry and academia.

[17] Technopolis, Impact analysis of the technical industrial research institutes in Norway, 2015

RTOs three-stage innovation dynamic and funding model



Long-term competence building upstream research

Typically, long-term competence building upstream research mainly requires long-term stable budgets from public funding sources. For instance, RTOs' long-term competence building activities are essential for allowing RTOs to perform their strategic roles and are often carried out in close collaboration with universities and academies of science to harvest ideas from basic research done outside of their organisation. This includes strategic high-risk research of medium to long-term duration, in-house competence development, acquisition and maintenance of large-scale technology infrastructures and specialised equipment and platforms.

Depending on each Member State, such core basic public funding is granted to RTOs either unconditionally or upon the fulfilment of a set of Key Performance Indicators. The use of such core funding is generally to be freely managed by the RTO itself. Part of this funding can also be tied to a government mandate to be used for a specific public-oriented mission (e.g. defence, energy). This often explains the differences between the levels of basic funding received by RTOs at national/regional level. Such funding is mostly fixed for several years, which is crucial to enable RTOs to set-up long-term strategic plans (incl. investments plans in technology infrastructures) as well as scientific & research roadmaps and strategies. Sometimes, private companies are interested to participate in such upstream research programme: they can do so via co-funding such activities or by being involved in RTOs' "users groups" providing directions to RTOs' long-term research programmes.

Medium-term high-risk strategic pre-competitive technology development activities

Strategic public competitive research programmes, mainly targeting key technology and societal challenges, often extend over many years and require a decade or more of programmed work to reach full fruition, having a positive impact on citizens' daily lives. RTOs' pre-competitive technology development activities are typically collaborative

research projects and programmes with industry and a variety of other stakeholders. Such technology development is often generic to many possible applications (e.g. key enabling technologies).

These activities are mostly financed through 1) European/national/regional public competitive research programmes, and 2) collaborative RD&I projects partly funded by industry. These projects are co-funded by RTOs' own funding used as leverage. Such projects provide medium-term return on investments and often target societal and industrial challenges. RTOs automatically partner with industry and any other stakeholders to maximize the impact and dissemination of research results.

Short-term knowledge and technology application activities

By contrast, knowledge application collaboration between RTOs and industry may last only months. RTOs' knowledge and technology application activities are often short-term either 1) collaborative projects, mostly co-funded by external private funding (or funded 10% plus a margin), or 2) very short term high TRL contract research to provide services such as testing, validation, training (funded 100% full cost plus a margin by the private company). In those projects, RTOs provide short-term added value and foster knowledge co-creation and dissemination to industry.

In those close to market applications, RTOs' partners are typically from industry, although partnerships with regulators are not unusual. These activities are a key element of RTOs' business model, where an in-depth understanding of industry's needs and market is key. In this context, "industry" includes large, mid-caps and small companies both based in the RTO's country of origin or abroad. Besides, as RTOs are non-profit organisations, any revenues gained from technology transfer, dissemination and deployment activities are re-employed to fund new innovation cycles and competence building. In addition, RTOs also share the research results with their industrial partners, including IPRs with respect to the value of their contribution and respective interest. RTOs then use such IPRs to increase their own background IP pool, as a mean of further technology diffusion, to create new collaborations with other partners in other sectors. RTOs are by their nature spurring knowledge circulation in Europe.

Grant-based versus repayable advances or equity-based public funding: different target groups

In order to foster private investments in Europe, the use of new financial instruments such as loans, repayable advances, equity-based public funding and other credit-based funds increased in recent years (e.g. European Fund for Strategic Investment (EFSI) launched in 2015). Such financial instruments might be interesting complements for very high TRL activities only. Regarding equity-based funding for instance, RTOs welcome the set-up of investment platforms to support RTOs' efforts on spin-offs' creation (e.g. positive experiences with EIF investments)[18].

However, high-risk pre-competitive RD&I activities cannot be financed through loans. EARTO members support the EU Competitiveness Council conclusions of 1st December 2017, stressing that *"grants should continue to be the main form of funding in the FP"*. Besides, the wide majority of RTOs are prohibited by law/statutes from using credit-based financial instruments. In addition, their accounting systems do not enable them to use loans or repayable advances[19]. RTOs' financial model heavily rely on grant-based programmes. Therefore, if funds for credit-based financial instruments happen to be diverted from grant-based programmes, this would have a detrimental impact on RTOs' business models and accountability, as well as on the public sector's capacity to alleviate market failures. As detailed above, grant-funded programmes are essential to reduce the risks and stimulate private sector's investments. Such instruments should therefore be limited to private companies and to very high TRL projects.

[18] EIB Report, Access to Finance for RTOs and their Academic and Industrial Partners, 2017
[19] EARTO, Background Note on Repayable Advances, 2018

EARTO RECOMMENDATIONS

1 BOOST IMPACTFUL PUBLIC INVESTMENTS IN RD&I AS KEY DRIVER FOR PROSPEROUS AND SUSTAINABLE GROWTH

FUNDING LEVEL

Bring to the forefront of the EU RD&I policy a clear and ambitious target of raising RD&I investments. EU Member States should strongly commit to prioritise RD&I spending in the next EU Multiannual Financial Framework (MFF) post-2020 as well as at National and regional levels. This is crucial to strengthen Europe's capabilities to remain amongst the frontrunners of the innovation race and ensure Europe's sustainable growth. The EU 3% target of GDP investment in R&D should not be questioned and should rather be increased. In any case, the 2021-2027 Multiannual Financial Framework (MFF) should aim at making it a reality. Fulfilling this commitment would give the right signal to boost public and private RD&I investments in Europe. A concrete roadmap to achieve an ambitious target of RD&I investments should be the focus of the upcoming revision of the European Research Area's (ERA) strategy by the Council.

Scale-up the overall EU budget for Horizon Europe to at least €120 billion (in 2018 prices). EARTO, along with 90+ European RTOs & Industry associations, has repeatedly called for an increased budget for RD&I in Europe. A €120 billion budget is the minimum needed to reach our ambitions and deliver on the societal and industrial challenges of today with real impact, while ensuring that Europe remains a model of economic and social prosperity.

Secure and ring-fence the European RD&I budget to preserve it from any spending cuts for the whole duration of the next MFF. On 10 January 2018, the EU Commissioners have unanimously agreed to spare R&I from spending cuts in the next MFF, which is now the official European Commission position. EARTO calls on the other EU Institutions to take similar engagements.

IMPACT-ORIENTED RD&I POLICY

Define RD&I policies aiming to deliver impact for society, enhancing and leveraging RTOs' capabilities to boost sustainable growth in Europe. RTOs will be key enablers of such policies: delivering societal and economic impact is deeply rooted in their business models and stated in their public missions. Making official data on the RTO sector available at OECD and EU level would be an important step to further support European evidence-based policy making. This could be included in the upcoming revision of the European Research Area's (ERA) strategy by the Council.

SYNERGIES OF FUNDS

Ensure complementarity between all EU funded programmes for the implementation, deployment and optimal (re-)use of new technologies and innovations, each focussing on its own strengths (incl. Horizon Europe, Digital Europe programme, Space programme, Defence programme, Structural and Investments Funds especially with INTERREG and its component 5, Invest EU). This is essential to leverage technologies and innovations that are reaching market maturity in areas of public interest, especially for those that had previously benefitted from previous EU level investments.

Create concrete possibilities for effective synergies of funds, especially between EU FPs and the Cohesion Funds. For this, the provision proposed by the EC enabling Members States and regions to transfer up to 5% of their Cohesion Funds to other EU programmes, such as Horizon Europe, is a key advancement in the area of joint programming and synergy of funds. EARTO also very much welcomes the new Interreg component 5 for Interregional Innovation Investments, which should be preserved in the next MFF with at least its €970 million budget in order to enable the envisaged impact. In addition, this component 5 should be linked to Horizon Europe's 'Innovation Ecosystems' part in pillar 3 and to its pillar 4 to allow a 'teaming and twinning of ecosystems'.

GRANT-BASED FUNDING

Continue to use competitive grants as the main form of funding in the European Framework Programmes. Funds for blended-finance instruments should not be diverted from grant-based programmes. If Horizon Europe includes a "reimbursable advances" or "blended finances" scheme, it should be confined to parts of the programme strictly targeting specific types of beneficiaries able to work with such schemes (e.g. start-ups, SMEs, mid-caps) and focusing on high TRLs.

2 FOSTER CROSS-BORDER RD&I COLLABORATION TO JOINTLY TACKLE TODAY'S GLOBAL SOCIETAL & INDUSTRIAL CHALLENGES

The OECD[20] recently demonstrated that increasing productivity through RD&I and enabling our economies to absorb, adapt and reap the full benefits of new Key Enabling Technologies (KETs) is essential to boost companies' growth. The crucial role of RD&I activities to support and boost industrial competitiveness is now at the heart of the 2017 European Industrial Policy Strategy.

Recent technology trends have changed the way companies do RD&I: technology is more complex, technology cycles are shorter, knowledge becomes global. New products and services often require combining different technologies together, which necessitate the integration of a wide range of skills and infrastructures. Such complexity and the interdisciplinarity of technology make it more difficult for industry to fully capture its full value creation potential. In addition, market-ready solutions increasingly require clear added value that go beyond mere problem-solving, which necessitates an important understanding of non-technological aspects as well. Responding to today's complex societal and industrial challenges, including for the development of new products and services, requires competences from a large array of sectors, implying a need for a stronger interdisciplinary and integrated approach.

As a consequence, RD&I collaboration and co-creation at global scale are even more crucial today: RD&I has clearly expanded beyond the national borders. Today, the creation of excellent knowledge, ideas and innovations are nurtured by international networks of cooperation.

EU FPs' ADDED VALUE: CROSS-BORDER MULTIDISCIPLINARY COLLABORATIVE RD&I

Excellent cross-border RD&I collaboration delivers impact

In this context, the Lamy report recognises that the EU added value lies in an ecosystem approach with cross-border and multidisciplinary collaboration between all actors in industrial value chains. The strongest aspect of the EU Framework Programmes is their focus on excellent and cross-border multi-disciplinary collaboration across a variety of RD&I actors. It is an indispensable element to build long-term trust-based partnerships between all RD&I actors.

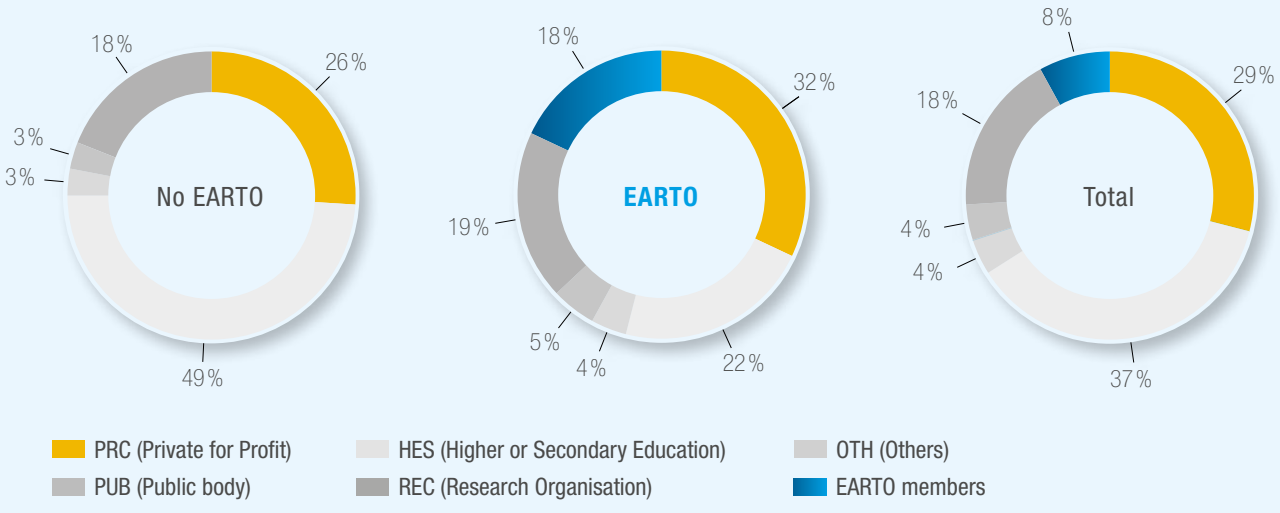
[20] OECD, The future of productivity, 2015

EU Framework Programmes enable to pool resources, expertise, skills and RD&I infrastructures and equipment from different countries, sectors and organisations, building critical mass of scientific, research and development capacities. This in turn enables complex and often very expensive RD&I activities to be carried out, which would not have been feasible at national level. Pan-European RD&I collaboration is also required to speedily produce EU industrial standards, ensuring Europe's positioning on a global scale. It provides an incentive for additional public and private investments in collaborative research projects, giving rise to an important leverage effect.

As previously explained, cross-border RD&I collaboration is at the core of RTOs' business models. RTOs are essential for building long-term and trusted ecosystems of RD&I partners all along industrial value chains. With their multi-disciplinary understanding of technology and their technology infrastructures for the demonstration, integration, and testing of new products and services, RTOs foster knowledge co-creation, application and dissemination with high impact. Besides, RTOs' in-depth understanding of industry's needs enables them to lower the risk of RD&I investments for their industrial partners. RTOs orchestrate the innovation collaboration between public and private partners across European industrial value chains.

For RTOs, such co-creation process can take various forms (e.g. strategic partnerships, consortia, or bilateral collaborative agreements) to suit their partners' needs and business volumes (large and small). It is then not a surprise that RTOs play a key and prominent role in the EU FPs, even though their participation represents on average less than 10% of their turnover. This demonstrates that EU FPs are not a simple set of resources: they are a strategic instrument with high added value, fostering pan-EU cross-border and multidisciplinary collaboration. RTOs also foster the participation of their industrial partners into the FPs, including SMEs and midcaps. Maximising the participation of

RTOs foster industry participation in EU FPs



The average industrial participation in H2020 projects increases to 32% when EARTO members are involved in the project from 26% when they are not part of the consortium. This clearly highlights RTOs' crucial mission to make the link between the different actors in pan-EU cross-border and multidisciplinary collaboration. In both FP7 and H2020, projects with EARTO members involved are indeed quite balanced on average in terms of participating organisations, with roughly 1/3 industrial partners, 1/3 academic partners and 1/3 RTOs.

Source: eCorda data March 2018

industry in the EU FPs helps to strengthen Europe's RD&I ecosystems and industrial value chains, while allowing our industries to better absorb and scale up mature technologies into new solutions, products and services.

Providing RD&I solutions to societal challenges and achieving the Sustainable Development Goals requires EU-level collaboration

Europe is confronted with environmental, societal, and economic challenges such as climate change, citizens' health, wellbeing and security. Pan-EU RD&I collaboration is essential to pool resources and expertise and jointly find solutions to cope with these challenges. Joint efforts at EU level need to be reinforced to achieve the transformation that Europe needs, to build a prosperous, safe, inclusive and sustainable future for the next generations, as recognised by EU leaders during the Sibiu Summit. EU FPs enable Europe to deliver on today's societal challenges and anticipate those of tomorrow.

RTOs' core activities are based on interactions between disciplines, trans-disciplinary and user-centric approaches. Such multi- and inter-disciplinary approaches are key strengths of RTOs when developing solutions for societal and industrial challenges. As innovative problem-solvers, RTOs are key actors of the next production revolution, yielding affordable and cleaner energy, new methods transforming manufacturing and services, and novel responses to societal and environmental challenges such as ageing, mobility, and climate change.

By combining the knowledge built while supporting the industry and collaborating with academia, RTOs identify the potential of new technology developments as solutions to societal challenges. Such solutions may not have yet been identified by industry. RTOs play a key role in solving market failures and supporting the crossing of the "valley of death", also in areas not (yet) covered by industrial interests. They facilitate the development of sustainable technological solutions, and later the production of innovative products, by bringing different types of public and private stakeholders together. In this context, the United Nations Sustainable Development Goals (UN SDGs) are used as guiding principles to target RTOs' research efforts. For instance, some RTOs are already mapping how their projects contribute to one or more sub-targets of the SDGs, which then feeds into their research programming.

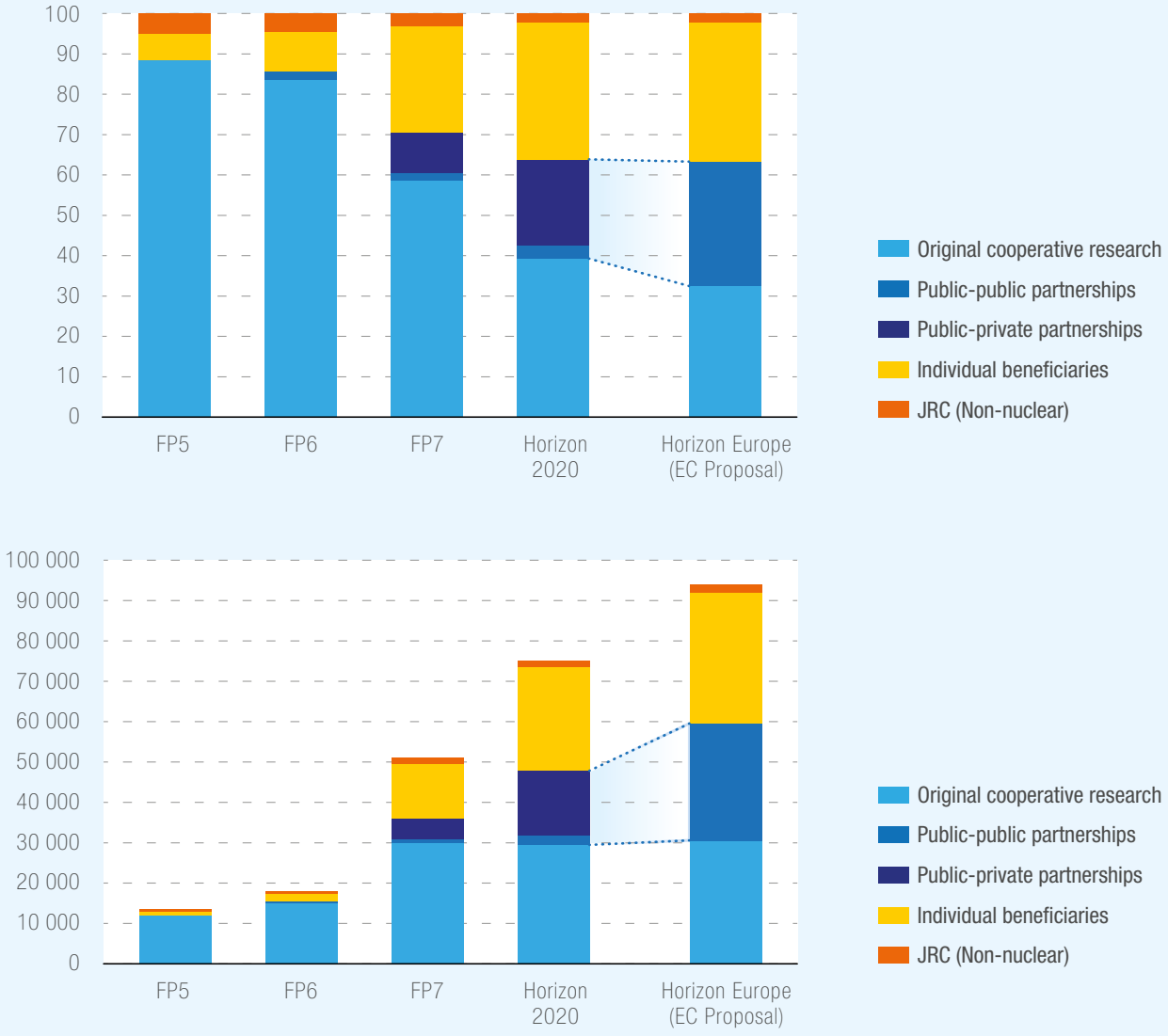
RTOs delivering societal impact

SINTEF (Norway) is working across multiple dimensions to integrate societal impact and the SDGs into its operations. Its RD&I projects, as well as spin-off companies, are currently being mapped towards the SDGs. SINTEF wants to communicate its societal impact via projects for private and public entities, while at the same time reporting on its own direct footprint. The organisation is also integrating sustainability into key performance indicators and management tools, to track and improve impact going forward.

Horizon Europe needs to reverse the decreasing trend of cross-border RD&I collaboration

Cross-border collaborative RD&I has been the main instrument for the implementation of the FP since FP1. However, as a European Parliament report[21] shows, the creation of a large range of instruments and structures since FP6 has led to the increase in the funding's share devoted to single beneficiary actions and instruments.

Evolution of cooperative and individual beneficiary actions in EU FPs (% total budget and € million)



Source: EPRS based on EUR-Lex (FP5 to H2020) and EARTO based on EC proposal (Horizon Europe)[22]

[21] EPRS Report, EU framework programmes for R&I: Evolution of key data from FP1 to Horizon 2020 in view of FP9, 2017

[22] The budget for individual beneficiary actions includes the full budget for the MSCA, the ERC, the SME instrument, the instrument for risk finance, and the EIC accelerator for Horizon Europe. For Horizon Europe, figures are based on the EC proposal: the EIC pathfinder, and pillar IV are included in "original collaborative research", while the EIT budget and 49% of pillar II budget are attributed to partnerships (no distinction between the budget for P2P and PPP can be made at this stage).

The share of funding attributed to "original cooperative research" (whose topics are defined in the FP work programme) decreased since FP6. Despite the increased FP budget, the total funding for original cooperative research activities decreased between FP7 and Horizon 2020. EARTO clearly worries that it could decrease even further in Horizon Europe depending on the final MFF agreement.

Unfortunately, even taking the partnerships into account, the collaborative research's share ("original" plus partnerships) in the total FP budget has still decreased over the last FPs. Of course, even if the public-public and public-private partnerships also fund collaborative projects, they follow a different process, requiring intermediate structures and different procedures for the attribution of funding.

In the meantime, the share of funding dedicated to individual beneficiaries' activities (i.e. Marie Curie Actions, the ERC and the SME Instrument) has tripled between FP6 and H2020: it reaches more than one third of the budget (38% foreseen in Horizon Europe based on the EC proposal). EARTO is calling EU leaders to reverse this trend and take a more balanced approach.

OBJECTIVE-DRIVEN RD&I INSTRUMENTS IN HORIZON EUROPE: RTOs' ROLE

European public-private partnerships foster trust-based and long-term RD&I collaboration

Supporting European cross-border industry-driven collaborative RD&I is crucial to make the ongoing technological transitions a success for both European economy and society.

As one of the key missions of RTOs is to support industry's access to technology and innovation, they have played a key role in European partnerships such as contractual public-private partnerships (cPPPs), Joint Technology Initiatives (JTIs) and EIT KICs since their creation. These instruments are efficient vehicles for excellent industry-driven collaborative research in Europe: they promote innovation at EU scale, leveraging industrial RD&I investments in Europe and strengthening industrial involvement in a context of EU collaborative research, helping SMEs and start-ups to engage in European and international supply chains. They give RTOs much-appreciated opportunities to work with various sectorial industries: their original equipment manufacturers (OEMs) and suppliers (large & small). In EARTO members' experience, these partnerships have been supporting Europe's industrial supply chains and innovation ecosystems around a good set of key industrial sectors, as well as enabled the creation of new value chains.

In particular, cPPPs and JTIs are well-suited instruments for[23]:

- promoting the definition of more ambitious EU targets for various key European industries in terms of their renewal, sustainability, or digitalisation for example, via the definition of strategic research and innovation agendas,
- leveraging industrial R&I investments in Europe,
- strengthening Europe's industrial base by enabling excellent cross-border industry-driven collaborative research,
- increasing the links of global companies with the European innovation ecosystems gravitating around their European supply chains,
- incentivising large industry to connect their various supply chains at EU level (with many SMEs).

RTOs' support to EU Mission-oriented policy

Besides partnerships, Horizon Europe will also include another type of objective-driven RD&I instrument: missions. Such mission-oriented approach to RD&I policy making implies setting pre-defined goals addressing global challenges, with specific targets and expected impact, and working to achieve such targets in a set timeframe.

With their strong technological knowledge, expertise and infrastructures, European RTOs naturally operate in an ecosystem approach, often playing the role of orchestrators. Being themselves mission-oriented actors and having national and regional experiences to share on mission-oriented policy, RTOs should become key actors of the future European missions.

Advising policy makers and performing technology foresight feeding into industrial & national strategies is also part of RTOs' public mission. RTOs will prove to be essential to the well-functioning of Horizon Europe's missions, and should therefore be involved in their governance.

Setting up a mission-oriented policy in the Netherlands


Energy transition & sustainability


Agriculture, water & food


Health and care


Security

TNO has a pivotal role in the new mission-driven innovation policy in the Netherlands, where 25 missions, related to four societal themes and key enabling technologies, were established by the relevant ministries. Private company sectors, or "Topsector coalitions", then worked out a Knowledge and Innovation Agenda outlining their contribution and commitment to delivering the missions, including through funding public-private partnerships. Its active involvement both in the development of the missions and in the Knowledge and Innovation Agendas enabled TNO to adjust its research programming on maximizing synergies between the missions, the Topsectors and key enabling technologies, combining societal and economic impact.

[23] EARTO contribution to the EC consultation on public private partnerships, 2017

2 FOSTER CROSS-BORDER RD&I COLLABORATION TO JOINTLY TACKLE TODAY'S GLOBAL SOCIETAL & INDUSTRIAL CHALLENGES

FUNDING FOR CROSS-BORDER COLLABORATION

Reinforce Europe's excellent multi-disciplinary, collaborative and applied RD&I by strengthening the budget share of Horizon Europe pillar II to 60% of the total Horizon Europe budget. Such budget share will be essential to build on the successes of H2020 and scale up previous investments while covering new activities, such as the funding of new key enabling technologies, the creation of public-private partnerships in crucial sectors, and a mission-oriented approach. EARTO, with the support of its industrial partners, has repeatedly called for more emphasis to be given to pillar II (Joint Declaration I, Joint Declaration II, Joint Declaration III).

Ensure funding for medium-term strategic pre-competitive technology development at lower TRLs in Horizon Europe pillar II, through collaborative research projects. Such activities are necessary to turn promising basic research results into technologies with industrial maturity, reducing the risks for private investments. Such pre-competitive technology development is typically carried out through collaborative research projects driven by RTOs with their academic and industrial partners. The decreasing trend over the past FPs for the funding of such activities can be quite damaging for the medium-term impact of RD&I in Europe. Pre-competitive technology development is indeed a crucial part of the RD&I process which should not be forgotten in Horizon Europe's pillar II.

PARTNERSHIPS

Support the continuity of public-private partnerships, as efficient instruments for excellent industry-driven collaborative research in Europe. EARTO welcomes the continuity offered by the Horizon Europe strategic planning on public-private partnerships: trust between RD&I stakeholders takes time to create, and trust is an indispensable element for those partnerships to be able to face today's challenges. Such continuity is essential if Europe wants to capitalise on the investments that these partnerships already represent.

Involve RTOs in the governance and implementation of European partnerships and missions. This will ensure the connection of such instruments to the relevant national and regional initiatives, as well as to the future European Industrial Strategic Values Chains. The interaction between partnerships and missions should also be ensured.

Improve the co-funding mechanism of partnerships at a time when funding is expected to be scarce, with the capping dedicated to the 40+ partnerships being set at 49% of Horizon Europe's pillar II. Some joint EU-Member States' co-funding models (e.g. ECSEL) could be used as example in Horizon Europe, provided that they ensure equal opportunity between participants from all Member-States. National or regional (incl. EU Structural Funds) co-funding should be set-up from the start of the partnership in order to be automatic once proposals have to be funded (i.e. central management). Reporting requirements and practices should be harmonised to avoid extra administrative works and control layers. In addition, such co-funding model should be kept simple, avoiding double applications at EU and national levels, and solving the potential state aid related issues that may arise.

Create further connections between the different partnerships to raise their innovation potential and increase their impact.

Continue the simplification of the European partnership landscape (i.e. central management including rules for participation). Common procedures and rules amongst European partnerships (incl. current JTIs, cPPPs, EIT KICs) within EU FPs will contribute to significantly improve communication on funding opportunity and accessibility. Areas of simplification include calls accessible on the Funding & Tenders portal, single set of rules for participation and for funding, harmonisation and centralisation of submission, evaluation, financial and technical reporting procedures, and contractual structures (to avoid multiple layers).

MISSIONS

Set up Horizon Europe's missions as an ambitious shared agenda across public and private actors and citizens, pooling expertise across sectors to jointly deliver concrete changes to society with real impact.

Set up Horizon Europe's missions as integrated programmes across pillars and policies at EU, national and regional levels. For that, breaking down silos and ensuring policy coherence are required. To set up such an integrated approach, funding for the missions should not only be derived from Horizon Europe's pillar II, but rather from all Horizon Europe's pillars/instruments, as well as other EU programmes.

MODEL GRANT AGREEMENT

Preserve continuity in Horizon Europe's rules for participation and Model Grant Agreement (MGA), while continuing the efforts towards simplification where relevant, with the aim of continuous improving the management and efficiency of the FP.

Continue to consider stakeholders' return on experiences and inputs, in order to efficiently co-create the rules that will apply to Horizon Europe. EARTO has already put forward RTOs' inputs on several topics, including those covered in the EC consultation on Horizon Europe's implementation.

3 ADOPT AN ECOSYSTEM APPROACH BOOSTING KNOWLEDGE CO-CREATION AND (LARGE & SMALL) INDUSTRY'S ACCESS TO TECHNOLOGY

Boosting the development and diffusion of emerging technologies is essential for the shift towards the next industrial transitions, which could take 20 years. As detailed in the EC report "re-finding industry", Europe needs to tackle two main challenges: 1) increasing productivity in established companies which face obstacles to implement new technology, and 2) increasing the number of new companies entering the market and helping them to grow. Only one fifth of EU companies are highly digitised, and only one in five manufacturing companies has already used advanced manufacturing solutions. Addressing these two aspects of technology development and diffusion is essential: RTOs play a key role in today's European RD&I ecosystems to support such development and diffusion.

Almost 40% of the European industrial workforce is structured around different industrial clusters and ecosystems. With the evolution of RD&I and the increased importance of collaboration and networks, the emergence of innovation hubs and ecosystems at regional and national level grew over the last two decades. Supporting existing networks and the creation of new networks of RD&I stakeholders, including SMEs and subcontractors, is key to enable the European Industry transition and to find appropriate and economically viable solutions to today's challenges.

Technology infrastructures are the backbone of these dynamic RD&I ecosystems. They are crucial for any innovative technology to reach high enough maturation level and to be validated via early stage experimenting, developing, upscaling, prototyping, and for new solutions to be tested and validated before they can enter the market, demonstrating their value for end-user clients and investors. It is also about risks sharing when investing in new solutions.

RTOs' KEY ROLE TO ENSURE EUROPE'S TECHNOLOGY SOVEREIGNTY

RTOs: developing new technologies with a systemic and market-oriented approach

The development of innovative technologies and skills is indeed key to address societal challenges and create new markets and new industries. Key enabling technologies (KETs) have been a priority for EU industrial policy for many years. They are the essential technology building blocks which underpin Europe's global leadership in various industries, especially in high value added and technology-intensive products and services. The EC report on Strengthening Strategic Value Chains for a future-ready EU Industry identifies six new strategic value chains to

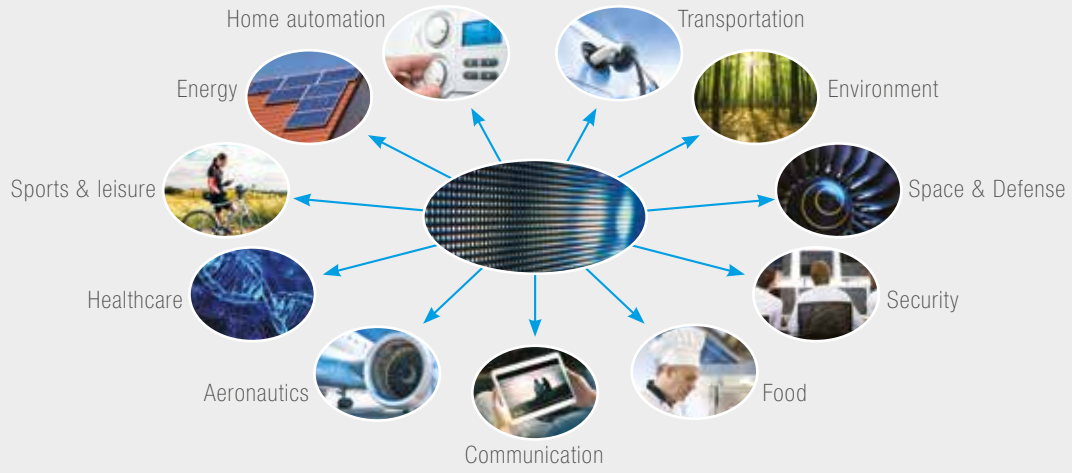
build and maintain Europe's technological capacity and ensure its leadership at global level: Connected, clean and autonomous vehicles, Smart health, Low-CO2 emission industry, Hydrogen technologies and systems, Industrial Internet of Things, and Cybersecurity.

In addition to the development and maturation of technology, RTOs also provide the knowledge and expertise needed to bind and integrate various technologies together, connecting one technology to various applications used in different industrial contexts. In today's digital age, making the connection between digital and deep-tech is essential to change the way we design, produce, commercialise and generate value from products and related services. RTOs also connect technologies to non-technological disciplines, and they incorporate users' perspective while looking at solutions bridging commercial interests and societal needs.

The technologies developed by RTOs have a strong industry focus and could be divided into two different categories: 1) breakthrough innovation creating new markets based on breakthrough technology, and 2) incremental innovation through use, resolving large profit & loss problems. Both are needed today in Europe. RTOs support technology diffusion, finding applications in areas far removed from the original goal of the original research idea.

CEA example: from technology to application, and from challenge to technology

KETs drive new developments across a broad range of industries (Example: Nanoelectronics)



Developing innovative new products by combining and integrating several KETs (Example: Electric vehicles)

RTOs technology infrastructures: essential to develop and mature technology and enable industry's uptake

Technology infrastructures are the backbone of dynamic RD&I ecosystems and stable innovation-driven value chains. These physical or virtual user environments are essential for industry to undertake a system-level testing of entire products, services or processes in controlled and safe conditions, and validate them to end-user clients and investors. Industry depends on the availability of technology infrastructures for upscaling, prototyping and validation of new solutions before they can enter the market.

Industry may own some production facilities: those are typically designed to analyse and develop existing solutions incrementally, and rarely suitable for the development, maturation and testing of new technologies. When developing the readiness of a manufacturing process for a new technology together with the development of the product itself, it is necessary to enable scaling of production amounts from single demonstrators to small series. This is often possible only in dedicated technology infrastructures, which are most of the time beyond the investment capabilities and skills needed to operate them for one single industrial stakeholder, even for very large companies.

RTOs have long taken the role of supporting industrial value chains by housing those complex large-scale technology infrastructures, including multi-use research (prototype) and low-rate manufacturing (test & validation) facilities. Depending on the context, a single technology infrastructure can be used for a wide range of activities: from investigating completely new technology, to piloting, but also spin-off incubation, testing changes in existing products, and validating emerging concepts, either with single industry partners (large and small) or together with a consortium of several players. This is essential to manage both the costs and the risks of RD&I investment, making it more accessible to industries of all sizes.

Therefore, in order to maintain and sustain Europe's technology leadership and innovation capacity, the long-term sustainability of its technology infrastructures must be ensured, with a balanced portfolio of activities and sources of operational income. These technology infrastructures require high level investments and highly skilled technical staff to be maintained and kept at the forefront of innovation.

Examples of RTOs' technology infrastructures

© Fraunhofer IPMS

Fraunhofer (Germany): Research Fab Microelectronics is a unique platform combining all major publicly funded Institutes of Applied Research in microelectronics in Germany. When completed in 2020, FMD will have over 12,500 sqm of clean room facilities for new microelectronic devices prototyping, testing and pilot production. All current and new technologies to produce new semiconductor devices and smart systems will be establish at FMD and available for industrial users.


© AstaZero

RISE (Sweden): AstaZero - Active Safety Test Area is the world's first full-scale test environment for future road safety. A unique feature of the facility is the different traffic environments that make it possible to test advanced safety systems and their functions for all kinds of traffic and traffic situations.


© Tecnalia Harsh Lab 1.0

Tecnalia (Spain): Harsh Lab 1.0 is an advanced floating platform moored 1 mile off Armintza's coast (Bay of Biscay, Spain) designed for the evaluation of materials and components against corrosion, ageing and fouling phenomena in real offshore environment. Harsh Lab allows the evaluation of standardised probes and components both in splash and immersion zones.


© Bioruukki Pilot Centre

VTT (Finland): Bioruukki Pilot Centre is a unique innovation and demonstration platform for bio- and circular economy process concepts and businesses. Bioruukki supports solving innovation challenges e.g. in low carbon energy solutions, efficient biomass refining, new biomass-based products, recycling and waste utilisation and sustainable chemicals. All the required expertise, modelling and piloting capability is under one roof.

RTOs' support to policy makers for technology foresight

Providing technology foresight and assessment, including policy impact assessments and science-based policy monitoring, is an important part of RTOs' activities when supporting their local, regional and national governments with policy development and defining their own strategic orientation. This includes for instance the identification of emerging technologies worth investing in from economic and societal points of view, the activities that are needed to introduce new technologies to the market, or the measures required to speed-up innovation. RTOs are working closely with their regional authorities in carrying out and defining new strategies and priorities for their regional RD&I smart specialisation strategies (RIS3).

RTOs' foresight and support actions also feed into industrial strategies as well as stimulate political decision making. The close connection of RTOs to industry gives them first-hand information on the needs of industry and thus the ability to create innovative concepts of industrial relevance.

EC report on Future technology for prosperity

RTOs very much appreciated the opportunity to use their experience and capabilities for technology foresight and horizon scanning also at EU level, and welcome the EC report on Future technology for prosperity.

AN ECOSYSTEM APPROACH WITH RTOs AT THE CORE TO BOOST INDUSTRY'S UPTAKE OF TECHNOLOGY

RTOs as orchestrator of innovation hubs along industrial value chains

Innovation hubs are networked organisations that support the co-creation, maturation and transfer of excellent technology to industry, in order to apply innovative technological opportunities. They aim at enabling efficient and sustainable technology uptake and scale-up, boosting industry productivity and competitiveness with high impact for society.

With their open-innovation business model, RTOs strengthen Europe's industrial base by developing highly innovative key enabling technologies. By collaborating with their public & private partners in an ecosystem approach, RTOs aim to accelerate technology uptake and ensure that their industrial partners bring those technologies to the market. European RTOs naturally operate in an ecosystem approach as it connects them early on with industrial partners allowing them to align technology maturation with concrete market needs[24].

These networks of RD&I partners are the crucial element of the so-called innovation hubs, providing all technological and non-technological services needed to accelerate the uptake of innovation by large and small industry. To efficiently connect and facilitate the relations between all those actors, RTOs very often act as hub orchestrators and integrators along key industrial value chains.

Innovation hubs: networked organisations

Source: TNO (2015)

[24] EARTO, European Innovation Hubs: an ecosystem approach to accelerate the uptake of innovation in key enabling technologies, 2018

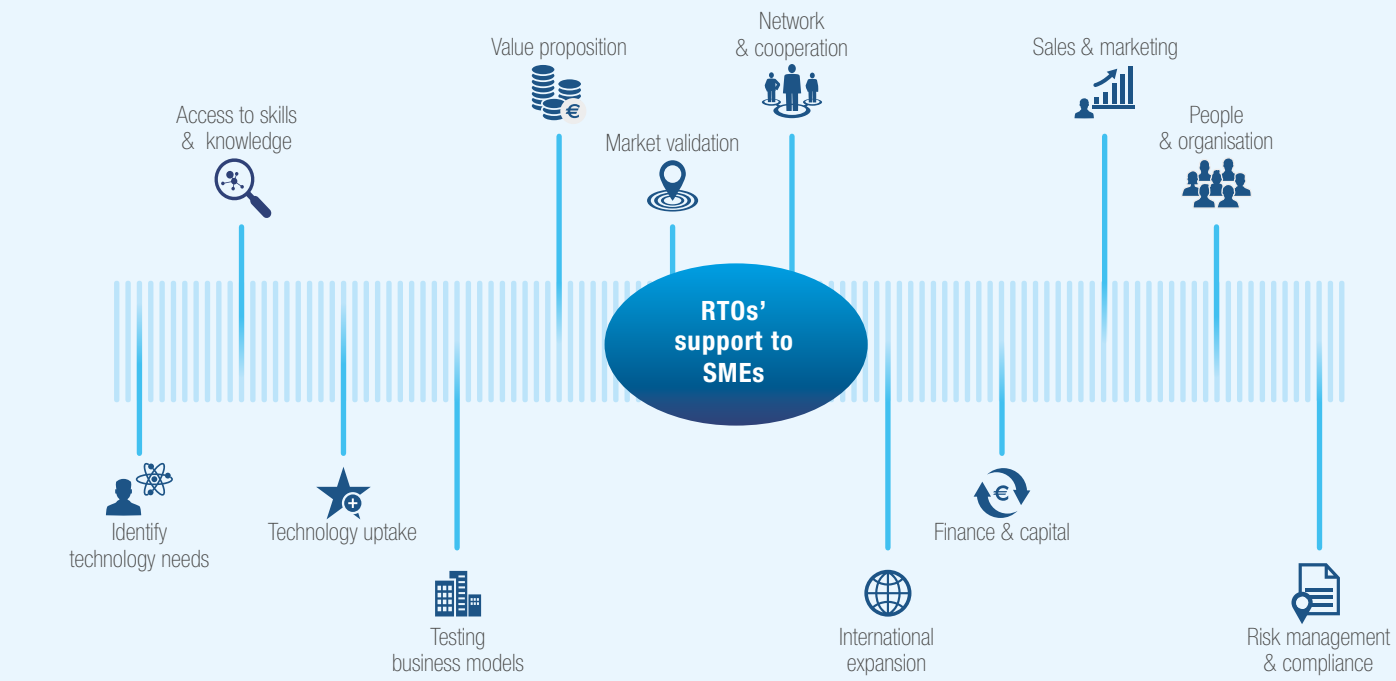
RTOs' support for SMEs' technology uptake

SMEs are an extremely heterogeneous group. They are numerous and widely spread geographically, mostly oriented at regional level. RTOs' support tends to focus on innovative and growth-oriented companies expanding to foreign markets. Such high-tech SMEs tend more and more to be used by large industry not only for the repetitive supply of components or materials but also for their development, design and engineering. RD&I has therefore become essential for their competitiveness. However, these SMEs often must invest upfront and earn return on the investment later on during the subsequent repetitive supply period. An SME today does not have the financial means to invest in RD&I, let alone all the skills, capabilities and facilities needed in the different development phases.

Moreover, RTOs also support SMEs in more traditional sectors. Even though they have a lower RD&I capacity than more high-tech SMEs, they need access to technology to incrementally integrate innovation into their products, which enable them to boost their competitiveness. RTOs support these SMEs to innovate, whether alone or together with other companies, by co-developing a new product, including new technologies into existing products, modernising their production process or gaining insight into new technological possibilities. RTOs provide high-quality, medium to short-term, affordable applied research that SMEs could not otherwise afford. They enable SMEs to accelerate their technology adoption process, and help smaller manufacturers to continually upgrade their processes and products, and to stay ahead of the competition.

RTOs' specific and personalised support to SMEs takes many forms, from understanding their business-model and investigating their bottlenecks and challenges, to facilitating technology uptake. RTOs provide access to advanced technical expertise as well as trained personnel and advanced technology infrastructures. RTOs know which measures are required to make implementation a success: they help SMEs do it rapidly and with ease.

RTOs support to SMEs



Source: imec, modified by EARTO

Examples of RTOs' support to SMEs


© AIT's CaSTLE

AIT (Austria): The Cyber Security Training and Learning Environment serves as a virtual environment for the flexible simulation of critical digital IT systems with different system components and user structures. It provides a secure and realistic environment to test and validate security measures, verify the resilience of different IT architectures and provide trainings for different security processes, and specific incident response processes for cyber incidents. CaSTLE especially addresses cybersecurity SMEs.


© CEA

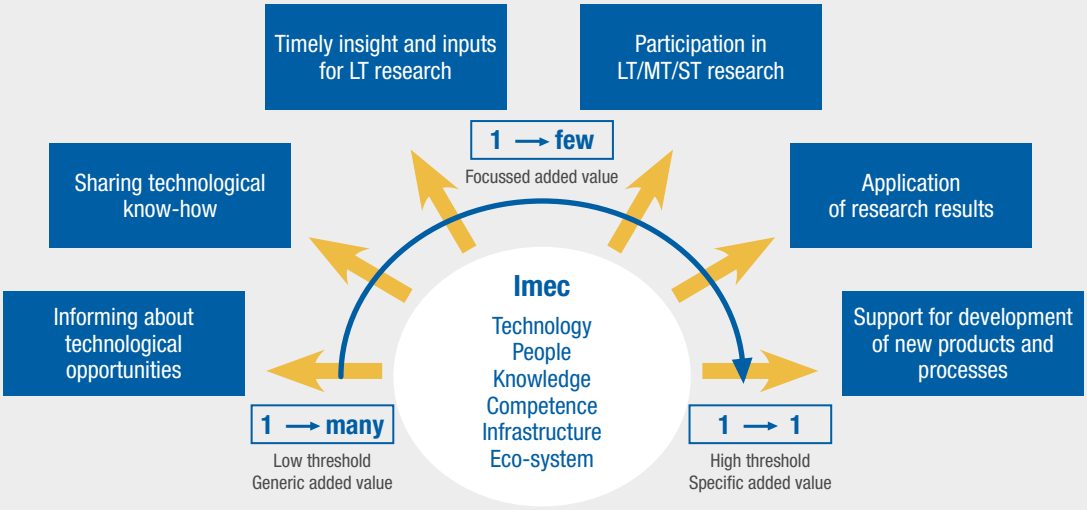
CEA (France): The Platform for Technological Innovation for Enterprises - CEA's "Pepite" - proposes a range of offers to SMEs and mid-cap companies, allowing them to engage in innovation, by reducing the technological risk thanks to skills and know-how of CEA's RD&I teams. In a structured approach, the Pepite platform offers 1) creative sessions to identify new products & services with higher added value, 2) complete project engineering, feasibility study, proof of concept and model, and 3) bilateral RD&I medium term collaboration to create innovation, up to the industrialisation and production phase.

© Flanders Make

Flanders Make (Belgium): Make Lab is a mobile living laboratory in which Industry 4.0 technologies are demonstrated on real industrial use cases. This mobile lab is used for demonstration, training purposes and feasibility studies, with a specific focus on SMEs. It forms part of Flanders Make industrial support programme and is quite unique in the innovation landscape.


© LEITAT IAM 3D Hub

LEITAT (Spain): IAM 3D Hub aims to accelerate the adoption of additive manufacturing and 3D printing technologies as an alternative way to design, develop and manufacture new competitive products and services. This is a joint initiative between RTO, Industry and regional actors with partners such as HP, Renishaw, ArcelorMittal, BASF, Abrast by Coniex and ACEO by Wacker and Fira de Barcelona.



Imec (Belgium): istart is Imec's open innovation Business Acceleration Programme. It supports digital tech and nanotech startups for minimum 12 months, with coaching, technology, (international) network and funding (up to €150k pre-seed funding as equity investment) to prepare them for first sales, growing their team & internationalisation. It is open for startup projects with a proof-of-concept of their innovative product, a complementary founding team and with the potential and ambition to become a global leader in its market niche.

Developing the skills for the future: RTOs' role and needs

Closer to market, the need for specialised and highly skilled personnel and know-how is high. RTOs are a valuable source of highly skilled and specialised human capital and know-how, without which creating bridges between the many different disciplines and knowledge necessary to solve societal and industrial challenges would not be possible. Besides, RTOs maintain good contacts both with the academic research world and the close-to-market industrial world, ensuring that their facilities operate across the TRL scale. It is for instance recurrent for RTOs' employees to occupy part-time positions as professors in universities, and to co-supervise doctoral thesis and master's degree final projects. RTOs also strongly contribute to the training of professionals on-the-job at the front end of industry's technology needs. RTOs also support the development of T-shaped profile skilled employees, capable to co-create and collaborate with experts in other areas and innovate across disciplines. This enables applied research to find its way into the industry and then turn into innovation. Transfer of heads between RTOs and industry is frequent.

In addition, RTOs are committed to support their own researchers' skills, career paths and working conditions, by offering trainings, skills and competences' development in many areas (e.g. quality aspects, IPRs and standardisation, data management, ethics, research integrity, project management, etc.).

Examples of RTOs' professional training programmes

Digital Catapult (UK): Cyber 101 is a training designed to help support cyber security enterprises boost their business skills in an open innovation environment powered by peer-to-peer learning and mentorship. Selected companies that successfully complete the workshop are shortlisted for an annual Demo Day, which provides a direct opportunity to pitch to potential customers and investors.

DTI (Denmark): The Danish Technological Institute has provided trainings to the Danish business community since 1906. Each year more than 17,000 people participate at DTI's courses and trainings covering a wide range of topics and technology areas: IT, energy and construction, production, measurement and metrology, quality, food, environment, etc.

Fraunhofer (Germany): Since 2006, the Fraunhofer Academy provides continuing education and a range of training programs, especially for employees of technology-oriented companies. The Fraunhofer Academy passes current research knowledge and expertise of the Fraunhofer institutes on to private sector business enterprises seeking to provide their employees with the best possible qualifications.

Imec (Belgium): Imec Academy offers specialised courses on nanoelectronics and digital technology and engages in research on educational technology. Its technical training programs combine world-class expertise with hands-on applications for the local and international industry, academia and the imec employees. With its smart education research, Imec strives to increase learning effectiveness by using smart technologies.

RTOs CREATE DEEP-TECH START-UPS WITH HIGH IMPACT

Deep-tech start-ups are also key to Europe's competitiveness and industrial renewal, delivering high socio-economic impact contributing to strengthen the European Research Area. Contrary to US-type digital companies, or unicorns like Uber or Airbnb, EU-type deep-tech start-ups have great life expectancy and low rate of failure, as demonstrated by EARTO economic footprint study. However, in order to deliver such good results, the support that these EU deep-tech start-ups need early-on to make innovation investment-ready are much higher, even though they tend to balance out at a later development stage.

RTOs provide essential support for the creation of these deep-tech start-ups[25]. When the innovative technologies developed by RTOs are mature, one of the ways for RTOs to make sure that such technologies can reach the market is to create successful deep-tech start-ups themselves. This often happens when no existing company is willing to take the risks and bear the investments needed to commercialise a new technology. These RTOs' spin-offs are based on

[25] EARTO paper, how to Exploit the Untapped Potential of RTOs' Deep-Tech Start-Ups, 2017

deep technology: unique, differentiated, and often IP protected or hard to reproduce. The creation of these start-ups requires four key actors with aligned incentives: 1) a strong and smart team combining both technology experts and entrepreneurs, 2) developing a promising technology with strong IP 3) with a market-oriented approach and potential industrial clients, and 4) smart capital fuelling the whole process.

RTOs' specific in-house support to their spin-offs, often called "tech start-up accelerators", is the key to their success. Such multifaceted support can range from giving access to in-house financial and legal support to staff detachment, or to support in launching and implementing these companies' business plan. RTOs have strict spin-offs policies that leverage the inherent risk of these operations and are oriented at producing investable opportunities for "smart capital" to invest in. Thanks to these internal programmes, RTOs support new entrepreneurs to create business models, produce prototypes, assess IP issues, connect to industry, find seed money, and finally create a spin-off company that transforms an innovation into a commercial innovative product.

EARTO Economic Footprint analysis showed that 7 RTOs in 2016

Had
387 active spin-offs

which created
19,000 jobs

with
€2.4 billion revenues

and an average of
7.7 years life expectancy
with 83% survival rate
after 5 years
(EU average being less than 50%)

RTOs' deep-tech start-ups have a balanced socio-economic impact, ensuring job creation, increased turnover and capitalisation across the value chain. In addition, the human capital moving from the founding RTO to the spin-off contributes to the availability and dispersion of highly qualified knowledge and skills to the local economy and related industries.

EARTO RECOMMENDATIONS

3 ADOPT AN ECOSYSTEM APPROACH BOOSTING KNOWLEDGE CO-CREATION AND (LARGE & SMALL) INDUSTRY'S ACCESS TO TECHNOLOGY

RD&I ECOSYSTEM & INNOVATION HUBS

Adopt an ecosystem approach for EU RD&I policy making, boosting collaboration and co-creation, giving RTOs a clear mandate to drive the development of Europe's innovation hubs along key industrial value chains, as highlighted in the EC report on Strengthening Strategic Value Chains. Creating synergies and alignment between the existing European (incl. Horizon Europe and the Digital Europe programme), national and regional strategies would be essential. Strengthening of consistent mixed-funding schemes at European, national and regional levels for those hubs would also be very valuable in achieving the industry transition across the EU. Such schemes should also support innovation hubs' orchestration activities.

Refocus the European Research Area on developing a strong industrial base, where SMEs and midcap companies play a key role, often being "the hidden champions", with sustainable company management and strong corporate social responsibility. Addressing the technology development and diffusion challenges is essential to boost SMEs' productivity and growth.

TECHNOLOGY DEVELOPMENT AND MATURATION

Develop and scale-up the key enabling technologies that will power our society in the 21st century and make them an integral part of all clusters of Horizon Europe Pillar II as cross cutting enabler. This will be key to strengthen Europe's technological expertise in key areas and ensure Europe's technological leadership. Pre-competitive technology development should not be hijacked for specific targeted goals, but rather allowed to be tested in different environments bringing different applications across industries and sectors. The pillar II budget should dedicate sufficient funding to cover the exploitation of the H2020 KETs as well as the newly defined emerging KETs for Horizon Europe.

Provide recommendations to promote the European technology capability in the post-2020 European Industrial Policy Strategy, including to support the creation and the long-term sustainability of technology infrastructures. This will be key to boost inclusive productivity growth and competitiveness and foster European industrial value chains. This should be prioritised as such in European policy strategies.

Support both breakthrough innovation and incremental innovation in all technology areas, not only digital. Both breakthrough and incremental innovation are needed to create new markets based on game-changing technology, and to boost the diffusion of existing technologies (broad roll-out), in particular to SMEs. ICT is of course key to foster digital transformation and open the way towards Industry 4.0. However, there are also many other promising technological fields to be looked at, including biological transformation, smart materials, or nanotech. Creating connections between digital and non-digital technology also has a lot of potential.

Further use RTOs' experience and capabilities for technology foresight and horizon scanning at EU level. Repeating the experience of the first EC report on the "Future Technologies for Prosperity" on a regular basis would help Europe to invest in the right emerging technologies. These findings should be feeding into the EU Framework Programmes and the European industrial strategy.

TECHNOLOGY INFRASTRUCTURES

Create a European Strategy on Technology Infrastructures. EARTO very much welcomes the EC SWD on Technology Infrastructures and is looking forward to the next steps. A strategic approach is needed to ensure that we have the technology infrastructures that are required in Europe to answer technology needs and support European industry to develop their innovation capacity and business transformation.

Boost public & private investments in technology infrastructures and ensure a good and sustainable funding mix, with European, national, regional support depending on the business model and target of the infrastructures. At EU level, the prioritisation of strategic investments in key unique-in-Europe technology infrastructures based on industry needs, gaps and opportunities is essential. At regional level, synergies with structural funds would be key. Besides, such technology infrastructures need to be built with sustainable business models that ensure their long-term sustainability and make sure that they can stay up to date over time.

Ensure pan-European access to technology infrastructures by companies of all sizes, regardless of their geographical location within Europe. Horizon 2020 I4MS calls are good examples of what could be used to connect different regional-based technology infrastructures together and boost SMEs' access.

Better cover the real operational costs of technology infrastructures within EU FP projects by enabling the allocation of direct technical costs to projects using unit costs, based on the usual cost accounting practices of the beneficiary. This should be made clear in Horizon Europe's Model Grant Agreement (MGA) .

EARTO RECOMMENDATIONS

EIC & SPIN-OFFS' CREATION

Implement the EIC Pathfinder instrument to provide the pre-seed funding grants needed for the technology maturation/incubation phase, to make innovations investment ready. Private investors cannot invest at such an early stage: they lack the expertise to assess the combined value of what technology can do in the targeted application field. This pre-seed development therefore needs to be supported through public instruments, with the objective to increase the length of the maturation phase. This would secure the market of the future deep-tech start-up, ensuring at least a few customers for the new product, improving the chances of success of the spin-off. This type of activity requires grant funding schemes, equity being too risky at that stage.

Enable the EIC Accelerator instrument to provide access to liquidity to RTOs' spin-offs after the seed-funding rounds. There is a strong need for an increased public and private support to provide liquidity to those start-ups at a later stage after their creation. Only then would the high investment they require be worthwhile. This would also help keep them in the EU, potentially leading to creating jobs and sustainable growth in Europe.

SUPPORT TO SMES AND MIDCAPS

Foster the use of a lump-sum based cascade funding scheme in Horizon Europe, which is key to support SME's access to RTOs' infrastructures. Improving the cascade funding scheme by making it lump-sum based would lower the administrative burden and risks for the beneficiaries, third parties, and auditors (cash flow issues, liability, documentation efforts). Returns on experiences from H2020 projects should be used to improve the efficiency and sustainability of cascade funding mechanisms for SMEs and midcaps.

Ensure that the EIC is flexible enough to allow for cross-border collaboration between SMEs and RTOs, either through the EIC pathfinder and/or an adaptation of the SME instrument. Collaboration helps SMEs not only in terms of access to expertise, infrastructure and technology, but also to access a wider network of experienced and skilled organisations, including in non-technology areas.

SKILLS

Adopt an integrated approach for the development, maturation and dissemination of cutting-edge technologies, which should include the acquisition of the necessary skills for the deployment of such technologies by industry. Such skills are a prerequisite for a successful industry's uptake of new technologies, especially for SMEs. RTOs deliver first-hand knowledge from industrial reality and play a crucial role in professional education for industrial transformation. These training activities should be integrated as part of Horizon Europe's collaborative projects, beyond the only Marie Skłodowska Curie Actions (MSCA) and accepted as eligible costs of the projects. A pan-European approach for such professional trainings in key industrial sectors would boost the impact of the EU FPs.

Develop specific support for the training and transfer of skills from RTOs to industry, which is essential for industry's uptake of new technologies, especially for the digital transformation of industry. EU instruments such as EIT KICs should be further used to develop and roll-out professional training courses on cutting-edge technologies, including digital skills.

4 ENSURE THE RIGHT FRAMEWORK CONDITIONS TO STIMULATE KNOWLEDGE AND TECHNOLOGY CO-CREATION IN EUROPE

Public sector policies and rules (and how they are interpreted) can create unwanted barriers to innovation and block innovative options. At EU level, different applications and/or manners of transposition of national, local and EU legislation have led to a policy and legislative framework that is not always adequately supporting innovation and its market uptake. Failing to consider the specificities of public investments in RD&I as a mean to alleviate market failure and reducing risks to stimulate industry's investment and technology uptake can have damaging consequences on the European RD&I funding landscape. Ensuring the right framework conditions are essential to stimulate knowledge and technology co-creation in Europe. For instance, Europe needs to strike the right balance between the social benefits of enhanced reuse and sharing of data and analytics, and individuals' and organisations' legitimate concerns about such openness, including the protection of privacy, economic impact, job creation and intellectual property rights.

EU STATE AID RULES FOR RD&I

The EU has a unique system of state aid control aiming at safeguarding free and fair competition in the EU internal market. As there is no equivalent abroad, the EU state aid rules for RD&I can hamper EU's competitiveness in today's globalised world distorting the playing field at the EU's disadvantage, including for RTOs. This often makes European RD&I investments much less efficient and slower for RTOs than for their global competitors with a clear damaging effect on European competitiveness. This issue was already stressed in the report of the High-Level Group on Maximising EU R&I Impact noting the need to make EU state aid rules more innovation-friendly. The EC sponsored ENIRI study on state aid for RD&I reinforced such message stating that *"the EU's State Aid Framework constitutes a handicap for EU industry and research"*. The right balance needs to be found between the need to protect the EU market with EU state aid rules, and the RD&I objective to support Europe's economic and social wealth in the common public interest.

The main issue with the EU state aid rules for RD&I arises from the margin for interpretation left to EU Member States which leads to a fragmented application of such rules. Some Members States tend to be risk-averse and often have a too narrow interpretation of these rules, often resulting in difficulties for RTOs. For instance, the increased administrative burden due to the application and strict interpretation of EU state aid rules in some EU countries create important barriers to the creation and management of state-of-the-art technology infrastructures, which can result in important delays and loss of competitiveness via-a-vis other global competitors, and limit industry's access accessibility to these technology infrastructures.

EARTO Paper on EU RD&I state aid rules

In order to provide guidance both for RTOs and for their discussions with Member States, the EARTO paper on EU RD&I state aid rules aims at detailing in particular the current legal basis and rationale behind the EU state aid rules and how these apply to RTOs, from the point of view of EARTO legal experts. In particular, this note sheds light on:

- The key definitions of the concepts of "economic" (e.g. research services at very high TRL on behalf of undertakings funded by industry at 100% full costs plus a margin) and "non-economic" activities (e.g. effective collaborative research co-funded or funded by industry up to 100% full costs without margin) in the context of EU state aid rules. These most of the time differs from definitions of "economic" activities under national taxation law. In addition, the term "contract research" is also to be understood differently in EU state aid rules (i.e. limited part of RTOs' activities focused on high TRL RD&I services such as testing, validation, training or "consultancy-like") compared to the common usage made of the term (i.e. all contracts between RTOs and industry, including EU FPs' contracts, which are most of the time collaborative co-creation projects).

- How to apply the EU state aid rules when an RTO or a research infrastructure carries out both economic and non-economic activities, and the special case of public investment in research infrastructures.

In this view, EU policy makers should further integrate RD&I and competition policies preventing any unwanted regulatory barriers that hampering the EU's innovation capacity and preventing Europe from keeping its seat amongst the frontrunners of the technological revolution. In that respect, EARTO appreciates the JRC efforts to address the knowledge and awareness gaps regarding EU state aid rules for RD&I[27]. Once published, such detailed work should support RD&I organisations and Member States to correctly interpret the RD&I state aid framework. EARTO also appreciates the EC plan to revise the EU state aid rules for combining EU instruments[28]. In addition, the specificities of the RD&I sector should be clearly recognised in the revised EU state aid rules, for instance by distinguishing the construction of research and technology infrastructures by non-profit actors like RTOs from the most common infrastructures cases such as ports or airports. The legal framework for pre-commercial procurement should also be improved in the state aid rules. The revision of the EU state aid rules should aim at finding a better balance between the need to safeguard free and fair competition in the EU internal market and the need to boost EU competitiveness through knowledge co-creation and innovation.

OPEN SCIENCE AND INTELLECTUAL PROPERTY RIGHTS

RTOs' open innovation business model

As coined by Henry Chesbrough, open innovation is characterised by the simultaneous presence of "value creation" by the partners working in collaboration, co-creating knowledge to boost innovation output, and "value capture" under

[27] JRC TTO Circle presentation, EC study on state aid, 2019
[28] EARTO and Vanguard contribution to the public consultation on targeted review of the GBER, 2019

conditions that enable each partner of the collaboration to capture a share of the economic value created in common. When both conditions are met, powerful incentives exist for knowledge and technology creators like universities and RTOs, and technology buyers like industry, to interact and collaborate with each other, thereby creating a thriving technology marketplace and jointly developing solutions to societal challenges. Open innovation is about collaborative risk-sharing: the costs and benefits of research are allocated proportionally between all entities that invest in a research project.

Open innovation is embedded in European RTOs' business models. RTOs develop new breakthrough technologies, with a market-oriented approach and the objective to develop strong Intellectual Property (IP). This enables them to ensure that the technology they develop reaches the market with high impact. They have different ways to do so:

- Directly commissioned collaborative projects with private partner(s): RTOs and their private partners collaborate in a co-creation setting, with a common objective and agreement on the reasonable efforts needed to fulfil such objective. There is a fair division of work between the partners, who often share the technological, scientific and other risks - even though one of the partners may bear the financial risks on its own. The partners also often share the research results: Intellectual Property Rights (IPRs) and access rights can be allocated to the different partners with respect to the value of their contribution and respective interest. Most of the time, in the case of an exploitation by the partner, royalties are attributed to the RTO with respect to the value of their contribution and the value of the technology. Non-IPRs results are widely disseminated through conferences, publication, open access repositories, or free or open source software.

- IP licencing among various participating partners is an important model of "open innovation" collaboration. A license is a consent by the owner to the use of IP in exchange for money or something else of value. Licenses may either be for certain IP rights only, or for all the IP rights that are necessary to reproduce, make, use, market, and sell products based on a type of technology.

- Spin-offs' creation: as described above, RTOs have the capabilities and support mechanisms in place to create successful spin-offs based on strong and exclusive sectorial IP licences that are transferred to the new start-up. IP is indeed essential to set up a spin-off company, in particular for the valuation of the spin-offs, as outside investors use IP as collateral.

RTOs support any incentive given to the exploitation and dissemination of technology, under conditions that enable each collaborating partner to capture a share of the economic value created in common, as detailed in a business and exploitation plan and a clearly defined roadmap.

The key role of IPRs and standardisation in the EU RD&I ecosystem

The long-standing experience of RTOs shows that industry is usually only willing to invest in RD&I leading to a competitive edge over entities that have chosen not to invest. This requires protecting certain results with IPRs. IP systems are designed in large part to provide adequate incentives for creators and inventors to invest in the production of novel ideas and content, while at the same time encouraging beneficial diffusion of knowledge.

As detailed by the World Intellectual Property Organisation (WIPO), IP is a broad concept and includes many different intangibles, such as patents, copyright, know-how, trade secrets, trademarks, industrial designs.

IPRs play at least two different important roles for RTOs in RD&I ecosystems:

1. **A coordination or trust-creating role**: IP is used as a mean to create new collaborations with other partners. For RTOs, this is the most important role of IPRs: a way of giving value to technology. RTOs use their patent portfolio as a tool to signal their competences and market their know-how as the background of future RD&I collaborations with industry. This explains why keeping ownership or joint ownership of IPRs when collaborating with industry is important for RTOs to increase their pool of proprietary IP. It fosters further collaboration in an open innovation model. In addition, waiving the ownership of the patents to industry would mean that RTOs lose the possibility to have new agreements with other companies in different industrial sectors, which would in turn significantly limit technology diffusion. Patents also play a key role to structure, secure and facilitate tacit knowledge exchanges between partners during collaborative projects.

2. **An incentive role**: IP play also an incentive role as it provides legal certainty, enabling RTOs to mitigate the costs of patent filing by earning royalties. However, this is never RTOs' main objective when filing patents. The cost of patenting itself justifies the need for royalties' income. Filing a patent itself is done against a fee. The interviews between patent attorneys and inventors can also have a high internal cost. The annual fee for keeping the patent increases each year, with the patent's 20th anniversary fee being the highest.

These two roles of IP are deeply interconnected as the royalties earned by an RTOs (incentive role) often follow a collaborative project with an industrial partner (coordination role).

In addition, RTOs are actively participating in Standard Setting Organisations (SSOs), Standard Development Organisations (SDOs) and digital standardisation communities (e.g. CEN-CENELEC, ETSI, ISO, ITU, DVB, ATSC, IETF, OMG). This allows RTOs to support the development of essential technical standards. Those technical standards are of great importance to allow European industry to scale up technology developments to new products and services that will be internationally competitive and as such further develop the European Digital Single Market. However, standardisation is costly, and it should be further supported and incentivised both at national and EU levels.

A balanced open science policy focused on the optimal re-use of research results

As detailed in the JRC report on IPRs, technology transfer and open science, *"there are no incompatibilities between IPRs and Open Science. On the contrary the IPRs framework, if correctly defined from the onset, becomes an essential tool to regulate open science and ensure that the efforts from different contributors are correctly rewarded"*. It is part of RTOs' public mission to strategically decide what to do with their know-how so it can have the highest impact in fulfilling their public mission.

The general aim of the European open science policy is to enable the replicability and/or the uptake of research results by others, to speed up the uptake of innovation. However, there are several ways to reach this objective, including using IPRs. An unbalanced one-size-fits-all European open science policy where the concept of "open science" is still too often associated with "free of charge access for all" would be highly detrimental to European RD&I ecosystems. This would prevent industry from securing the element of shared "value capture" essential to open innovation. The emphasis of the EU Open Science policy should therefore be on the availability and wide dissemination of knowledge and technology rather than on the absence of pricing.

Regarding the EU FPs' data management policy, the focus should be on the optimum re-use of research data, which should be looked at in terms of an optimal allocation of the costs and benefits of the research effort, thereby attaining a maximum societal impact of the public research funding spent. Research data should therefore be "open" where reasonably possible and "restricted" where reasonably required. With regards to data sharing, relevant privacy and security interests, as well as IPRs, confidentiality, global economic competitiveness and other legitimate interests need to be taken into account.

RTOs very much support the FAIR principle[29] and support the responsible management of research data by mainstreaming the use of data management plans within the EU FPs. Data Management Plans (DMPs) are the pre-condition for making data reusable: RTOs are using them. However, DMPs need to remain flexible instruments to fit every possible situation and should not exclusively be connected to immediate opening of data. FAIR is not necessarily open: this needs to be clearly reflected in the FPs' Model Grant Agreement (MGA), including in the definition of FAIR data. Besides, only high-quality data will be re-used. In addition, the cost to manage and curate data for long-term periods must be recognised. A clear distinction should also be made between 1) input data needed to carry out a RD&I project, and 2) output data of the RD&I project itself. Finally, any obligation to publish further data, pre-prints, intermediary findings, or software associated with the publication could also make it incompatible with IPRs protection, and technology transfer, and needs to be avoided.

EU RD&I PUBLIC PROCUREMENT POLICY

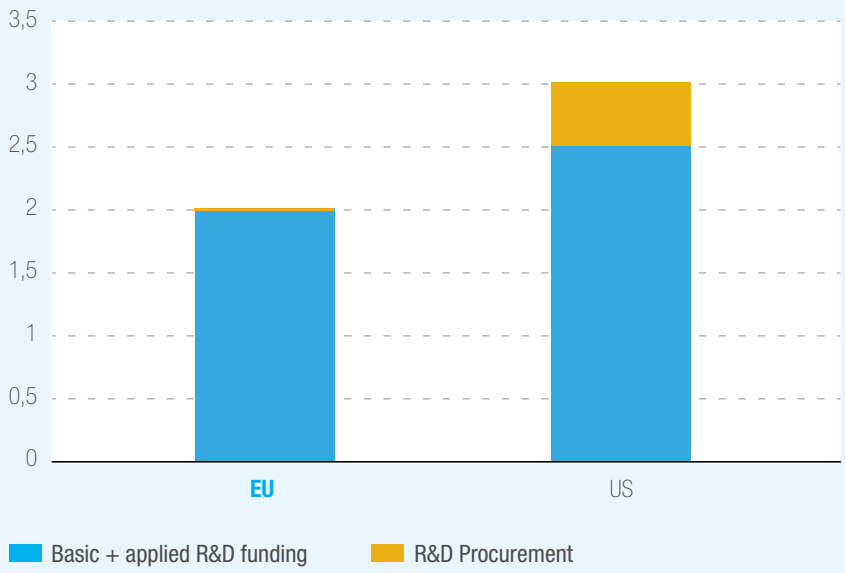
Public procurements should play a much bigger role in the EU. It enables to share the risks and benefits of designing, prototyping and testing a limited volume of new products and services with the suppliers. It helps creating the optimum conditions for the wide commercialisation and uptake of RD&I results, in a limited setting. A public purchase of RD&I often involves a RD&I phase at high TRLs, followed by a manufacturing & commercialising phase, both requiring investments of resources.

Public procurement of RD&I remains underused in Europe compared to other parts of the world, despite the efforts undertaken by the EC to promote such instrument in Europe (including in H2020). This is mainly due to the separation of EU public procurement of RD&I into two distinct phases with two distinct calls for tenders: 1) the research and development phase and 2) the one for the deployment of commercial volumes of end products. This is not the case in other countries such as the US. As explained in the ENIRI Study[30]: *"Undoubtedly the USA has put a driving force innovation in place through its public procurement policies. However, the (European) Union, through Pre-Commercial Procurement (PCP), cannot copy the US system without undertaking profound legal adjustments"*. Indeed, in the US, the public purchaser can make public procurement in a single call for tender for both the RD&I phase and the manufacturing/commercialisation phase when the public procurements are reserved to SMEs, which is the case in the US PCP-like projects (SBIR programme).

[29] FAIR: Findable, Accessible, Interoperable and Reusable

[30] EC Commissioned study, ENIRI - "State aid support schemes for RDI in the EU's international competitors in the fields of Science, Research and Innovation" (p.622-625)

R&D Expenditure as % of GDP in EU and US



Even though the total public expenditure is lower in the US than in the EU, the US R&D expenditure is close to the 3% target, whereas this is not the case in the EU where R&D expenditure barely reaches 2%. An important part of this difference is due to R&D public procurement: 20 times less is spent via such instruments in the EU (€2.5bn) than in the US ($50bn).

Source: European Commission (data 2015)

Promoting innovation through public procurement very much depends on the ability of public authorities to purchase the innovative products developed. Having only one call for tender for both phases would provide additional incentives for companies to take part in the RD&I phase since they would be assured to get an opportunity to recover part of their RD&I investment in the commercialisation phase by bringing their innovation to the market[31]. It would also provide additional incentives for RTOs to take part in the RD&I phase in partnership with companies, as this one-phase process would be more aligned with their IPRs' policies. This would allow RTOs to:

- Keep ownership of the foreground IP it created (e.g. when the foreground IP created in the PCP is new or an improvement of a RTO's background IP).
- Possibly grant an exclusive sectorial license on such IP to the industrial company they partner with, acting as their RD&I provider.
- Develop the IP in other industrial sectors, through exclusive IP licensing to other industrial companies in other sectors.

A clear improvement should be brought to the RD&I public procurement legislation in the EU, including in the EU state aid rules for RD&I.

[31] See EARTO Paper on How to Boost Pre-Commercial Procurement in Horizon 2020, April 2016 and EARTO Response to the European Commission Public Consultation on the EU State Aid Framework for R&D&I - February 2014

4 ENSURE THE RIGHT FRAMEWORK CONDITIONS TO STIMULATE KNOWLEDGE AND TECHNOLOGY CO-CREATION IN EUROPE

EU STATE AID RULES

Improve the regulatory framework at EU level such as the state aid rules for RD&I (and the interpretation of such rules) so as not to create counterproductive barriers to the efficient co-creation and transfer of knowledge, especially avoiding delays in the investments for the new technology infrastructures that Europe needs.

Undertake the revision of the EU state aid rules in 2022 with the objective to take into account the specificities of the RD&I sector, remove the barriers to innovation (incl. for technology infrastructures), and harmonise the interpretation of those rules between the often risk-adverse EU Member States. Stakeholders like EARTO should be involved in the revision of those rules. The EU state aid rules need to consider the special case of RD&I, including the different timeframes, risk-level and realities it represents: RD&I is not a product on the market and should not be considered as such.

IPRs & OPEN SCIENCE

Foster a balanced approach between Open Science and Intellectual Property (IP)'s policies. IP's crucial role in innovation and in fostering knowledge co-creation needs to be further recognised. EU policy makers should take great care to balance the envisaged benefits from "openness" for society at large against the proven needs of the existing technology marketplace, the latter requiring a clear competitive edge as well as clear return on its investments in innovation activities, where collaborative research plays a crucial role. EU policy makers should support a strictly bottom-up growth of Open Science, preserving scientific freedom, knowledge co-creation and technology transfer.

Provide effective incentives and support to researchers to efficiently disseminate and exploit their research results and encourage their translation into the commercial world, especially through patent filing. This can be done for instance by creating incentives to researchers to file patents, reviewing the reward system for scientific careers, or creating incentives for RD&I organisations to participate in standardisation activities.

Focus the EU FPs' data management policy on the optimum re-use of research data, following the principle "as open as possible, as closed as necessary", with mention of the necessary safeguards including concerns related to IPRs, privacy, security, legitimate commercial interests, global EU competitiveness, etc. The data management policy should be

focused on making research data FAIR, and clearly dissociated from the concept of "free of charge, immediate access to all". The emphasis should therefore be on the availability and wide dissemination of knowledge, rather than on the absence of pricing. FAIR is not necessarily open: this needs to be clearly reflected in the EU FPs' MGA, including in the definition of FAIR data. Beneficiaries' decision not to open their data based on one of these safeguard clauses should not require further justifications and should not have any negative consequences on the evaluation and financing of the project.

Simplify the IPRs clauses in Horizon Europe MGA to encourage not-for-profit organisations to efficiently disseminate their results through licensing. The prerogative of exploiting or using research results should always lie with their owner(s). The conditions that enable each partner of the collaboration to capture a share of the economic value created in common should be clearly defined in the projects' roadmaps and business and exploitation plans. In addition, the royalty-free option should be removed, for the access to not-for-profit research organisations' research results and for the access to the background needed to commercially exploit those results. In case of joint ownership, a financial compensation needs to be paid by the directly exploiting party to the indirectly exploiting party. Indeed, given the efforts and costs incurred by patent filings and long-term maintenance of patents, royalty-free options would demotivate research actors to file patents, which would in turn weaken the potential for commercial exploitation of results.

Organise trainings for researchers in the frame of EU FPs to increase their awareness of the requirements deriving from the EU Open Science and data management policy, and to enable them to fulfil these requirements based on proper data management plans. Such trainings should be organised by the EC for EU FPs beneficiaries, and cover several topics, including IPRs protection, the standardisation of meta-data, FAIR principle, etc. It should raise awareness on how to integrate both IPRs and Open Science issues, from the conception of projects up to the dissemination of the research results. Such trainings should be made mandatory for EU project coordinators.

PRE-COMMERCIAL PROCUREMENT

Improve the EU regulatory framework and leverage the potential of public procurement of RD&I in Europe, making European public procurement policy a driving force of innovation. Improved Pre-Commercial Procurement (PCP) rules would already be feasible by removing the restrictive clause stating that "the public procurer can impose on the suppliers to concede non-exclusive licences to all third parties that would request it", as it is already the case quite successfully in some EU countries (see PWC study on "National innovation procurement policy frameworks across Europe"). This would significantly contribute to simplify the PCP projects within Horizon Europe and boost the attractiveness of such instrument.

Negotiate a derogation with the World Trade Organisation's Government Procurement Agreement (WTO GPA) committee on public procurement of RD&I. Such negotiation should aim to exclude the procurement of the goods resulting from successful RD&I for the small businesses (commercialisation phase) from the scope of the WTO GPA to have the same rules as those negotiated by the US. This would enable to amend the EU Public Procurement Directives and the H2020 PCP's rules accordingly, exempting from their scope not only the provision of RD&I services but also the subsequent purchase of the products resulting from the successful RD&I.

CONCLUSION

Today, European Leaders have the chance to define Europe's future: delivering on our key societal, environmental, and economic challenges. As detailed within this paper, European RD&I policy post-2020 will be essential to build a prosperous, safe, inclusive and sustainable future for the next generations. RTOs will be a key enabler to achieve such ambitious goals. As key actors in the European RD&I ecosystem and innovation-driven strategic value-chains, RTOs have a prominent role in EU RD&I programmes and policies. They are therefore very well positioned to provide concrete recommendations to policy makers to develop impactful post-2020 RD&I policies in Europe.

EARTO's recommendations are structured along the four following dimensions:

1. **Boost public investments in RD&I as key driver of prosperous and sustainable growth, recognising that Europe's technological capabilities will be the decisive strategic factor to build Europe's future.** Concrete and ambitious targets of raising RD&I investments aiming to deliver impact for society need to be set at EU, national and regional levels. Effective complementarity and practical synergies between EU funded programmes should also be ensured.

2. **Foster cross-border RD&I collaboration as the solution to jointly face the global societal & industrial challenges of today, especially through the pillar II of Horizon Europe.** This includes ensuring funding for medium-term strategic pre-competitive technology development and supporting the continuity of public-private partnerships, both essential to turn promising basic research results into technologies with industrial maturity.

3. **Support a European RD&I ecosystem approach along strategic value chains, boosting technology co-creation and (large & small) industry's uptake of innovative products and services.** For this, the development and scaling-up of key enabling technologies is essential, for both breakthrough and incremental innovation, in all industrial sectors (not only digital). This will require the set-up of an ambitious EU strategy on technology infrastructures, targeted support to SMEs, and the creation of deep-tech start-ups in Europe (incl. with the European Innovation Council's support).

4. **Ensure the right framework conditions to stimulate knowledge and technology co-creation in Europe and prevent the creation of unwanted regulatory barriers hampering European innovation capacity.** Taking into account the specificities of the RD&I sector in the revised EU state aid rules for RD&I will be key. In addition, a balanced approach needs to be fostered between the EU Open Science and the Intellectual Property policies, focusing on the optimum dissemination and exploitation of research results.

EARTO and its members hope that this set of recommendations will support EU Leaders' decision-making in the coming years, especially in the development of an EU funding programme for RD&I at the level of Europe's ambitions. EARTO remains of course ready to further discuss these recommendations with the European Institutions.

EARTO Highlights

350 RTOs Members of EARTO

From **29 countries** in Europe and beyond

Network of **150,000 highly skilled researchers, engineers & technicians**

€ 23 billion revenue every year

Several hundreds state-of-the-art technology infrastructures

More than **100,000 large & small companies** supported each year

EARTO Members in H2020 in Figures

(eCorda data October 2019)

EARTO members represent 1% of the beneficiaries, but receive 8% of the available funding

Industry participation increases to 32% when EARTO members are involved in the project (from 26% when they are not)

EARTO members coordinate 32% of the projects in which they participate

EARTO members participate in large collaborative projects with on average €5bn EU contribution and 14 partners per project

63 % of the funding spent in Pillar II (Industrial Leadership) given to projects with EARTO members

51 % of the funding spent in Pillar III (Societal Challenges) given to projects with EARTO members

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