EUROPEAN ASSOCIATION OF RESEARCH AND TECHNOLOGY ORGANISATIONS

EU R&I POLICY & DATA-DRIVEN DECISION MAKING

Knowing your innovation ecosystem actors: data on European RTOs

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1. Introduction

Europe's economic ranking is changing rapidly. Many estimate that by 2050 Europe's share of world GDP will be half of todays. In order to secure its place among the most advanced economies, Europe needs to improve its economic performance. Two of the main drivers for growth are research and innovation. This is why impact and market-driven research are so important and why current policy discussions at EU level are concerned with improving Europe's innovation performance by building scale and scope in European research and technological capabilities.

In his letter to Carlos Moedas[1], new Commissioner for Research Science and Innovation, Jean-Claude Juncker, the new President of the European Commission, asked for "*more applied research, with a greater participation of the private sector and a special focus on SMEs, in particular in Horizon 2020, with a view to reinforcing our industrial leadership and our capacity to address societal challenges*", and also to "*maximize the value-added and impact of Horizon 2020, assuring effective use and dissemination of project results.*"

European Research & Technology Organisations (RTOs) will be great supporters of EU innovation policy in order to achieve such targets thanks to their long experience of collaboration across the whole value chain means: RTOs are ideally suited to manage existing and build new ecosystems and clusters that are driven by value chains.

In its paper on the Innovation Union[2], the European Commission quotes Eric Emerson Schmidt, Google's 2001-2011 CEO, who said: "*We want to change the way leaders take decisions in governments and society, let's start by embracing data-driven decision-making*".

Data-driven decision-making is indeed what is needed for policy to be realistically adapted to the context and the actual needs of the sector it affects. How is Europe doing in terms of research, development & innovation (RD&I) performance and investments? Data is clearly available today on universities – also on their education activities. Data is well available on industry and its private investments on research & innovation. Data is also available on Member States' public spending on research & innovation. However, data is desperately lacking when it comes to RTOs. It is only with a complete picture of the European innovation ecosystem that Europe's RD&I policies can expect to be comprehensive, well targeted and effective.

To work efficiently, EU RD&I decision-makers require more public and independent information on the more than 350 existing European RTOs regrouping a pool of more than 150 000 researchers. Statistical data needs to be collected not only by EARTO or WAITRO as an EU or international RTOs association but also by public authorities. This will enable realistic and independent evaluation of what are the capacities of RTOs and to what extent they actually support public and industrial innovation. It is clear that RTOs are essential actors contributing to key objectives set up by the European Commission – an impactful Horizon 2020 Programme and a functioning and effective European Research Area. This need for statistical data is crucial to evaluate the impact of the RTOs sector today in order better understand how to further mobilize their capabilities to improve EU's innovation performance.

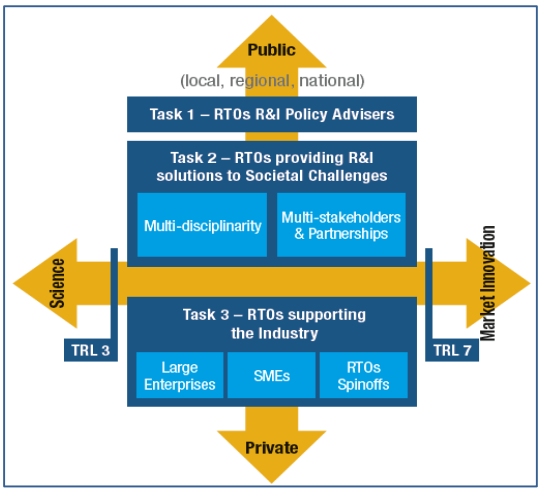
EARTO thus strongly encourages EUROSTAT, the OECD and the European Commission to rethink the way they categorize RD&I actors and to start collecting specific and robust data on European RTOs.

[1] Mission letter to Carlos Moedas, Commissioner for Research Science and Innovation, Jean-Claude Juncker, November 2014
[2] Innovation Union: A pocket guide on a Europe 2020 initiative, DG RTD, European Commission, 2013

2. The distinctive mission of RTOs

RTOs are diverse and constantly evolving RD&I actors, this is also one reason why data on RTOs have not been collected so far as well. However, despite their heterogeneity and various legal forms, RTOs share functional specificities that distinguish them from other RD&I organisations. Statistically speaking, RTOs now require a unique definition and a set of robust data to be built up, reflecting their specific function in EU innovation ecosystems and value chains.

Figure 1: Understanding RTOs activities

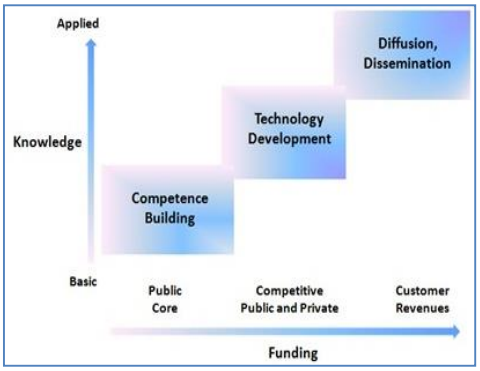


European RTOs' core mission is to harness science and technology in the service of innovation for public bodies and industry, to improve the quality of life and build economic competiveness in Europe. Thus, RTOs occupy a "hybrid" position between two different axes (figure 1). RTOs are neither public nor private; they support fundamental and close to market research with the aim to bridge the gap between basic science and market solutions. They are distinct from universities and enterprises but have close links with them, as well as with local, regional and national governments.

RTOs' operations and services are based on three main types of RD&I activities[3]:

- **Activities bringing the future** are typically funded without industrial sources but rather with basic funding (if available, supported by national/regional governments) and open institutional funding. RTOs have very strong links with their national and regional governments in defining strategic innovation plans and they collaborate closely with universities to harvest ideas from their basic research and bring them to higher Technology Readiness Levels (TRLs) as a result of applied research.

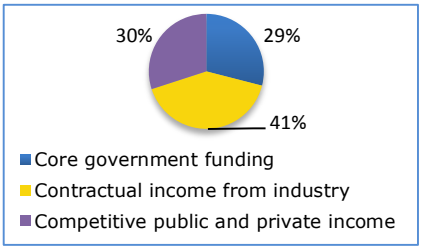
Figure 2: RTO three-stage innovation dynamic and funding model



- **Activities addressing the pre-competitive** are typically applied research programmes jointly funded with 40-70% external funding. They provide short-term return on investments and are tailored to relevant funding and competition rules. These RD&I activities are performed through collaborative projects under regional, national or European competitive calls. RTOs will automatically partner with industry as well as any other stakeholders to maximize impact and dissemination of research results.
- **Activities addressing the immediate** are typically based on research contracts with 100% external funding. Here, RTOs provide immediate added value and foster knowledge dissemination with access to validation, testing and certification. In close to market applications, clients are typically industry, although partnerships with regulators are not unusual. These activities are the core business of RTOs, where an in-depth understanding of the industry is key. In this context "industry" includes large, medium and small companies both in the RTO's country of origin and abroad.

RTOs distinctive mission is further reflected in their three-fold funding scheme that is broadly correlated with their three-stage innovation dynamic (figure 2). In recent years, the share of core-government funding in European RTOs' budget tended to decrease while contractual income from industry tended to increase (figure 3, data collected by EARTO).

Figure 3: EARTO members average funding scheme (2013)



RTOs' mission, organisation and business model have a significant impact on how RTOs respond to EU RD&I policy. The first step to properly leverage RTOs' role in the construction of the ERA is thus to better understand RTOs' specificities by thoroughly collecting statistical data on the sector. This will allow to have a complete and realistic picture of their size and impact in Europe. Today such data is lacking.

[3] EARTO Recommendations for Future EU Innovation Policy, EARTO, 2014

3. Lack of European statistical data on RTOs

3.1. OECD & EUROSTAT data: 4 institutional sectors performing R&D

In their statistical analysis on research & development, the OECD[4] and EUROSTAT[5] both consider four main institutional sectors where R&D is performed:

- **The business enterprise sector** (BES)
- **The government sector** (GOV)
- **The higher education sector** (HES)
- **The private non-profit sector** (PNP) which covers *"non-market, private non-profit institutions (NPI) serving households (i.e. the general public) and private individuals or households. These provide individual or collective services to households either without charge or at prices that are not economically significant. They include NPIs such as professional or learned societies, charities, relief or aid agencies, trades unions, consumers' associations, etc."*

This map of the R&D performing organisations clearly fails to take into account the specific nature of RTOs, which often fall in-between existing categories, not having its own.
Moreover, classifying RTOs in one of these four categories is a challenge on its own since:

- they are not part of the business enterprise sector since their objective is not to make commercial profit, even though they may have a business legal setting,
- they cannot be included in the Higher Education sector since RTOs' main mission is not education but to provide research and innovation services,
- they cannot be included in the government sector since the non-competitive public part of RTOs' income represents less than half of their funding schemes, the rest being contractual income from industry and competitive research programmes,
- and finally, RTOs are not fully included in the private non-profit sector because even though RTOs have a public non-profit mission and employ their revenues to fund new innovation cycles, they may have a business legal setting.

To help with the classification of R&D performing organisations, the OECD's Frascati Manual, whose last update dates back to 2002, proposes a decision tree for sectoring R&D units[6] (figure 4). However, the questions asked in this decision-tree to determine into which category an organisation should be included fails to take into account the functional specificities of RTOs. Indeed, reducing the decision to the way an organisation is controlled and financed by another actor cannot encompass RTOs since their funding model includes various sources of income and their legal setting can be the one of a public authority or of a business enterprise[7]. Since the main objective of the OECD and EUROSTAT in regards to research and innovation is to provide policymakers and other actors with a clear and realistic picture of innovation ecosystems, it seems therefore time in the current new update of the Frascati Manual to look at the way research performing organisations are categorised and classified.

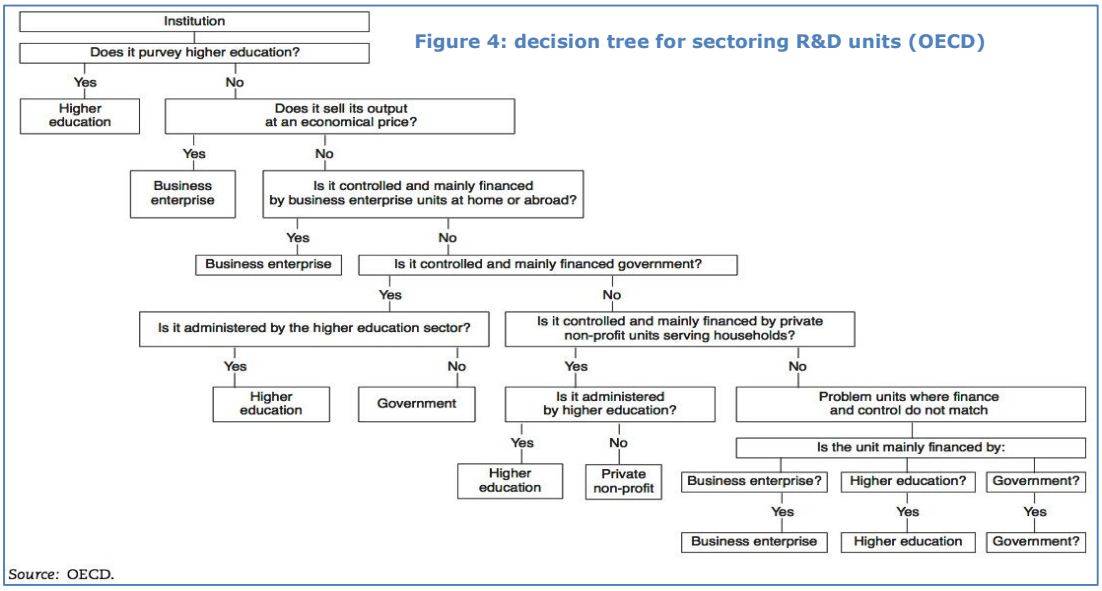


Figure 4: decision tree for sectoring R&D units (OECD)

Source: OECD.

[4] Main science and technology indicators, Volume 2013, OECD, 2013
[5] Science, technology and innovation in Europe, 2013 edition, EUROSTAT, 2013
[6] Frascati Manual: Proposed standard practice for surveys on research and experimental development, OECD, 2002
[7] EARTO Report on the Implementation of the ERA MoU signed between EARTO and the EC, 17 July 2012, EARTO, 2013.

3.2. OECD Innovation Policy Platform: 4 types of research organisations not used in data collection so far

The Innovation Policy Platform of the OECD[8] has published in 2011 an article studying Public Research Organisations that where divided into four ideal-types, as shown in figure 5.

Figure 5: Ideal types of Public Research Organisations (OECD)

Ideal types	Status	Main focus	European examples
Mission oriented centres (MOCs)	Owned and sometimes run by government departments or ministries at the national or sub-national level	Perform research in specific topics or sectors, and support policy making	National research centres specialised in energy and environment (CIEMAT in Spain), health (INSERM in France), etc.
Public research centres and councils (PRCs)	Overarching institutions of considerable size	Perform (and sometimes fund) basic and applied research in several fields	CNRS in France, CNR in Italy, CSIC in Spain, Max Planck Society in Germany, etc.
Research technology organisations (RTOs)	Also known as industrial research institutes, Often in the semi-public sphere, not for profit.	Link research and private sector innovation; transfer of S&T to the private sector and society	Fraunhofer Society in Germany, TNO in the Netherlands, VTT in Finland, Tecnalia in Spain, SINTEF in Norway
Independent research institutes (IRIs)	Semi-public founded under different legal forms, at the boundaries between the public and private sector	Perform basic and applied research focussed on issues or problems	"Centres of excellence", "cooperative research centres"; "engineering research centres", CNIO in Spain

This classification is not optimal: the distinction between the IRI and the RTO category is not yet well defined and the distinction between the 4 categories remains unclear. So far, the OECD has not been using this categorisation to collect data. The OECD has only used its first categorisation where the "private non-profit sector" category seems to be the closest to RTOs.

3.3. Technopolis: 3 types of research organisations for data collection

In 2010, Technopolis stressed that one of the reasons why research organisations "*do not occupy the place they deserve*" in research and innovation policy discussions is because they are treated indistinctly in a sort of "*bucket category that contains many heterogeneous things*"[9]. Even though some multidivisional organisations could be included in different sub-categories, Technopolis Group has defined three types of research organisations as shown in figure 6.

Figure 6: Ideal types of research organisations categories (Technopolis)

Ideal types	Status	Main focus	European examples
Scientific Research Institutes	Origins in Research councils or Academies of Science. Both research funding & performing. Very high proportion of core funding in their income.	Tend to do fundamental or applied science, largely do the same kind of research as universities.	Max Planck institutes (Germany), CNRS (France), national academies of science in new member states.
Government Laboratories	Can be referred to as "sector institute", generally state-owned. High part of income from the ministry whose policy mission they support.	Focus on producing public goods to meet knowledge needs of the state & society. They deliver services and policy-relevant information to government.	Nuclear research, marine institutes, and metrology, etc.
Research technology organisations (RTOs)	"Applied research institutes", originating from testing laboratories and product & process developers for industry. Earn greatest part of funds competitively. Use public funds to create the knowledge & capabilities needed to support customers.	Tackle the needs of industry for knowledge related services. Focus on user or problem-oriented research for the benefit of society. Assume some of the risks of industrial innovation, helping companies go beyond what they would be able to do based on their technological capabilities.	Large scale examples include Fraunhofer in Germany, VTT in Finland, TNO in the Netherlands, but there are also smaller and more specialised institutes.

This classification has some similarities with the one from the OECD's Innovation Policy Platform. Technopolis' "scientific research institutes" and "government laboratories" categories can be respectively linked to OECD's "public research centres" and "councils and mission oriented centres" categories. However, Technopolis presents a more coherent classification since it does not differentiate RTOs from "independent research institutes" like in the OECD table. Technopolis' three subcategories of research institutes could thus be used by the OECD and EUROSTAT to gather more precise statistic data about RTOs in view of having a complete statistical picture of the European Research Area.

[8] Actor brief on public research organisations (PROs), OECD Innovation Policy Platform, 2011
[9] Research Institutes in the ERA, Technopolis Group, 2010

3.4. European Commission: RTOs not taken into account in the measurement framework of the Innovation Union Scoreboard

The statistical data used by the European Commission's DG GROW to measure innovation is mainly taken from EUROSTAT. It differs from the data available in the contract database of DG R&I used for EU funding Programmes, thus failing to take into account the added-value provided by RTOs.

The annual Innovation Union Scoreboard of DG GROW provides a comparative assessment of the research and innovation performance of the EU Member States and the relative strengths and weaknesses of their research and innovation systems. It helps Member States to assess areas in which they may need to concentrate their efforts in order to boost their innovation performance.

The measurement framework used in the Innovation Union Scoreboard distinguishes between 3 main types of indicators and 8 innovation dimensions, capturing in total 25 different indicators[10].

- The Enablers capture the main drivers of innovation performance external to the firm and cover 3 innovation dimensions: human resources; open, excellent and attractive research systems; as well as finance & support.
- Firm activities capture the innovation efforts at the level of the firm, grouped in 3 innovation dimensions: firm investments; linkages & entrepreneurship; and intellectual assets.
- Outputs cover the effects of firms' innovation activities in 2 innovation dimensions: innovators and economic effects.

It is quite clear that this measurement framework fails to take into account the size and efficiency of the national RTO sector as a specific indicator to measure the innovation capacities of a country. The next update of the Innovation Union Scoreboard should look into such issues.

4. Importance of European RTOs

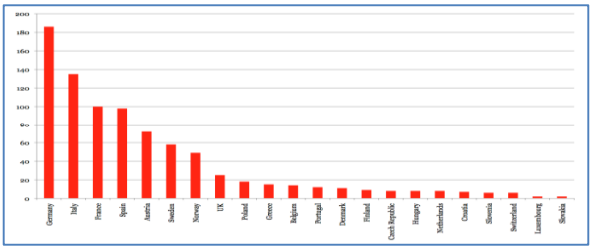
Despite the lack of robust data, various studies have clearly demonstrated RTOs' key contribution to Europe's innovation chain.

4.1. RTO sector estimated size

In 2014, EARTO launched a survey to collect data from its members based on their 2013 Key Performance Indicators[11] (KPI) and their available financial and activity reports. The results of the survey have shown that EARTO represents around 350 RTOs from 23 European and associated countries (here there are surely more RTOs than EARTO members: EARTO membership is representative but not exhaustive), with an annual turnover of more than €23 billion and over 150 000 researchers, engineers and technicians. These figures are reasons enough to further study RTOs by starting retrieving proper public and independent statistics.

Over the years, several estimations have been made on EU RTOs. Accordingly, in 2002, the EUROLABS inventory of research institutes[12], thus not limited to RTOs, counted 754 institutes in Europe. Another survey made in 2008[13] shows that the largest 151 European research institutes employed about 293 000 people and had a total income of some €31 billion.

Figure 7: Number of RTO institutes per country



Finally, Technopolis in its 2010 fact-finding study about the impact of European RTOs[14], estimated the size of the sector between 697 and 849 institutes in Europe (figure 7), collectively turning over about €18,5-23 billion annually. The size of EARTO's membership along with the outcome of these past studies show that RTOs have their place in OECD & EUROSTAT statistical efforts.

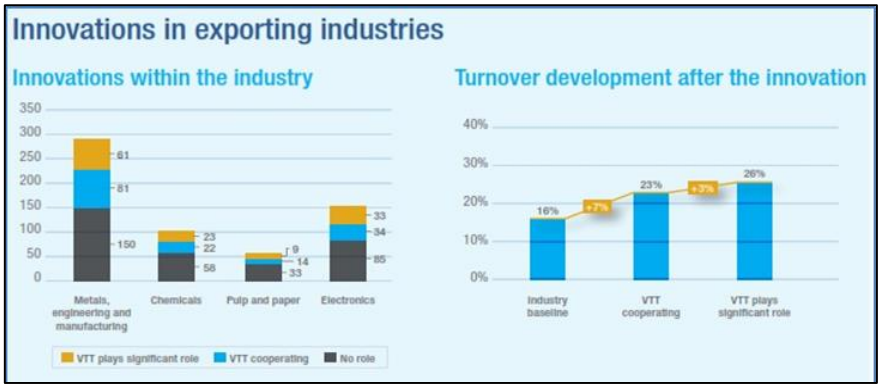
[10] Innovation Union Scoreboard 2014, *The Innovation Union's performance scoreboard for Research and Innovation,* European Commission, 2014
[11] EARTO Recommendations for Future EU Innovation Policy, EARTO, 2014
[12] *A comparative Analysis of Public, Semi-public and Recently privatised Research Centres*, Manchester University, Prest, 2002
[13] Co-ordination and co-operation – non university research performing organisations, Lyngby, Cowi, 2008
[14] *Impact of European RTOs: a study of social and economic impacts of Research and Technology Organisations*, a report to EARTO, Technopolis group, 2010

4.2. RTOs high impact

The European Commission has shown that European countries where the level of investment in R&D was the highest in Europe were also the most resilient during the 2009 economic downturn[15]. A recent Dutch study has indeed shown that for each euro invested in R&D, a cumulated average effect of 2.3 euro extra GDP would be incurred over the years. It is important to underline that in many European countries, better economic performance during the crisis could also be attached to RTOs activities as they account for almost half of Europe's expenditure on R&D[16].

In recent years, the RTO-industry partnership has had significant impact on industrial performance. A recent study by VTT in Finland showed that when VTT contributed significantly to an industry innovation, the industry turnover after the innovation increased considerably: by 10 percentage points (figure 8). VTT study presents just one example among several of the important impact of RTOs on the economy. Achieving impact in economic and social terms is high on RTOs strategies due to their national/regional mandate. Most RTOs report to their national/regional supervising authorities using a wide range of KPIs such as the turnover coming from industrial contracts, the number of new spin offs, the elaboration of long-term partnerships with industrial companies and with universities, the number of first patent fillings, etc.

Figure 8: Impact of VTT's role in the innovation of export industries



Accordingly, in its survey launched to collect data from its members based on their 2013 KPIs, EARTO collected such data which showed the following key figures on their links with industry:

- 150 000 industrial clients of which over 60% are SMEs
- 86% average customer satisfaction

And some other interesting figures to be added to their partnerships with universities:

- 23 000 peer-reviewed papers
- 8000 PhD projects guided or (co)funded
- 11% of employees fulfilling a part-time university research position

In 2008, Oxford Economics estimated the economic impact of RTOs as being of 4.1 billion euro per year[17] for the UK only. In 2010, to assess the economic impact of the RTO sector at EU level, the Technopolis Group considered four components of economic impact[18] (using wide and narrow definitions of RTOs). The data showed that the economic impact of European RTOs would be between €25 billion and €41 billion annually (figure 9).

Figure 9: Economic impact of European RTOs (Technopolis 2010)

Component of Impact	Economic Impact wide definition	Economic Impact narrow definition
A "direct" component, representing the contribution of RTOs to GDP	€12,2 billion	€9,8 billion
An "indirect" component, which incorporates the dependence on the RTOs of their suppliers and users of their outputs	€10,8 billion	€8,7 billion
An "induced" component representing Keynesian-type "multiplier" effects, whereby expenditures by RTOs and their employees stimulate activity in other sectors	+/- €4,6 billion	+/- 3,7 billion
A "social return" component, representing the return to R&D investments, including "spill-over" to other sectors of the economy	€12,9 billion	€10,4 billion
TOTAL IMPACT:	**€31,3-40,5 billion**	**€25,2-32,6 billion**

These studies estimate RTOs' impact to be significant in Europe. In this context, raising robust statistical data on RTOs seems largely justified.

[15] Communication from the Commission: Research and innovation as sources of renewed growth, European Commission, 2014
[16] Research Institutes in the ERA, Technopolis Group, 2010
[17] Study of the impact of the intermediate Research and Technology sector on the UK economy, Oxford Economics, 2008
[18] Impact of European RTOs: a study of social and economic impacts of Research and Technology Organisations, a report to EARTO, Technopolis group, 2010

4.3. RTOs as key actors of EU funding programmes

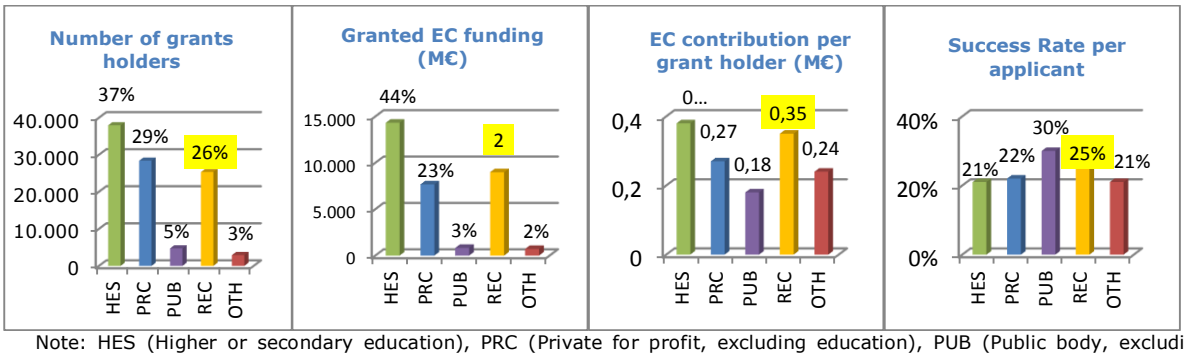
Data from the European Commission own contacts database has shown that RTOs are also actively involved in EU RD&I Framework Programmes (FPs). The European Commission collects data on the participation of beneficiaries to its Framework Programmes via its ECORDA database. The data on beneficiaries is collected according to the following classification scheme[19]:

- Higher or secondary education (HES)
- Private for profit (excluding education) (PRC)
- Public body (excluding research and education) (PUB)
- Research organisations (REC)
- Other (OTH)

Most RTOs are falling under the REC category. The ECORDA database can therefore provide a good overview of the characteristics of the RTO sector. However, apart from collecting information on the programmes themselves, the database is not currently used to extract other public data and can only give an indication of the participation of registered contractors.

It is important to note that between 2007 and 2012[20], research organisations (REC) accounted for 26% of all grants holders and received 28% of granted EC funding. Moreover, the Commission's contribution to research organisations per grant holder is one of the highest since each REC grant holder received on average €350k. The REC group was the second most successful with a success rate per applicant of 25% (Figure 10).

Figure 10: Research organisations' participation to the 7th framework programme



Note: HES (Higher or secondary education), PRC (Private for profit, excluding education), PUB (Public body, excluding research and education), REC (Research organisations), OTH (Other).

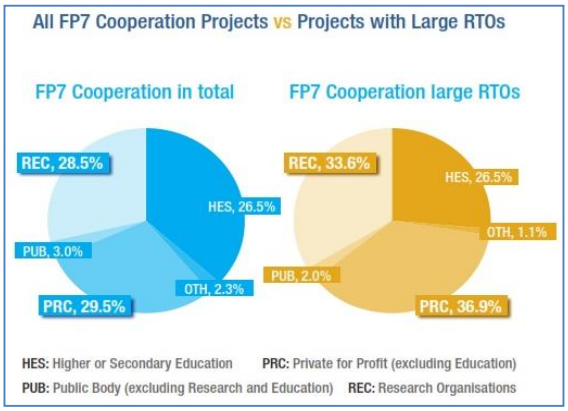
The EC Sixth Monitoring report of FP7[21] has also shown that RTOs occupy the first positions in the overall FP7 ranking in terms of participation while EARTO members are very well represented in the top positions of the REC category (figure 11).

Figure 11: Research organisations' participation ranking in the 7th framework programme

REC Rank	Overall rank	Organisation	Partici-pations	RTO member of EARTO
1	1	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	1189	No (FR)
2	2	FRAUNHOFER-GESELLSCHAFT	889	Yes (DE)
3	4	CONSIGLIO NAZIONALE DELLE RICERCHE	556	No (IT)
4	5	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	550	Yes (FR)
5	6	MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	540	No (DE)
6	7	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	528	No (ES)
7	14	TEKNOLOGIAN TUTKIMUSKESKUS VTT	347	Yes (FI)
8	15	INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE (INSERM)	332	No (FR)
9	16	DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV	327	No (DE)
10	17	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK	303	Yes (NL)
11	25	JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	259	Non (EU)
12	26	FUNDACION TECNALIA RESEARCH & INNOVATION	258	Yes (ES)

[19] FP7 Sixth Monitoring Report, DG Research and Innovation, European Commission, 2013
[20] Ibid. *No official data for 2013 has been made public by the European Commission up to the publication of this report.*
[21] Ibid.

ECORDA data for FP7 showed that participation of RTOs in FP7 is positively correlated to the involvement of industrial partners in such EU funded projects. The average industrial involvement in FP7 projects increases to 36.9% when RTOs' participation is at its best (figure 13). As reliable data shows, RTOs are and will continue to be essential actors for the success of EU RD&I funding programmes. And will support industrial participation to those programmes.



5. Conclusion

In the current debate on the stronger need for data-driven and evidence-based policy-making, we hope that EARTO call for developing better data collection on RTOs will be heard. Today, the picture drawn by currently available statistics fails to accurately reflect the reality of Europe's innovation ecosystems and neglects RTOs and their importance for the effective functioning of our innovation ecosystems and value-chains. Data on RTOs is today desperately lacking from reliable and independent sources such as the OECD, EUROSTAT and European Commission Innovation Union Scoreboard.

Accordingly, EARTO strongly recommends EUROSTAT, the OECD and the European Commission:

1. To urgently rethink the way they categorize RD&I actors in their statistics;
2. For the OECD especially, to insert such need in their current update of the Frascati manual and its definitions/decision trees so as to properly collect data on RTOs;
3. To start collecting specific data on European RTOs as soon as possible, including by means of surveys, in order to allow for proper decision-making regarding EU innovation policy.

EARTO remains at the disposal of the OECD, EUROSTAT and the European Commission to further discuss how to implement such recommendations.