



Economic footprint of 9 European RTOs

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EXECUTIVE SUMMARY

THE ECONOMIC FOOTPRINT OF 9 EUROPEAN RTOs IN 2014

RTOs primarily aim to generate a scientific and/or technological impact in society. However, their activities also leave a so-called 'economic footprint' – an impact that is much less known and documented. The focus of this study is to specifically highlight the economic footprint of RTOs' activities, based on information from 9 European RTOs, members of EARTO.

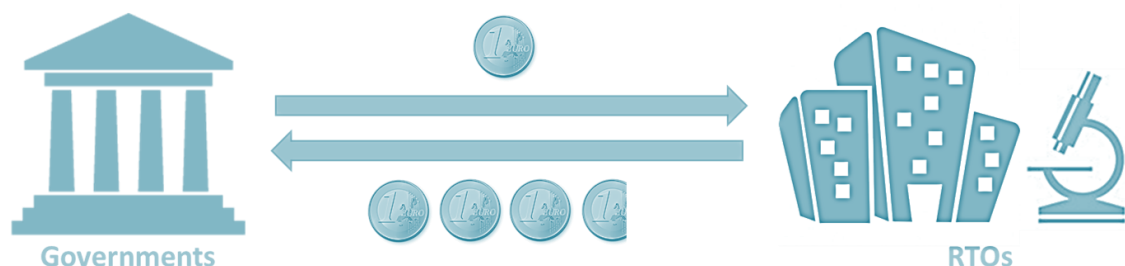
In the analysis, we focus on two types of activities that are expected to generate a strong economic impact:

- ▶ the economic leverage of the RTOs' core activities through spending and employment;
- ▶ the economic leverage of the knowledge transfer through bilateral contract research and spin-offs.

Although we are well aware of the fact that the total economic footprint of RTOs goes beyond the above mentioned effects, we have consciously chosen a conservative estimation of the economic footprint, to avoid double-counting (and thus overestimations). The analysis results in objective and robust observations on the economic effect of RTOs on the European economy – results that can be quoted as a lower boundary.

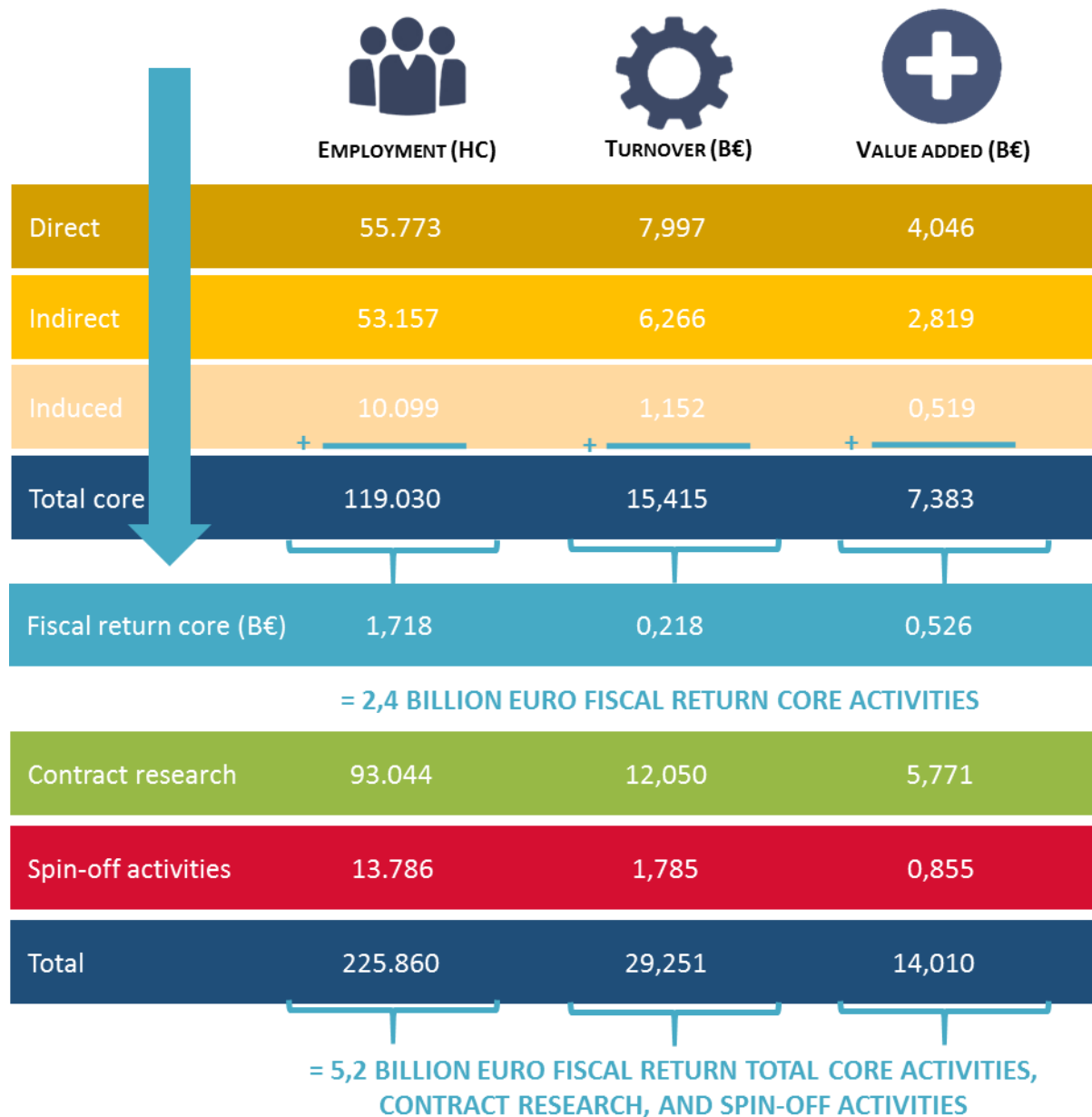
As a result of our analysis, we find that:

- ▶ **A total of 225.900 jobs in head counts (HC) (equivalent to 194.700 full-time equivalents (FTE)) that can be linked to the activities of the 9 RTOs included in this footprint were created in the European economy in 2014, corresponding to a total turnover of 29,3 billion euro and a total value-added of 14,0 billion euro:**
 - Over 119.000 HC jobs (or 102.600 FTE) in Europe in 2014 stem from the **core activities** of the 9 largest RTOs, corresponding to a total additional turnover of 15,4 billion euro and a value added of around 7,4 billion euro. The "value added" is defined as direct turnover, including the operational grant, minus the cost of the goods sold.
 - The **bilateral contract research** that RTOs engage in created a total value of over 5,8 billion euro at the side of the receivers of the knowledge transfer in 2014. This value creation resulted in another 93.000 HC jobs or 80.200 FTE jobs that can be linked to the RTOs' activities.
 - Similarly, the **spin-off activities** of 7 RTOs led to the creation of 13.800 HC jobs or 11.900 FTE in Europe in 2014, partly directly in the spin-offs, partly at their suppliers and partly in the broader economy thanks to additional consumption by the first two groups.
 - This is a lower boundary to the total economic leverage effect, which would take into account all other types of impact (technological, social, tourism, human capital development, etc.).
- ▶ **For each job in the RTOs, another 3 jobs are created elsewhere in the European economy (on top of the 1 direct job in the RTO).**
- ▶ The operational grants received by the RTOs in this study, are earned back by national governments through fiscal return mechanisms. **For each euro invested in the form of operational grants, almost 4 euro flow back to the national governments.** The total fiscal return adds up to 5,2 billion euro (core activities, contract research, spin-offs activities), of which 2,4 billion euro stems from the RTOs' core activities.





The table below summarises the key results from this economic footprint study of 9 RTOs in Europe (with HC=head counts and B€=billion euro). The quantification of the economic footprint of RTOs in Europe demonstrates the RTOs' as well as EARTO's value for the economy and society in Europe.





INTRODUCTION

As an international non-profit association, EARTO represents the interests of 350 Research and Technology Organisations (RTOs) in the European Union and FP-associated countries. It has 90 direct members, some of which represent several RTOs.

EARTO's mission is:

- *"to 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 R&D and innovation programmes are best attuned to their interests;*
- *to provide added-value services to EARTO members to help them to improve their operational practices and business performance*
- *to provide them with information and advice to help them make the best use of European R&D and innovation programme funding opportunities."*

RTOs are considered to be important technology transfer agents in the national innovation systems. In 2005, the European Research Advisory Board (EURAB) concluded¹ that *"Research and Technology Organisations (RTOs) are distinctive, mission-oriented R&D organisations which perform key functions in European innovation systems and which exhibit characteristic strengths."* EARTO defines RTOs as organisations with the *"core mission to harness science and technology in the service of innovation, to improve quality of life and build economic competitiveness."*

² RTOs thus distinguish themselves from universities, whose predominant activity is education, and from enterprises, whose predominant activity is the production and sales of goods and services.

RTOs have a distinctive role in research collaboration with industry, and in particular with small and medium size enterprises (SMEs)³. Also in regional research and innovation, and in smart specialisation, RTOs are driving and/or steering actors. They *"occupy nodal positions within innovation eco-systems, bringing together key players across the whole innovation chain [...]"*⁴. In this sense, their contribution to the realisation of the European Research Area (ERA) is acknowledged⁵.

To support EARTO in its mission to reinforce the profile of RTOs in Europe, IDEA Consult has estimated the economic footprint of 9 of its largest RTO members.

The methodology is based on the classic input-output approach, combined with micro-data input from the RTOs. The advantage is that direct economic effects are exact and that the quantification of the indirect effects is based on the RTO-specific data rather than on sector averages. Both elements benefit the accuracy of the results.

In addition to the direct and indirect economic effects, also induced impact (the effect of additional direct and indirect employment leading to extra consumption in the local economy) and fiscal return (the return for the governments via fiscal flows originating from direct, indirect and induced impacts) are calculated.

Particularly interesting are the leverage effects we see arising from the economic footprint results: what is the additional employment in the European economy that can be related to one person employed at an RTO? If grants are received, how many euros flow back to governments for each euro they invest in the daily operations of RTOs?

This economic footprint assessment is further complemented with a number of indicators on the scientific and technological activities of these 9 RTOs. For this report, the focus is put on two forms of knowledge transfer and

¹ European Research Advisory Board (EURAB) Final Report, Research and Technology Organisations (RTOs) and ERA: https://ec.europa.eu/research/eurab/pdf/eurab_05_037_wg4fr_dec2005_en.pdf

² Website EARTO: <http://www.earto.eu/about-rtos.html>

³ See for example Albers-Garrigós J., Rincon-Diaz C. A. & Igartua-Lopez J.I. (2014). Research technology organisations as leaders of R&D collaboration with SMEs: role, barriers and facilitators, Technology Analysis & Strategic Management, 26(1), 37-53.

⁴ Website EARTO: <http://www.earto.eu/about-rtos.html>

⁵ European Research Advisory Board (EURAB) Final Report, Research and Technology Organisations (RTOs) and ERA: https://ec.europa.eu/research/eurab/pdf/eurab_05_037_wg4fr_dec2005_en.pdf



knowledge conversion that typically have a strong economic impact: public or bilateral research projects and spin-off creation.

The quantification of these largely unknown economic effects is an important value added in the demonstration of RTOs' and EARTO's value for the economy and society in Europe.

In the underlying report, we present the methodology and results of the economic footprint of the 9 European RTOs. We first define the scope and outline the methodological framework of the study in Part 1. Next, we guide the reader through the methodology for the economic footprint (Part 2) and for the economic evaluation of scientific/technological activities (Part 3). In these parts of the report, we also present the detailed results of each step. In Part 4, we compare the results to existing studies and data as a benchmark and in Part 5 we synthesise the results and formulate our conclusions.

As we explain in part 1 on the scope of this study, we are aware that we do not measure the full impact of RTOs in Europe - which would be scientific and technological in the first place. Instead we focus on the footprint that their activities generate throughout the European economy. To fully grasp the meaning of the results, it is interesting to situate and compare them with results from other existing footprint and impact studies in the field (mainly for universities, and occasionally for individual RTOs). In many cases, however, the methodology or parameters applied are responsible for different outcomes and it is important to understand these to the full extent before considering the existing material as a reference or benchmark. We will guide the reader as much as possible in the comparison of our results with these existing studies (Part 4).



PART 1: Framework and Scope



1/ Objectives

Despite the general recognition of the relevance and importance of RTOs for the scientific community, as well as for companies and society at large, the impact of RTOs' activities in the European economy or the economic value of technological spillovers to the European industry, have not been mapped before. With the study at hand, EARTO aims to demonstrate the economic footprint of RTOs in Europe in the period 2013-2014.

Economic impacts are generally defined as the effects of an event, organisation, policy, etc. on the economy in a specific area or region. An economic impact analysis measures the change in economic activity in case an 'event' occurs, compared to the situation where it does not occur (counterfactual). [In this study, we measure the economic effects of RTOs activities in the European Union, compared to a situation where RTOs would not exist⁶](#). Our economic footprint model is cost-based and measures output effects as the total increase in revenues in the economy, based on the costs or suppliers invoices of RTOs.

We account for:

- ▶ The economic leverage effects that RTOs generate via their day-to-day activities and their purchase of goods and services in the European economy;
- ▶ The economic leverage effects of RTOs as 'senders' of knowledge, in particular through bilateral contract research and spin-off creation.

2/ Framework

2.1 Dimensions of impact

It is a methodological choice in this study not to try to cover the full spectrum of dimensions of impact, but rather to focus on a detailed analysis of the two above mentioned activities with a strong economic impact. Nevertheless, to situate the analysis of the economic footprint in the right context, this section sheds a light on which other types of impacts and effects can be expected from RTOs, but these are not measured here.

Important to mention in this respect, is that 1) an RTO's mission is not necessarily economic but rather scientific/technological so that this analysis only grasps a specific dimension of RTOs' impact and; 2) many more dimensions of scientific and societal impact that one could (try to) translate into economic value are being realised in RTOs, such as cooperation, training, conferences and events, visitors (tourist impact), etc.

Without meaning to be exhaustive, Figure 1 below gives an overview of the outputs and impacts that can be expected in relation to the role and objectives of RTOs and their inputs⁷. Many are indeed related to their technological mission, and in particular to the transfer and conversion of knowledge: to have a technological impact in Europe, the results of research are further transferred to relevant knowledge receivers. These receivers gain more in-depth knowledge and apply or modify the knowledge to the specific needs of the economic or social framework, region or company. The following phases are distinguished in the process from research to innovation/commercialisation:

- 1) **Knowledge creation:** knowledge base and know-how built up over the lifetime of the RTO.
- 2) **Knowledge transformation and knowledge transfer:** transformation and transfer of knowledge through a variety of channels such as research collaborations with both academia and industry, publication, lectures, training, etc.
- 3) **Knowledge conversion:** reaching a diversity of knowledge receivers, who take up the knowledge and further apply it. For the receivers, the knowledge has a particular value as it entails the potential for innovation in the production process or product design.

⁶ In this, we do not take into account the operational grants that would be otherwise saved in the counterfactual situation.

⁷ Based on previous work by IDEA Consult and a review of existing studies.



Next to the primarily scientific/technological impact of RTOs, the following are also dimensions of the total impact of an RTO:

- Catalytic impact: The presence of RTOs in Europe is an important element in the location and collaboration decisions of many enterprises. Also the role of RTOs in the international research landscape and the overall ecosystem can be part of a catalytic impact assessment. The attractiveness and specialisation of a region in a specific field, combined with the technological and scientific cooperation of RTOs with both universities and industry, further supports regional (smart) specialisation.
- Human capital impact: Through employment, training and interaction with higher education, RTOs are expected to have a positive impact on the development of research capacity in Europe. Also the mobility of RTO personnel to other sectors in the economy, and in particular to industry, is considered a strong contribution to the European knowledge economy.
- Social impact: The social impact refers to the role that an RTO plays in supporting and informing the society at large through education, communication, interaction with the broader public, but also by addressing the societal challenges through research.
- Tourist impact: RTOs organise events, trainings, conferences that attract local but also international visitors to their region, who in turn consume in hotels, restaurants, transport, etc.
- Economic impact: Through its day-to-day activities, RTOs – as any other organisation – generate employment, value added and turnover. They buy from suppliers in the local (EU) economy, generating also additional turnover at these suppliers, and at these suppliers' suppliers and so on. The activities of RTOs thus also have a purely economic effect.

A typical characteristic of these different types of impact, is that they are in constant interaction with each other and consequently create a dynamic process. For example, an excellent reputation in R&D (technological effect) is reflected in the revenues from contract research (economic effect) and will stimulate further collaboration of European industrial and academic partners with the RTO and possibly international investments in the proximity of the RTO (catalytic effect). The presence of foreign top companies (catalytic effect) in turn gives a positive impulse to the knowledge creation process within the RTO (technological effect).

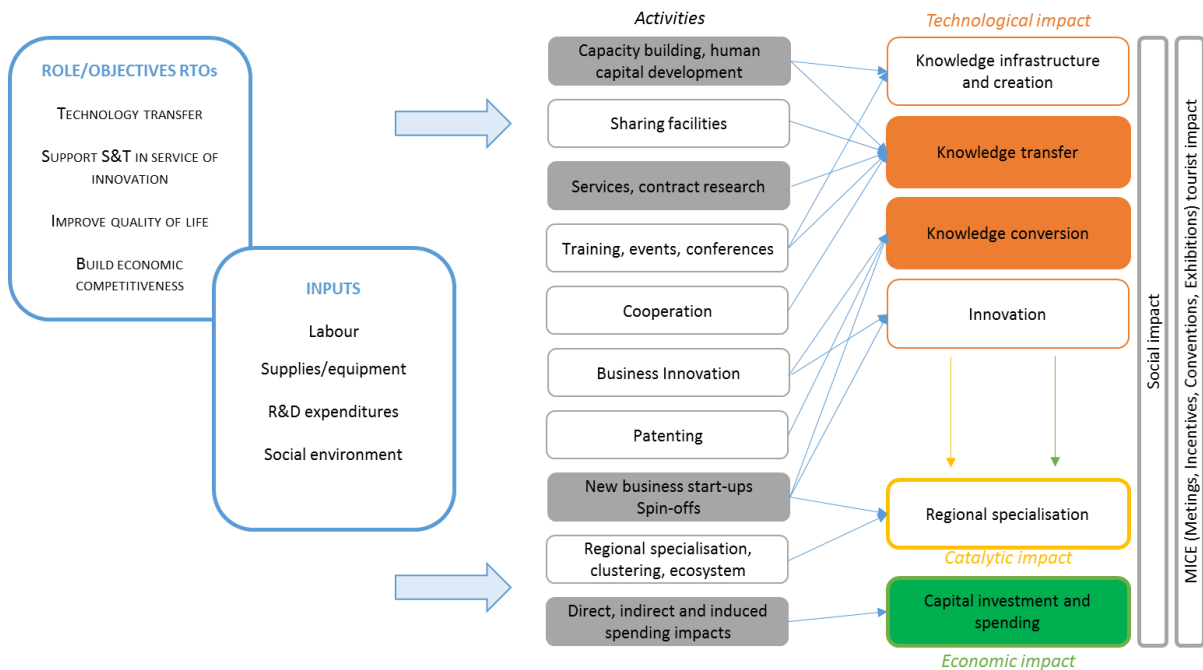
In underlying study, we will measure the economic footprint for 9 European RTOs related to those activities in the filled boxes in Figure 1: human capital development (employment, transfer of heads), contract research, spin-offs and spending impacts. Furthermore, the footprint concentrates on the economic effects of spending and on the economic effects of knowledge transfer and conversion through a selected number of channels. The focus of this study is thus not on trying to identify the full impact, which would be primarily scientific and/or technological. The focus is on demonstrating the economic value of RTOs in the European economy – a dimension much less known.

This choice was also a pragmatic one, in the first place to reduce the data requirements put upon individual RTOs. But also it is known that the further one moves away from traditional quantitative methods, the more results depend on hypotheses and assumptions and the less robust results turn out to be.

Therefore, our rather 'conservative' approach has the advantage that it avoids overestimations and results in objective and robust observations on the economic effect of RTOs on the European economy – results that can be quoted as a lower boundary and replicated.



Figure 1: Logic frame of expected outputs and impacts of RTOs

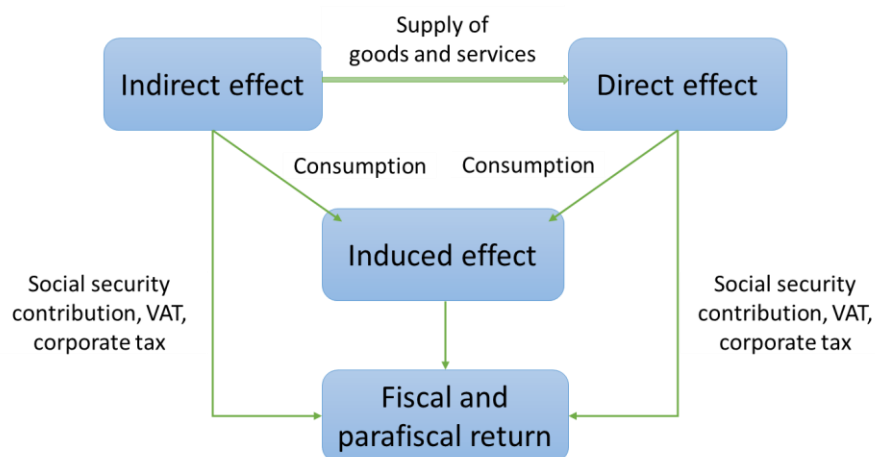


Source: IDEA Consult

2.2 Economic impact framework

As explained before, an economic impact analysis measures the changes in economic activity in a specific region in case an 'event' occurs, compared to the situation where it does not occur (counterfactual). *In this study, we measure the economic effects of RTOs activities in the European Union, compared to a situation where the RTOs would not exist⁸.* Our economic footprint model is cost-based and measures output effects as the total increase in revenues in the economy, based on the costs or supplier invoices of the RTOs. The framework is described in the following paragraphs and shown in Figure 3, the methodology is explained step-by-step in Part 2 of this report.

Figure 2: Analytical framework for the economic impact assessment



Source: IDEA Consult

⁸ In this, we do not take into account the operational grants that would be otherwise saved in the counterfactual situation.



Via its day-to-day activities, an RTO generates employment and economic added value. Often, this economic impact is only measured by means of the **direct effect** of research activities: employment, value added and output at the organisation itself. Yet, the total economic impact goes beyond this direct effect. Through upstream relations (with suppliers) and downstream relations (with client-users), an RTO creates an additional economic effect:

- RTOs buy goods and services from EU companies in a series of other industries. This in turn leads to additional employment and additional demand of these EU companies upstream. Such expanding impact of an RTO on the economy is what we call its **indirect economic effect**.
- The **induced economic impact** is created through the directly and indirectly created employment. RTOs' employees receive a wage higher than the social benefits at unemployment. This additional income is partly spent in the European economy through consumption of goods and services. Such spending generates additional upstream turnover and employment at the suppliers' side.
- Each of the above dynamics leads to a form of **fiscal and parafiscal return towards the respective governments** of EU countries where the RTO generates economic effects: the additional employment (direct, indirect and induced) leads to additional social security contributions in different EU countries; the additional production and turnover leads to additional VAT and corporate taxes. We value each of these effects and calculate the multiplier effect of the government grants in the RTOs with respect to this total return.
- Finally, the technological spillover effects of the RTO also create an economic leverage effect with its knowledge receivers through the valorisation of the technological knowledge into commercially viable activities. We will include two specific forms of knowledge transfer that typically have a substantial economic effect: bilateral contract research and the creation of spin-offs.



3/ Scope

3.1 Sample of RTOs

Nine of EARTO's largest members have participated in the study. They are listed in the table below and the next paragraphs provide a short description of each RTO's main activities.

Table 1: RTOs in the scope of the study

Belgium	imec	Interuniversitair Micro-Elektronica Centrum
Denmark	DTI	Danish Technological Institute
France	CEA	French Alternative Energies and Atomic Energy Commission
Finland	VTT	Technical Research Centre of Finland
Germany	Fraunhofer	Gesellschaft zur Förderung der angewandten Forschung
The Netherlands	TNO	Netherlands Organization for Applied Scientific Research
Norway	Stiftelsen SINTEF	Stiftelsen for industriell og teknisk forskning ved NTH
Spain	Tecnia	Fundación Tecnia Research and Innovation
Sweden	SP	Technical Research Institute of Sweden

► imec

In 1982 the Flemish Government set up a program in the field of microelectronics with the goal to strengthen the microelectronics industry in Flanders. The decision was inspired by the strategic importance of microelectronics for the industry, and by the major investments required to keep up with developments in this field. This program included setting up a laboratory for advanced research in microelectronics (imec), a semiconductor foundry (former Alcatel Microelectronics, now STMicroelectronics and AMI Semiconductor), and a training program for VLSI design engineers. The latter is now fully integrated in the imec activities.

Today, imec performs world-leading research in nanoelectronics. They leverage their scientific knowledge with the innovative power of their global partnerships in ICT, healthcare and energy. imec delivers industry-relevant technology solutions. In a unique high-tech environment, their international top-talent is committed to providing the building blocks for a better life in a sustainable environment.

Its staff of close to 2,000 people includes over 600 industrial residents and guest researchers. imec's research is applied in better healthcare, smart electronics, sustainable energy, and safer transport.

► DTI

The Danish Technological Institute, founded in 1906, is a self-owned and not-for-profit institution. They develop, apply and disseminate research- and technologically-based knowledge for the Danish and International business sectors.

The Institute participates in development projects, which are of use to society in close collaboration with leading research and educational institutions both in Denmark and abroad. On top of this, the Institute carries out consultancy and standardisation services, which contribute to a dynamic and harmonious development of society.

Their most important task is to ensure that new knowledge and technology quickly can be converted into value for customers in the form of new or improved products, materials, processes, methods and organisational structures. DTI works together with new and existing companies, either individually or in groups, on ways to enhance technological and management restructuring and efficiency, across a broad range of industries as well as in leading edge sectors.

Therefore, they focus on innovation and competitiveness, management and training, sustainable exploitation of resources and cost-effectiveness in company and society.



► VTT

VTT, Technical Research Centre of Finland, was founded in 1942. It produces research and innovation services that enhance the international competitiveness of companies, society and other customers and thereby creates prerequisites for society's sustainable development, employment and wellbeing.

VTT promotes the realisation of innovative solutions and new businesses by foreseeing already in the strategic research stage the future needs of its customers. VTT creatively combines its multidisciplinary expertise with the know-how of its partners. VTT also exploits global networking and the basic research results of universities in its services. Its activities are focused on three areas: 1) Knowledge intensive products and services, 2) Smart industry and energy systems and 3) Solutions for natural resources and environment.

VTT is impact-driven and from its wide multi-technological knowledge base, it can combine different technologies, produce information, upgrade technology knowledge, and create business intelligence and value added for its stakeholders.

► CEA

The CEA is the French Alternative Energies and Atomic Energy Commission (Commissariat à l'énergie atomique et aux énergies alternatives). It is a public body established in October 1945 by General de Gaulle.

There are two strands of activities in the CEA: civil activities and military activities. More specifically, it is active in four key areas: low-carbon energies (nuclear and renewable energies), defence and security, information technologies and health technologies. In each of these fields, the CEA maintains a cross-disciplinary culture of engineers and researchers, building on the synergies between fundamental and technological research.

The CEA is based in ten research centres in France, each specializing in specific fields. These CEA laboratories are located in 7 regions which give a strong regional identity and partnerships forged with other research centres, local authorities and universities.

CEA negotiates and implements scientific and technical cooperation agreements with international organizations in both the nuclear and non-nuclear research fields. It is also involved in implementing intergovernmental agreements between France and other countries in the nuclear energy field. Promoting and implementing bilateral agreements allows the French government to have the necessary elements to define its foreign policy in the nuclear area as well as to promote the international development of the French firms in partnership with the CEA. However, much of the international cooperation among scientists is spontaneous and many agreements are directly negotiated between laboratories and often include commercial relations.

► Fraunhofer Gesellschaft

Fraunhofer Gesellschaft zur Förderung der angewandten Forschung, is Europe's largest application-oriented research organization, founded in 1949. It promotes and conducts applied research in an international context to benefit private and public enterprise and is an asset to society as a whole. Their research efforts are geared entirely to people's needs: health, security, communication, energy and the environment. As a result, the work undertaken by their researchers and developers has a significant impact on people's lives.

By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their region, throughout Germany and in Europe. Their research activities are aimed at promoting the economic development of our industrial society, with particular regard for social welfare and environmental compatibility.

► TNO

TNO, the Netherlands Organisation for Applied Scientific Research, was founded by law in 1932 to enable business and government to apply knowledge. As an organisation regulated by public law, they are independent: not part of any government, university or company.

TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. This drives around 3,000 professionals at TNO in their everyday work.

The TNO strategy is a reflection of the trends they observe in society and technology. In close coordination with their stakeholders, TNO have defined five transitions on which they will focus. These are in line with the challenges and ambitions of the Top Sector policy and social themes in the Netherlands and the rest of Europe. The transitions can be summarised as follows:

- Industry: from economic stagnation to growth in high-technology industry
- Healthy Living: from illness and treatment to health and behaviour
- Defence, Safety & Security: from a wide range of threats to controllable risks
- Urbanisation: from urbanisation bottlenecks to urban vitality
- Energy: from conventional sources to sustainable energy systems.



► Stiftelsen SINTEF

Stiftelsen SINTEF is the largest independent research organisation in Scandinavia and was founded in 1950. Over the last 60 years, they have created value and innovation through knowledge generation and development of technological solutions that are brought into practical use.

Today, Stiftelsen SINTEF is a broadly based, multidisciplinary research institute with international top-level expertise in technology, medicine and the social sciences. It employs around 2,100 people of 70 different nationalities.

► Tecnalia

TECNALIA, Fundación Tecnalia Research and Innovation, was founded in 2011 as the result of a merger of eight smaller RTOs in 2011, all of them created in the 80's or earlier and located in the Basque Country.

Its mission is to transform knowledge into GDP improving people's quality of life by generating business opportunities for companies. It employs around 1,400 people and is active in 22 locations worldwide.

► SP

SP, Technical Research Institute of Sweden, is a leading international research institute. They work closely with customers to create value, delivering high-quality input in all parts of the innovation chain, and thus playing an important part in assisting the competitiveness of industry and its evolution towards sustainable development. SP was founded in 1920 in Sweden, Borås.

Their core expertise is paired with broad technical knowhow. They offer the combined expertise of the group in six business areas – efficiently and matched to their customers' needs. They assist you every step of the way, from initial idea to the marketplace.

3.2 Data coverage and quality

The data were collected by the 9 RTOs in the period June-July 2015. Table 2 gives an overview of the data requests and availability at the different RTOs.

In the end, all RTOs managed to deliver the requested data - sometimes in a more aggregated form. Only value added is missing in 3 cases. For the other indicators, this allowed us to work with the full scale coverage of the 9 RTOs throughout the analysis.

Where data were more aggregated or not available, we have used a simple extrapolation based on the remaining RTOs' aggregated data in order to come to the required level of detail. In some cases, the RTOs themselves suggested a rule of thumb based on their experience. We have carried out robustness checks on these rules of thumb (comparing with the aggregated data of the other RTOs), with good results.

The main assumption made in the extrapolations is that European RTOs have similar patterns concerning the international or intersectoral cooperation in bilateral contracts. Another assumption is that the employment in spin-off companies is more or less stable between 2013 and 2014, which is a reasonable assumption to make.

More detail on data quality and hypotheses are provided per indicator in the specific sections.



Table 2: Data coverage and quality

	imec	DTI	CEA	VTT	Fraunhofer	TNO	Stiftelsen SINTEF	TecNALIA	SP
<i>SCOPE</i>	<i>imec Belgium</i>	<i>Entire organisation</i>	<i>Both civil activities and military activities included. Bilateral contract research only includes the civil activities.</i>	<i>Parent company</i>	<i>German parent company (one legal entity) Bilateral contracts abroad include revenues of subsidiaries outside Germany.</i>	<i>Parent company (Organisation of TNO)</i>	<i>Entire organisation</i>	<i>Entire organisation</i>	<i>Entire organisation</i>
Employment	X	x	x	x	x	x	x	x	x
Turnover	X	x	x	x	x	x	x	x	x
Value added	X	x	NA	NA	NA	x	x	x	x
Operational grant	X	x	x	x	x	x	x	x	x
Purchase data	X	x	x	x (limited sector distribution)	x	x	x	x (limited sector distribution)	x (rule of thumb based on 80% of purchases, limited sector distribution)
Government funded research	X	x	x	x	EU funding aggregated (instead of per type of project)	x	Only 2014	x	x
Bilateral contract research	Type of contractor NA	x	x	SME indication NA	x (approximation share SME)	Region and type of contractor outside EU NA	Only 2014; SME indication NA	x	Type of contractor for foreign contractors NA
Spin-offs	X	x	Only 2013 employment data	x	Only recent spin-offs (started 2013-2014); only HC; only 2013 employment data	x (includes also subsidiaries)	x	x	x



3.3 Points of attention with respect to this footprint study

Important when reading the results is to keep in mind the activities that are included or excluded from the analysis:

1. The analysis focuses on the **economic footprint of the core activities** of the 9 RTOs. A list of the coverage and 'definition' of each RTO is provided in section 1.3 of Part 1.
2. Two types of technological activities are included as an illustration of how this type of knowledge transfer activities generates economic value for the receivers:
 - a. **Bilateral contract research:** these contracts between the RTO and an individual organisation reflect the value that knowledge or technology have for the organisation (willingness to pay) and we analyse how this value further translates into economic effects.
 - b. **Spin-off activities of the RTOs:** on the one hand, these spin-offs thank their existence to the founding RTO, so their effect is partly attributable to it. On the other hand, they have evolved since their creation and their current impact (in terms of employment, output and value added) is not only and entirely attributable to the RTOs anymore. This impact is influenced by a combination of other factors (e.g. management of the spin-offs, their collaborations with third parties, financial structures,...). We therefore cannot simply add the impact of the spin-offs to the footprint of the RTOs' core activities. The economic impact of the spin-offs is thus calculated and analysed, but separately from the RTOs' core activities and as an illustration of the importance of knowledge conversion from an economic point of view.

In geographical terms, this study focuses on the footprint of RTOs in the **EU28 and Norway** (hereafter equally called 'Europe', unless specified differently). Most parameters are only available at EU28 level. In this case, we have applied the same parameter for Norway as for the rest of the EU, assuming that the Norwegian economy and actors have similar patterns as the EU28. Other points of attention are:

1. The direct effect is concentrated in the home countries of the RTOs.
2. The first order indirect effect is measured by means of incoming invoices from all European countries to the RTOs.
3. The higher order indirect effect, at the suppliers of the suppliers, is calculated at an aggregated EU level. This means that the aggregated purchases in Europe (EU28 and Norway) are used as input for the model and the result is the aggregated higher order effect in Europe. Inter-EU flows are accounted for in this model, but imports and exports outside Europe are not.
4. The fiscal and parafiscal return concerns the tax flows to all European governments from the additional direct, indirect and induced impact in their country.

For further methodological details, we refer to Parts 2 and 3.



PART 2: Economic footprint of the organisations



1/ Direct economic effect

1.1 Methodology

The direct economic effect is measured at the level of RTOs. It is based on data delivered by the 9 RTOs of this study, combined with information from their websites and annual reports. The following data have been used:

- ▶ Employment: number of full-time equivalents (FTE) and head counts (HC) on the payroll
- ▶ Employment: number of researchers on the payroll
- ▶ Turnover
- ▶ Value added

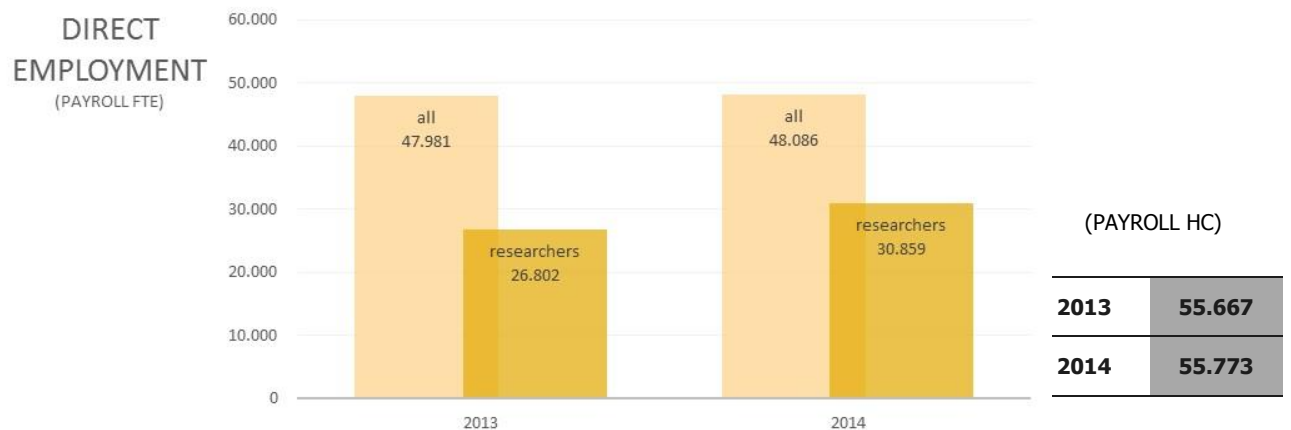
All data are available for the 9 RTOs, except for value added which is available for only 6 RTOs. The total 'value added' indicator is therefore extrapolated, based on the available data of 6 RTOs. Relative indicators based on value added (e.g. value added per FTE) are calculated on the basis of these 6 RTOs only. For instance to calculate the value added per FTE, we divide the sum of the value added of the 6 RTOs by the sum of employment (FTE) in these same 6 RTOs.

1.2 Results

Direct economic footprint: The 9 RTOs employ almost 55.800 knowledge workers (in head counts (HC), equivalent to 48.100 full-time equivalents (FTE)) in 2014

The direct economic effect of an RTO is defined by its in-house activities: the people it employs and the turnover and added value it creates as an organisation. An RTO has a particular profile in this respect: the majority of the staff is highly-educated and/or works as researcher. Their mission is first to develop scientific and technological activities, not to develop an economic activity as such. Generating a direct economic effect is a derivative of the scientific and technological activities. 7 out of the 9 RTOs in the study receive a public grant for operations to support their core activities.

- ▶ **Direct employment of almost 55.800 HC knowledge workers (or 48.100 FTE) in 2014**



Source: IDEA Consult based on RTO data

The 9 EARTO members jointly create employment for nearly 55.800 people (HC – head count) in Europe⁹ in 2014. This corresponds to around 48.100 full time equivalents (FTE). 64% (i.e. 30.900 FTE or 35.800 HC) work as researchers at these RTOs (2014).

⁹ 8 RTOs are located in the EU28, one in Norway. All effects thus take place in the EU28 and/or Norway, to which for reasons of simplicity we refer as 'Europe'.



► **Direct turnover worth 4,5 billion euro per year, excluding grants**

DIRECT TURNOVER

(EXCLUDING OPERATIONAL GRANTS;
BILLION EURO)

2013	4,421
2014	4,480

Each year, the 9 RTOs generate a total turnover of around 8 billion euro. This includes the operational grants that the RTOs receive (around 3,5 billion euro per year). Excluding the operational grants, the 9 RTOs generate a turnover of around 4,5 billion euro per year.

Source: IDEA Consult based on RTO data

► **Total direct value added amounts to 4 billion euro per year**

DIRECT VALUE ADDED

TOTAL

(BILLION EURO)

2013	3,935
2014	4,046

Together, the RTOs are estimated to have generated a total direct value added of around 4 billion euro in 2014¹⁰, taking into account the operational grants (of around 3,5 billion euro).

Employees in the RTOs (FTE) created on average 84 thousand euro value added (including grants) in 2014. This compares to an average value added per FTE in the research sector of between 57 thousand euro (according to Eurostat) and 70 thousand euro (according to the input-output tables).

DIRECT VALUE ADDED PER EMPLOYEE

(INCLUDING OPERATIONAL GRANTS;
EURO PER FTE)

2013	82.000
2014	84.100

Source: IDEA Consult based on RTO data (based on n=6)

¹⁰ This estimation applies an extrapolation of the value added per FTE as it is observed in the 6 RTOs where value added is known, to the 3 RTOs where only information on FTE is available.



2/ Indirect economic effect

The direct economic effect of RTOs mainly focuses on the income side and employment within RTOs. In order to generate turnover, goods and services are purchased, investments are made and wages are paid and (partly) spent. All these activities in turn create employment in other sectors. Employment created at the suppliers (and their suppliers) as a result of purchases of RTOs is called *indirect* employment. Employment resulting from the consumption of wages is called *induced* employment (see Part 2, section 3).

To estimate the indirect economic effect, we first calculate the output¹¹, the value added and the number of full-time jobs created by the RTOs at their own suppliers and service providers in Europe. These are the *first order* economic effects. Next, we estimate the *higher order* economic effects, i.e. output, value added and employment further upstream in the value chain at the suppliers of the RTO-suppliers and even further upstream in the chain. The first order indirect effect is measured by means of incoming invoices from all European countries to the RTOs.

2.1 Methodology

2.1.1 First order indirect economic effect

Incoming invoices of the RTOs are at the basis of the first order indirect effects calculations. The main advantage of using this type of information compared to national input-output-tables is that more specific multipliers for the concerned RTOs can be calculated. In other words, we know how the purchases made by the RTOs are distributed across sectors, and hence need not to rely on purchase patterns for the NACE sector 72 'Scientific research and development' as a whole, which is an aggregate of all companies and organisations that are active in this sector. Although input-output analyses are basically estimates at a sectoral / meso level, it has to be indicated that the accuracy can be significantly improved by capturing the RTO specific outlays, and therefore estimate at least the first round indirect effects in a precise manner.

The purchase data thus reflect the turnover realised at the first tier suppliers of the RTOs. In order to derive the value added and employment associated to this turnover, EU sectoral averages for the ratios "turnover over value added" as well as "turnover over employment" were used.

An important remark is that the first order indirect effects are based on the products and services invoiced to the RTOs directly. The use of taxis, restaurants or hotels that are linked to the RTO's activities (congresses, training,...) but are not paid for by the RTOs, are not part of this analysis. The latter are related to the tourist effect of RTOs, which is not in the scope of this study (cf. section 1/).

► Data

Seven of the nine RTOs have provided IDEA with a list of purchases aggregated by NACE sector and destination country, based on invoice data. For two RTOs, purchase data was available only at a much more aggregated level, for these RTOs the distribution of purchases across sectors was assumed equal to the average of the other seven RTOs.

► Hypotheses for the analysis

The use of EU sectoral averages to translate the first order turnover into employment and value added constitutes an approximation. In practice some EU countries (home countries in the first place) receive a higher share of the purchases of the RTOs compared to their share in the EU economy, and vice versa.

2.1.2 Higher order indirect economic impact

The expenditures of the RTOs at their suppliers, lead these suppliers to increase their demand at their own suppliers. Consequently, the suppliers of the RTOs in turn create additional production and employment at their suppliers. Ideally, a similar exercise could thus be done for each of these suppliers, based on their incoming invoices in order

¹¹ i.e. the share of turnover at the suppliers that is attributable to the RTOs invoices.



to calculate very accurately the higher order economic effect. In practice, however, this is far beyond the time frame and budget of this project.

To calculate the effect further upstream, we therefore use the latest input-output tables available at Eurostat. In order to calculate the higher order indirect effect we introduce the RTO's expenditures as a demand shock in the EU input-output table and derive the corresponding output, employment and value added effects. Based on the estimations of the higher order indirect turnover, we subsequently compute the higher order indirect employment and value added, using the sector ratios identified before (Eurostat).

Since we focus on the 'domestic' effects in the EU, import and export outside the European Union are not taken into account. However, cross-border purchases patterns within the European Union are taken into account in calculating the economic impact.

► Data

The starting point is the data on purchases of RTOs at their various suppliers (the first order indirect effect). Subsequently, through the information contained in the input-output tables, the ultimate indirect effects, capturing the effects of spending for suppliers in various rounds, can be modelled.

2.1.3 Total indirect economic effect

► Methodology

The first order indirect effects refer to the immediate relations with the RTO's suppliers. To calculate the first order indirect effect, we took into account only those invoices that effectively bring about additional turnover and employment in the European economies.

The higher order effects relate to the purchases that the first tier suppliers of the RTOs make at their suppliers. In order to calculate the total indirect economic effect, the first and higher order effects are added up.

2.2 Results

Indirect economic effect of RTO purchases: employment creation of over 53.200 HC (or 45.800 FTE) in the European economy in 2014

To support their activities, the RTOs buy goods and services from companies in a series of other industries. In 2014, purchases from the RTOs with European companies amounted to nearly 3,2 billion euro per year. This in turn leads to additional employment and additional demand of these companies upstream. This expanding effect on the economy is what we call the indirect economic effect.

► Indirect employment of over 53.000 jobs (HC) in 2014

INDIRECT EMPLOYMENT EFFECT

(FTE and HC)

	1° order		higher order		TOTAL	
	FTE	HC	FTE	HC	FTE	HC
2013	24.566	28.501	21.430	24.863	45.995	53.363
2014	24.664	28.607	21.167	24.551	45.831	53.157

Source: IDEA Consult based on RTO data

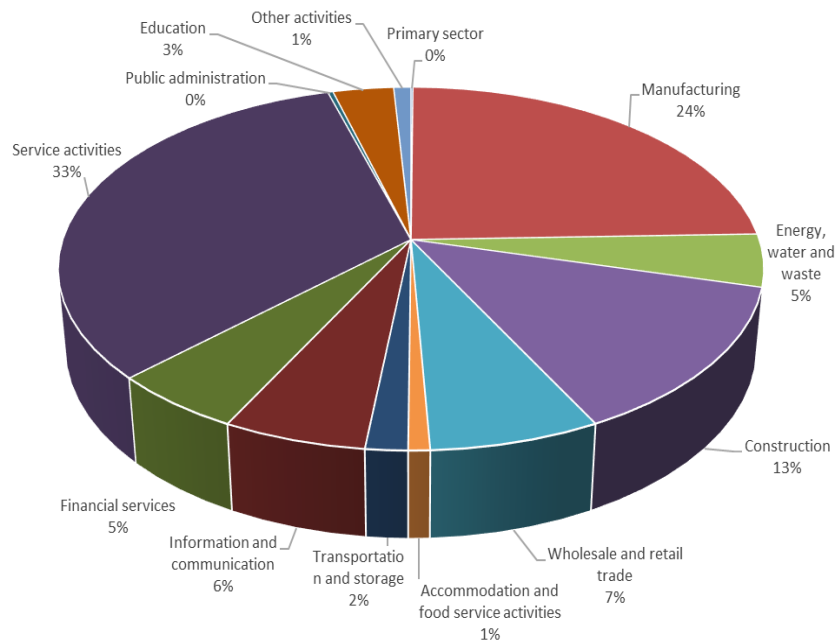
In 2014, the total indirect employment created in the European economy through the purchases of the RTOs amounted to around 53.200 jobs (HC - head count, equivalent to around 45.800 FTE), a slight decrease compared to 2013 (53.400 jobs, equivalent to 46.000 FTE).



More than half of the indirect employment creation happened at the direct suppliers of the RTOs (1° order indirect employment effect). Over 24.600 FTE or 28.600 HC positions have been created there thanks to the purchases of the RTOs. Another 21.100 FTE or 24.500 HC positions have been created further upstream in the value chain, with the suppliers of the RTOs' suppliers (higher order indirect employment effect).

As RTOs rely on a broad range of suppliers of goods and services, their activities result in the creation of employment across many different sectors. The three main benefitting sectors are the business service sector (33%, i.e. about 15.000 FTEs or 17.400 HC in 2014) which consists in many specialised organisations that support the research activities of the RTOs, the manufacturing sector (24%, i.e. about 11.200 FTEs or 13.000 HC) supplying primarily high-tech research equipment, and the construction sector¹² (13%, i.e. about 6.100 FTEs or 7.100 HC) taking care of RTOs' needs for research facilities.

INDIRECT EMPLOYMENT CREATION PER SECTOR (FTE, 2014)



Source: IDEA Consult based on RTO data

► Indirect turnover worth over 6 billion euro per year

INDIRECT TURNOVER (BILLION EURO)

	1° order	higher order	TOTAL
2013	3,279	3,038	6,317
2014	3,263	3,003	6,266

Source: IDEA Consult based on RTO data

RTOs purchase goods and services from suppliers, who then in their turn buy goods and services from their own suppliers, and so on. This way, in consecutive rounds of spending, a total turnover of more than 6 billion euro is generated in the European economy each year. Similar to employment, around half of this indirect turnover is created at the direct suppliers of the RTOs. The other half is created further up in the value chain.

¹² The scale and sectoral distribution of the purchases are to a large extent determined by the expense pattern of one RTO, active in military and nuclear research which requires the construction of specialised and complex plants.



► **Indirect value added creation of around 2,8 billion euro per year**

INDIRECT VALUE ADDED

(BILLION EURO)

	1° order	higher order	TOTAL
2013	1,469	1,364	2,833
2014	1,469	1,350	2,819

In total, the value added created throughout the economy as a result of the purchases of goods and services by the RTOs amounts to about 2,8 billion euro per year, of which around 1,5 billion is created at the direct suppliers of the RTOs.

Source: IDEA Consult based on RTO data

To benchmark the indirect effects, these figures can be compared to existing studies. For this, we refer to Part 4 of this report.



3/ Induced effect

3.1 Methodology

RTOs' activities generate income for their employees (direct effect), for the additional employees at their suppliers (first order indirect effect) and further upstream in the supply chain (higher order indirect effect). The spending of this additional income in the economy provides a third type of economic effect: the 'induced effect'.

The total *additional* wage expenses of the households, minus the amount of VAT¹³, for their part create additional output in several sectors. As we have no insights in how these wages are spent precisely, we estimate the induced value added and induced employment based on economy-wide average ratios of value added over turnover and employment over turnover¹⁴.

It is important to recall that we compare the situation 'as is' with the counterfactual that the RTOs would not be active. We thereby assume that employees (direct and indirect) would be unemployed if the RTOs did not exist. The additional impact of an RTO is thus the difference between employment and unemployment of the direct and indirect employees. In this situation, we assume that the unemployed would receive an unemployment benefit, so that their income would not decrease to 0. Many other impact studies¹⁵ in the field do assume that the unemployed have zero income in the counterfactual, which leads to an overestimation of the additional effects of the RTOs¹⁶.

► Data

As starting point, the figures on direct and indirect employment were used. These were multiplied with average net wages¹⁷ in the different sectors in the EU where the RTOs create direct and indirect employment. Subsequently, these were multiplied with average wage-spending quota¹⁸ (= how much of an income is actually spent by a household). Next, the fraction of income that is spent outside the EU was subtracted in order to arrive at net spending in the EU economy induced by the RTO's activities¹⁹.

However, not all of these expenses can be attributed to RTO-activities: only the part that results from the difference between the average unemployment compensation²⁰ and the average net wage of the direct and indirect employment can be considered as an induced impact of the RTOs. Therefore this average unemployment compensation was also subtracted from the average net wages.

► Hypotheses for the analysis

The use of EU averages for all parameters in the calculation of the net spending by the RTOs' and suppliers' employees, is an approximation given the rather unequal spread of the RTOs covered in our study in Europe, and given the fact that also a Norwegian RTO is included in this study.

We also make the assumption that all employees (direct and indirect) would be unemployed in the counterfactual situation that the RTOs would not be active.

¹³ Taxation trends in the European Union (2014), DG for Taxation and Customs Union and Eurostat.

¹⁴ An alternative method is using a closed model of the EU input-output table. However the results have not been found reliable, since import leaks, expenditures of households outside the EU, and savings are not incorporated, and therefore tend to overestimate the real impact. Our approach can be considered as a conservative estimate, indicating the minimum border of potential effects.

¹⁵ For example, the study of the Economic Contribution of the LERU Universities by BiGGAR Economics (2015) does not mention a correction for unemployment benefits.

¹⁶ On top, we do not account for the unemployment benefit itself: this is a cost for the government in the counterfactual situation without RTOs, which is omitted in the situation where RTOs do exist and generate additional employment in the European economy.

¹⁷ Eurostat data per sector for the EU28.

¹⁸ Eurostat data. The average domestic wage-spending quotient is the percentage of the wage income of a household that is on average spent on the purchase of goods and services from the domestic market (thus not imported).

¹⁹ Eurostat data on final consumption expenditures in the EU and abroad.

²⁰ Eurostat data for the EU28.



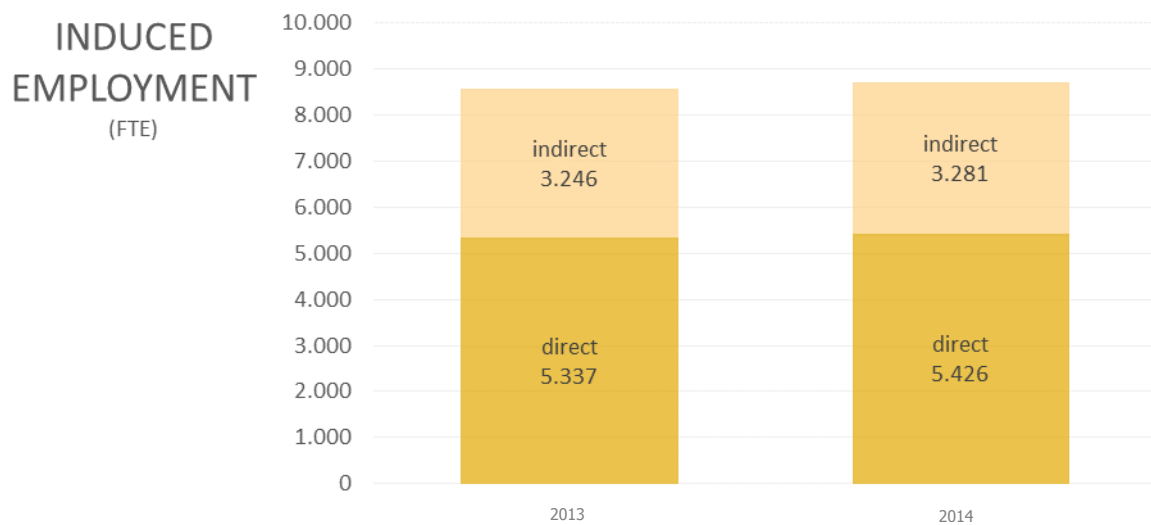
3.2 Results

Induced economic effect: Consumption of 1,1 billion euro per year in the broader economy

The induced economic effect is created through RTOs' directly and indirectly created employment. These direct and indirect employed people now receive a wage which is higher than an unemployment benefit. They spend part of their additional income in the European economy through consumption of goods and services, and in turn this spending generates additional turnover and value added in the European economy.

We remark that the results of other impact studies often do not account for an unemployment benefit in the counterfactual situation, leading to an overestimation of the additional induced effects. We can therefore not compare the results with other benchmarks or studies.

► Induced employment of around 10.100 jobs (or 8.700 FTE) in 2014



Source: IDEA Consult based on RTO data

The employment generated directly at the 9 RTOs and indirectly at their suppliers results in additional household expenditures in the European economy, which in turn creates new employment and value added. In 2014, an additional 10.100 HC jobs (equivalent to 8.700 FTE positions) were created in Europe as a result of this consumption. Somewhat more than 60% of this induced employment is generated by the household expenditures of the employees of the RTOs (around 5.400 FTE or 6.300 HC), while the remaining 40% (around 3.300 FTE or 3.800 HC) is generated by the indirect employees linked to the RTOs' purchases.

► Induced turnover creation worth over 1,1 billion euro per year.

INDUCED TURNOVER (BILLION EURO)

2013	1,146
2014	1,152

The turnover generated at companies who benefit from the extra²¹ household expenditures from the direct and indirect employees linked to the RTOs, amounts to more than 1,1 billion euro annually.

Source: IDEA Consult based on RTO data

²¹ i.e. on top of what would be consumed if these persons were unemployed and received unemployment benefits.



- ▶ **Induced value added creation of more than 0,5 billion euro per year.**

INDUCED VALUE ADDED

(BILLION EURO)

The corresponding value added generated by these companies is more than 0,5 billion euro annually.

2013	0,513
2014	0,519

Source: IDEA Consult based on RTO data



4/ Fiscal and parafiscal return to national governments in Europe

Based on the direct, indirect and induced effect, one can estimate the fiscal and parafiscal return to the national governments in Europe. This fiscal and parafiscal return is mainly generated through the following channels:

- the additional employment (social security contributions, wage tax);
- the additional output (corporate tax);
- the additional value added (VAT).

The estimation of the fiscal and parafiscal return is based on direct, indirect and induced effect on the employment, output and value added, as outlined in the previous chapters.

We have collected the following financial parameters, necessary to estimate the fiscal and parafiscal return in Europe:

- gross wages and labour tax rates²² - these were already used for the calculation of induced effects;
- sectoral profitability rates²³ and corporate tax rates²⁴;
- VAT rates²⁵.

The average tax rate for the EU28 was applied each time.

4.1 Methodology

4.1.1 *Labour taxes*

Data on the average implicit tax rate (ITR) on labour for the EU was used²⁶, which includes the various social security contributions (of both employers and employees) as well as personal income tax. This ITR was applied to gross wages paid by RTOs and suppliers, which was obtained from Eurostat (NACE 2 sectoral level).

In the assessment of fiscal and parafiscal return due to additional employment, we do not account for the potential reduction in unemployment benefits when additional people are employed compared to unemployed.

► Hypotheses for the analysis

As was already indicated earlier, and as also applies to the corporate tax and VAT estimations discussed further on, the use of EU averages is an approximation in the sense that only a subset of EU countries is represented through the nine RTOs (one of which being from Norway), and that the countries where most economic effect takes place may have different average parameter values than the EU28 as a whole.

4.1.2 *Corporate tax (turnover)*

Next to the additional employment, a second source of government income comprises the fiscal and parafiscal return from the corporate tax on the additionally created turnover. For each sector, we converted the increase in turnover (direct, indirect and induced turnover creation per country) to profits (using data on gross profitability per sector) and imposed the average EU corporate tax rate on these profits. For the RTOs (the direct effect) as well as sectors NACE 84 'Public administration and defence services; compulsory social security services' and NACE 85 'Education services', a zero profit rate was maintained in line with the mission of RTOs and of most organisations falling under these two NACE codes.

► Hypotheses for the analysis

²² Taxation trends in the European Union (2014), EC Taxation and customs union & Eurostat, data for 2012.

²³ Eurostat business statistics.

²⁴ Taxation trends in the European Union (2014), EC Taxation and customs union & Eurostat: data for 2013.

²⁵ Taxation trends in the European Union (2014), EC Taxation and customs union & Eurostat: data for 2014.

²⁶ Taxation trends in the European Union (2014), EC Taxation and customs union & Eurostat, data for 2012.



As noted earlier, the use of EU average tax rates is an approximation since only a subset of EU countries is covered, which may not have the same average rates as the EU as a whole.

4.1.3 VAT (value added)

A third pillar of the fiscal and para-fiscal return to the government is the amount of additional VAT revenues. These VAT revenues are estimated by applying the EU average VAT-rates on the additional value added creation in the EU (calculated as the sum of direct, indirect and induced impact).

► Hypotheses for the analysis

Also here, the use of EU average tax rates is an approximation as only a subset of EU countries is covered, which may not have the same average rates as the EU as a whole.

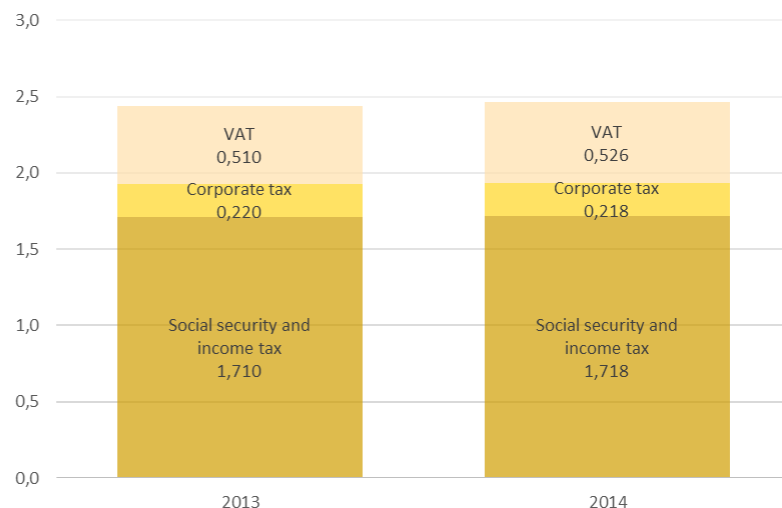
4.2 Results

Fiscal and para-fiscal effect: more than 2,4 billion euro flow-back to national governments each year

The direct, indirect and induced dynamics in terms of employment, turnover and value added each leads to a form of fiscal and para-fiscal flow-back towards the respective governments of the European countries where the RTOs generate economic effects. Below, we value each of these effects and calculate the multiplier effect of the government grants in the RTOs with respect to this total flow-back.

► Total fiscal and para-fiscal return for national governments of 2,4 billion euro per year

FISCAL AND PARAFISCAL RETURN (BILLION EURO)



Source: IDEA Consult based on RTO data

The direct as well as indirect and induced economic activities generated by the RTOs, generate major fiscal and para-fiscal revenues to European governments, amounting to 2,4 billion euro each year. These revenues come from social security and income taxes, VAT and corporate taxes paid by the RTOs, their suppliers across the value chain and through the induced effect.

The main component of these revenues are the taxes levied on the income of employees whose job is directly or indirectly linked to RTOs (social security contributions and income taxes).



SOCIAL SECURITY AND INCOME TAXES

(BILLION EURO)

	Direct	Indirect	Induced	TOTAL
2013	0,945	0,649	0,116	1,710
2014	0,951	0,649	0,118	1,718

Source: IDEA Consult based on RTO data

In total, 1,7 billion euro of fiscal return is generated each year through social security and income taxes (70% of the total fiscal return). Of this, almost 1 billion euro or 55% are paid by the employees of the RTOs (direct effect), another 0,6 billion euro or 40% by the employees of the suppliers in the value chain (indirect effect) and around 0,1 billion euro or 5% comes from employment that was created through extra household expenditures of the direct and indirect employees (induced effect).

The second, relatively minor component of the fiscal revenues are corporate income tax revenues collected from companies that supply RTOs (indirect effect) or their employees (induced effect) with goods and services. This third component amounts to around 220 million euro per year (9% of the total fiscal return). We assume that RTOs themselves do not pay any corporate income tax, so the direct corporate income taxes equal zero. The corporate income taxes amount to 0,2 billion euro (84%) through the indirect effect and to 0,03 billion euro (16%) through the induced effect.

CORPORATE INCOME TAXES

(BILLION EURO)

	Direct	Indirect	Induced	TOTAL
2013	0	0,187	0,034	0,220
2014	0	0,184	0,034	0,218

Source: IDEA Consult based on RTO data

The third source of fiscal revenue is the value added tax (VAT) that stems from the purchase of goods and services by companies and households.

VALUE ADDED TAXES

(BILLION EURO)

	Direct	Indirect	Induced	TOTAL
2013	0,046	0,354	0,110	0,510
2014	0,063	0,352	0,111	0,526

Source: IDEA Consult based on RTO data

The fiscal return from VAT amounts to 0,5 billion euro per year (21% of the total fiscal return). The VAT at the RTOs' level (direct effect) is rather limited due to the fact that the operational grants are excluded. It amounts to 0,06 billion euro or 12% of the fiscal return from VAT. Most of the VAT revenues are realised through the suppliers in the value chain (indirect effect): 0,4 billion euro or 67%. The induced effect results in a VAT effect of 0,1 billion euro or 21% of the total VAT effect.



- ▶ **Leverage effect: For each euro of government funding for RTOs (through the operational grants), about 1,5 euro returns to national governments through fiscal and parafiscal flows due to RTOs core-activities in 2014.**

LEVERAGE EFFECT

(FISCAL RETURN PER EURO OPERATIONAL GRANT)

2013	1,45
2014	1,50

Source: IDEA Consult based on RTO data

The grants that RTOs receive from national governments, trigger economic activity both at RTOs' level as well as indirectly at their suppliers'. As a result, a financial flow-back is generated, which exceeds the initial grants, as the leverage effect is higher than 1. For every euro invested in the RTOs, there is a return of 1,5 euros due to RTOs core-activities. In other words, 150% of the amount spent on operational grants for RTOs returns to governments through fiscal revenues. For reasons of representativeness of the results, we have excluded from the calculation of the fiscal multiplier the effect of government subsidies devoted to sovereignty activities (for example military activities) which are very different from other types of R&D activities and the subsidies allocated to them.



5/ Adding up the economic effects of the organisations

5.1 Methodology

In order to obtain a complete picture of the economic footprint of the 9 RTOs, the results from the previous four chapters (direct, indirect and induced impact, together with fiscal return) were combined. However, not all results from these different elements can be simply aggregated. In the following table, we present which parts can be added up in a methodologically sound manner.

Figure 3: Overview and add-up of the different economic impact elements

Direct	Indirect	Induced	Fiscal and para-fiscal return
Employment (in FTE)	Employment (in FTE)	Employment (in FTE)	Wage tax and social security contributions (in €) + Corporate tax (in €) + VAT revenues (in €) = Total return (in €)
Turnover (in €)	Turnover (in €)	Turnover (in €)	
Value added (in €)	Value added (in €)	Value added (in €)	

Source: IDEA Consult

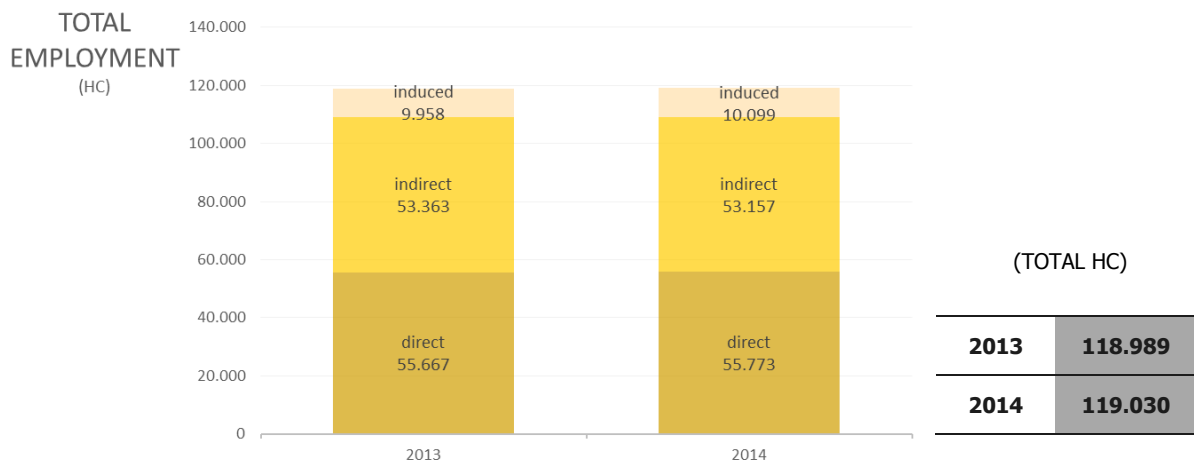
We can add up the employment that is created as a consequence of the direct, indirect and induced effect (horizontal sense). The same can be done for the realised turnover and value added creation. We cannot however add employment, output and value added (vertical sense), as these refer to the same effect only in other terms. Summing them would thus imply duplications. The different elements of the fiscal and para-fiscal return to the national governments, generated by the total output, employment and value added creation, can be added up as they represent real fiscal flows (last column of Figure 3).

5.2 Results

Total economic impact of core activities: 9 RTOs had an impact on 119.000 HC jobs (or 102.600 FTE) in Europe in 2014.

Aggregating the individual economic effects created by the 9 RTOs (direct, indirect and induced), results in an estimate of the total effect of the 9 RTOs' activities in the economy.

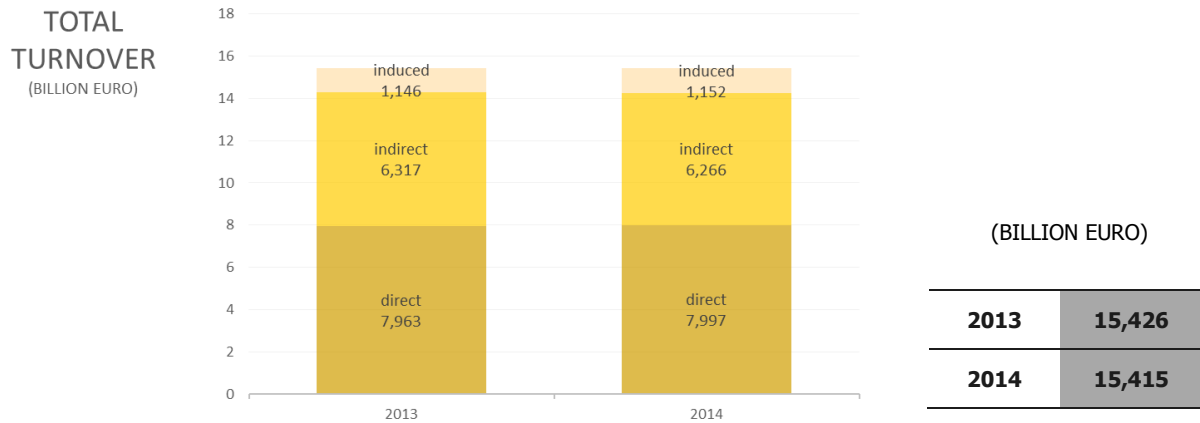
► Total employment creation of 119.00 HC jobs (or 102.600 FTE) in 2014



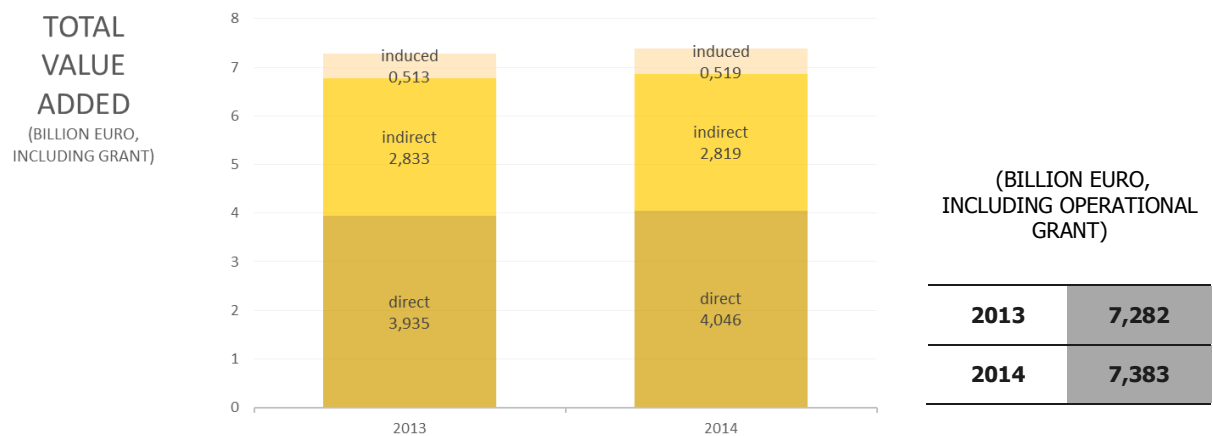
Source: IDEA Consult based on RTO data



Taking together the employment that is generated directly at the 9 RTOs, indirectly at the suppliers of the RTOs, as well as induced by the consumption purchases of these first two categories, the total employment generated amounts to nearly 120 thousand jobs. The largest share of this employment is generated directly at the RTOs (47%). Indirect employment also represents 45% of total employment, while induced employment accounts for 8% of the total.



Source: IDEA Consult based on RTO data

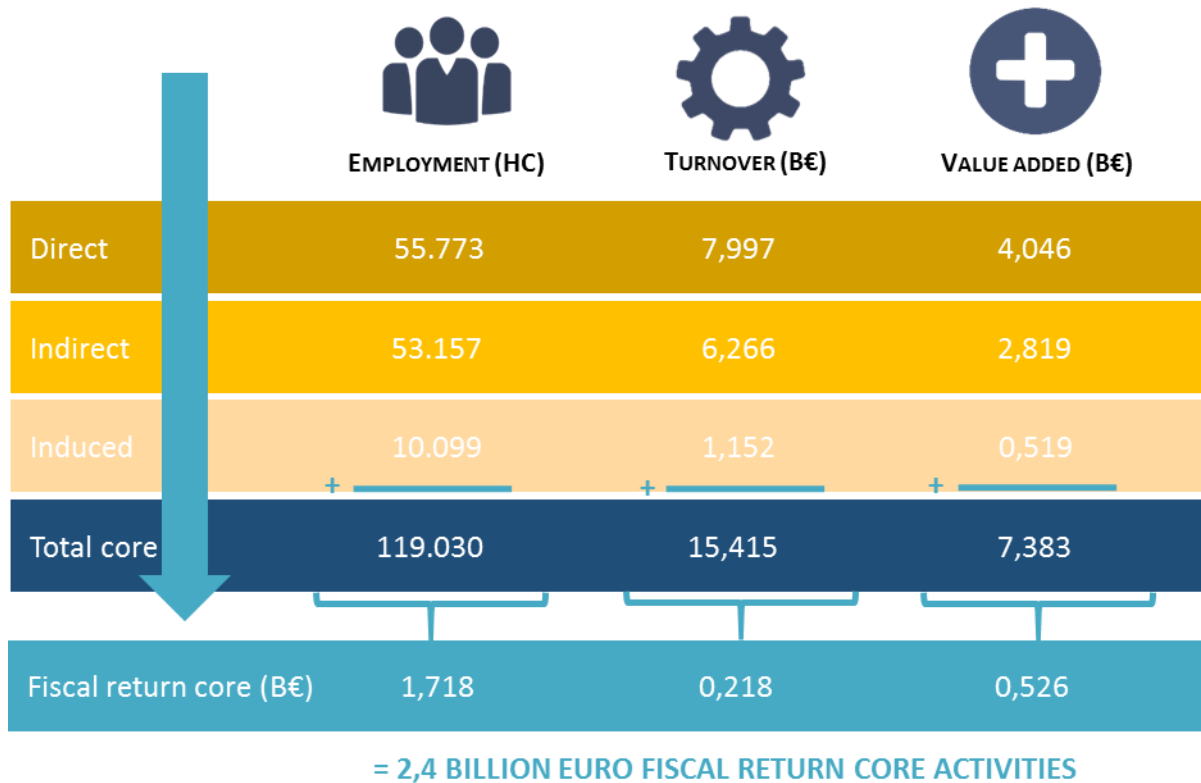


Source: IDEA Consult based on RTO data

Similarly, direct, indirect and induced effects add up to a total turnover effect of more than 15 billion euro each year and the total (direct + indirect + induced) effect of the 9 European RTOs translates into 3,8 billion euro of value added creation in Europe each year (excluding the operational grants).



► **In sum for the 9 RTOs in 2014:**



► **Leverage effect: For each job in a European RTO, 1,1 additional jobs are generated in the European economy due to RTOs' core-activities in 2014**

EMPLOYMENT MULTIPLIER

(DIRECT + INDIRECT + INDUCED EMPLOYMENT / DIRECT EMPLOYMENT)

2013	2,14
2014	2,13

As illustrated before, the economic footprint of the RTOs is not limited to their direct employment. Through indirect and induced effects, the total impact of the RTOs in terms of employment more than doubles. We find an employment multiplier of 2,1 for the core activities of the RTOs. Per direct job at an RTO, 2,1 jobs are thus linked to the core activities of the RTO (of which 1 direct job). This also means that for each employee working in an RTO, an additional 1,1 jobs are being created elsewhere in the economy (on top of the one direct job in the RTO).

Source: IDEA Consult based on RTO data



PART 3: Economic impact of a selection of scientific/ technological activities



1/ R&D input factors: staff

1.1 Methodology

One, and perhaps the most important input factor of an RTO is its human research capital. In section 1.2, we already reported on the direct employment in the 9 RTOs. We now also identify the number of researchers among these employees. The number and share of researchers is a good indication of the knowledge input and absorptive capacity in the RTO. The number of researchers is measured directly at the RTOs.

► Data

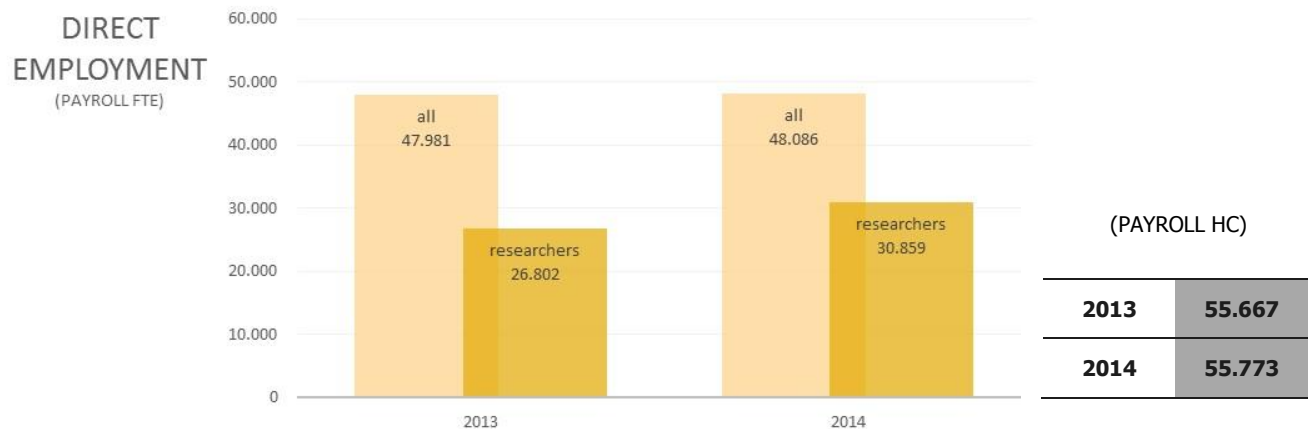
Employment: number of full-time equivalents and head counts on the payroll of the RTO; number of researchers. All data are available directly from all 9 RTOs.

► Hypotheses for the analysis

The analysis requires no prior hypotheses.

1.2 Results

- **Direct employment of almost 55.800 HC knowledge workers (or 48.100 FTE) in 2014, of whom 35.800 HC researchers (or 30.900 FTE)**



Source: IDEA Consult based on RTO data



2/ Knowledge transformation and knowledge transfer: contract research

Knowledge transformation and transfer at an RTO includes many aspects: its industry intimacy and cooperation strategy, sharing research and technological facilities, staff outflow, scientific transfers through publications, presentations, mandates in universities, PhD or master supervision, academic cooperation, education and training etc.

In this study, we focus on the aspect of contract research to illustrate the importance of this kind of knowledge transfer flows also from an economic point of view. Where 50 years ago, RTOs depended more on government budgets and pursued a mainly scientific mission, today RTOs are increasingly working on research or development for and with firms and are able to leverage their knowledge to attract private funding through contract research²⁷. The interaction between RTOs on the one hand and (local) industry on the other hand, adds substantially to the innovative performance and economic development of a region or country. The total scale of contract research in an RTO is an indication of the importance of this targeted knowledge transfer to industry. The total amount of the contracts is also a proxy for the value that this knowledge transfer has for an individual company.

2.1 Methodology

2.1.1 *Government funded research*

Government funded research is measured directly at the RTOs. The total scale of the funding is an indication of the importance of this kind of research, and a reflection of the research efforts delivered to these projects. It is based on data delivered by the RTOs.

► Data

- Total amount of government funded research in 2013 and 2014
- Divided by type of projects: national or subnational, Horizon 2020, ESA, other EU, and other international

Data on the overall scale are available for all 9 RTOs, but in one case the RTO could not divide the European funded projects per type (Horizon 2020, ESA or other) and in one other case only 2014 data were available. The figure in the publication therefore contains only the 2014 data and no distinction is made among EU projects.

► Hypotheses for the analysis

The analysis requires no prior hypotheses.

2.1.2 *Bilateral contract research*

Bilateral contract research is measured directly at the RTOs. Like with the government funded research, the total scale of the contracts is an indication of the importance of this kind of research. Further, the price a company or organisation is willing to pay for the research reflects the value of the knowledge for the receiver. This indicator is based on data delivered by the RTOs.

We remark that VAT from contract research is not included here, because this was taken into account in the direct effects of the RTOs and their total value added reported there (cf. section 1.2 of Part2). Including it again here would mean counting the effect twice.

► Data

- Total amount of bilateral contract research in 2013 and 2014
- Distributed by country of receiver and by type of receiver (private SME, private not SME, public sector organisation EU, public sector organisation national, other – e.g. universities, foundations, etc.)

Data on the overall scale are available for all 9 RTOs, but in several cases we faced data limitations: missing type of contractor or non-availability of SME indication, in one case also limited level of geographical detail and in another case only 2014 data were available.

²⁷ http://www.earto.eu/fileadmin/content/05b_Membership/RTOs_and_the_Evolving_European_Research_Area_WhitePaperFinal.pdf



► Hypotheses for the analysis

When data were more aggregated or not available, we have used a simple extrapolation based on the remaining RTOs' aggregated data in order to come to the required level of detail. In some cases, the RTOs themselves suggested a rule of thumb based on their experience. We have carried out robustness checks on these rules of thumb (comparing with the aggregated data of the other RTOs), with good results.

The main assumption made in the extrapolations, is that European RTOs have similar patterns concerning the international or intersectoral cooperation in bilateral contracts.

2.1.3 Value of knowledge transfer through contract research

The assessment of the value of knowledge transfer is a complex matter, given the implicitness of 'knowledge'. Two elements are of particular importance:

- the 'diffusion' and transfer of knowhow/technology needs first to be measured
- the 'value' of this diffusion needs to be assessable

The **measurement of the diffusion** and its value implies the point of view of the knowledge user. This user needs to appropriate a value to the transferred knowledge. We refer briefly to three different methodologies for measuring diffusion (Peeters, 1998):

- *Technology flows measured by patent data* through the use of technology flow matrices based on patent classifications according to industry/sector of origin and adoption which are used in order to identify R&D flows. Patents are considered to be carriers of technological knowledge in this methodology.
- *Surveys of the use of new technologies*: these surveys measure the rate of adoption of new technologies and provide a 'picture' of the technologies that industries use in a particular point in time.
- *Technology flows on the basis of input-output (I-O) matrices* based on transactions across sectors for intermediate and investment goods. The goods are considered to be reflecting the R&D efforts.

In this study, we focus on bilateral contract research as form of knowledge diffusion and on the contract amounts as value appropriated to the transferred knowledge by the users.

Also for **measuring the value of knowledge transfer**, a number of methodologies are available. Yet, most commonly, the empirical literature refers to a method based on the input-output method and using the 'technology multiplier'. This method is applied by Papaconstantinou et al. (1996) for 10 OECD countries and further refined, extended and updated by Knell (2008) for 25 European countries and the United States and Japan²⁸. These studies are based on OECD data (input-output database and ANBERD database).

The **technology multiplier** indicates the relation between total technology intensity and R&D intensity, in other words the relation between the total embodied R&D and the intramural R&D, taking into account the direct and indirect technology diffusion in the region. **The most recent estimation for the technology multiplier in the Euro zone is 1.98.** This means that for each euro of intramural R&D expenditures in the Euro zone, 1.98 euro of embodied technology is created.

We use the above mentioned technology multiplier to assess the value of the knowledge transfer of the RTOs through contract research. We apply the technology multiplier of the EU to all contracts as an average value for all countries involved (mainly the home countries of the RTOs but also other EU countries are receivers) and add up the effects into a total economic value creation through technology transfer by RTOs.

This multiplier methodology is developed at the level of countries, not institutions. Applying this multiplier to the technology transfer of an RTO therefore leads to results that need to be interpreted as illustrations rather than facts.

► Data

We start from the bilateral contract research revenues of the RTOs. These revenues are an indication of the willingness to pay of enterprises for access to the R&D of the RTOs. In line with the results of Knell (2008) we apply the multiplier of 1.98 for the EU to calculate the value of the technology transfer through contract research.

²⁸ Knell (2008) is based on the methodology described in Papaconstantinou et al. (1996) but additionally accounts for potential duplications as described in Hauknes and Knell (2006). The study is in other words a refinement of the methodology of Papaconstantinou et al. (1996).



► Hypotheses for the analysis

Three assumptions are important to bear in mind:

- The multiplier is developed at country level and applying it at institutional level gives results that are to be considered as an illustration rather than a fact.
- The multiplier is not regularly updated (also due to the delays in availability of input-output tables) so applying it assumes that we do not expect large changes in the multiplier over time, in particular in recent years.
- One technology multiplier is used for the entire EU, while the main receivers are located in the home countries of the RTOs (Belgium, Denmark, Finland, France, Germany, The Netherlands, Norway, Spain, Sweden) and thus concentrated in Western and Northern Europe. In most of these countries one might expect a higher technology multiplier thanks to a higher technology intensity.

2.1.4 *Economic impact of the technological knowledge transfer*

Knowledge transfer has an important economic value for the receiver. Furthermore, it generates in turn additional economic effects by the filtering through of direct effects to suppliers and consumers (upstream). Estimating these economic effects demonstrates the importance of the technological knowledge transfer also from an economic point of view.

In our framework, the value of the technology transfer corresponds to the direct value added created by the bilateral contract research. This direct value added is then further translated into turnover and employment and finally into estimations of the indirect and induced effects. For this, the specific economic ratios calculated for the RTOs in the detailed economic analysis are applied:

- Direct turnover knowledge transfer = direct value added knowledge transfer * (direct turnover RTOs/direct value added RTOs)
- Direct FTE knowledge transfer = direct value added knowledge transfer * (direct FTE RTOs/direct value added RTOs)
- For the three units (employment, turnover and value added):
 - Indirect effect knowledge transfer = direct effect knowledge transfer * (indirect effect RTOs/direct effect RTOs)
 - Induced effect knowledge transfer = (direct+indirect) effect knowledge transfer * [induced effect RTOs/(direct+indirect) effect RTOs]

► Data

The estimation of the value of bilateral contract research is available from the previous step. To calculate the direct turnover and value added, and to estimate the indirect and induced impact, the specific economic ratios of the RTOs are applied (cf. supra).

► Hypotheses for the analysis

By applying the RTO specific ratios we assume that the effects of knowledge transfer have similar upwards spillover effects as the RTO's core activities. We thus assume that the purchasing pattern of the receivers of the knowledge transfer and the profile of their employees (average wage and spending) are similar to the purchasing pattern and the profile of employees at the RTO.

2.1.5 *Fiscal return of the technological knowledge transfer*

To calculate the fiscal return through the economic impact of the technological knowledge transfer, each type of impact is translated to its specific fiscal return, i.e. turnover to corporate taxes, value added to VAT, employment to social security contributions and wage taxes. For this, the specific fiscal return ratios calculated for the RTOs are applied:

- Fiscal return from turnover knowledge transfer = turnover knowledge transfer * (fiscal return from turnover RTOs/total turnover RTOs)
- Fiscal return from value added knowledge transfer = value added knowledge transfer * (fiscal return from value added RTOs/total value added RTOs)
- Fiscal return from employment knowledge transfer = employment knowledge transfer * (fiscal return from employment RTOs/total employment RTOs)



► Data

The estimation of the economic effects of bilateral contract research is available from the previous step. To calculate the fiscal return stemming from each type of impact, the specific ratios of the RTOs are applied (cf. supra).

► Hypotheses for the analysis

By applying the RTO specific ratios we assume that the effects of knowledge transfer have similar fiscal returns mechanisms as the RTO's core activities.

2.2 Results

Knowledge transfer through contract research: 1,9 billion euro worth of contracts each year result in an annual technological value creation of 3,2 billion euro (directly) and an additional 93.000 jobs (80.000 FTE direct, indirect and induced) in the European economy

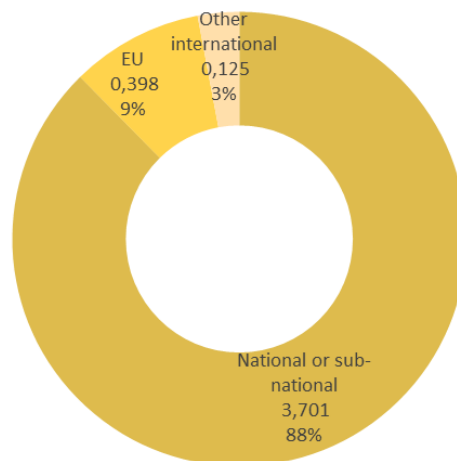
European RTOs apply their knowledge and infrastructure in a broad range of research projects. One type of projects are public research projects, often in cooperation with other research and industrial partners. But RTOs also regularly work together with individual (public or private) organisations bilaterally on specific research topics. Both types of projects have in common that they have an encouraging effect on knowledge transfer. The RTOs thus have a scientific/technological impact on the partners they cooperate with by sharing and applying their knowledge in a common research project.

In the case of the bilateral contracts, the value of the contract is a proxy for the willingness to pay for the knowledge by the receiving partner. By applying the technology multiplier to this value, the total technological impact of RTOs on the technological research community through bilateral contracts is quantified. Based on this value, also the economic impact and fiscal return of these activities in the broader economy is estimated.

2.2.1 Government funded research

Over 4 billion euro per year of publicly funded research activities

PUBLIC FUNDED
RESEARCH
(BILLION EURO, 2014)



Source: IDEA Consult based on RTO data

Thanks to their scientific focus and available resources (staff, infrastructure), the 9 RTOs attract each year an impressive volume of over 4 billion euro of public funds for research. The majority, around 88%, stems from national (or subnational) sources. Almost 10% is funded through European projects - of which two thirds via the R&D Framework Programmes and Horizon 2020.



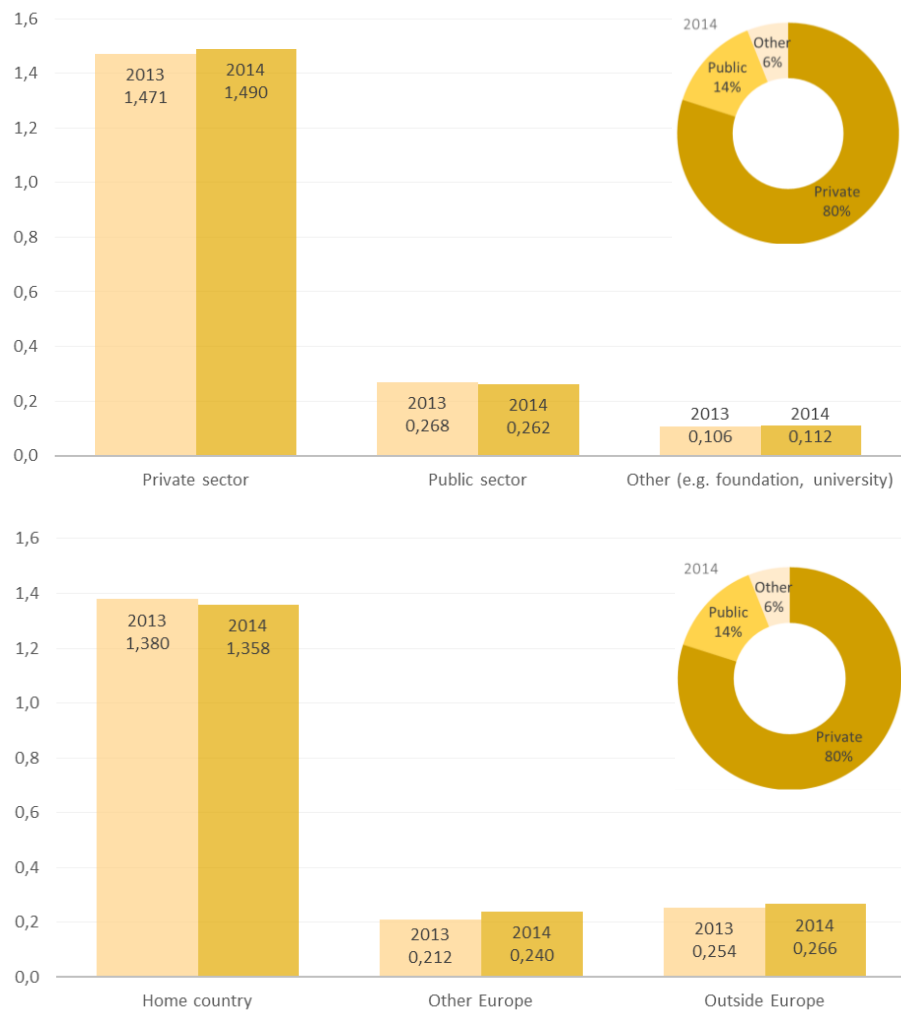
This confirms the observation that EARTO members were especially active in the R&D Framework Programmes, being involved in 22% of the FP6 projects - often so as project leader²⁹. In FP7, research organisations are the second most successful group of applicants and within this group, RTOs and EARTO members rank high in terms of participation³⁰.

The cooperation of public and private actors in publicly funded research projects brings about additional private investments for R&D. We did not collect the data in this study to calculate this effect for the entire sample of RTOs, but an example of one RTO gives a sense of magnitude of this leverage effect. This RTO estimated in its annual report that in 2013, for each euro granted to the RTO, another 3,4 euro was spent by its partners (industry or research institutes) in the project.

2.2.2 Bilateral contract research

Almost 1,9 billion euro turnover in bilateral contracts per year

BILATERAL CONTRACT RESEARCH (BILLION EURO)



²⁹ EARTO, Research and Technology Organisations in the Evolving European Research Area. A Status Report with Policy Recommendations:

http://www.earto.eu/fileadmin/content/05b_Membership/RTOs_and_the_Evolving_European_Research_Area_WhitePaperFinal.pdf

³⁰ EARTO, EU R&I Policy & Data-driven Decision Making. Knowing your Innovation Ecosystem Actors: Data on European RTOs, 13 March 2015. <http://www.earto.eu/>



(BILLION EURO)

2013	1,845
2014	1,864

Source: IDEA Consult based on RTO data

In 2014, the 9 RTOs participated in bilateral contracts with a total amount of 1,9 billion euro (1,8 billion euro in 2013). 80% stem from private industry, 73% correspond to partners located in the home country of the RTO. In the cooperation with a partner outside the home country, universities or foundations are more common than within the home country (19% in Europe and 22% outside Europe, versus 1% of all contracts in the home country).

These contracts correspond to a direct knowledge transfer to the contract partner, which is of great scientific/technological interest to them. Their willingness to pay, approximated by the amount of the bilateral contract, can be considered as a concrete estimate of the value for the receiving partner.

2.2.3 Value of knowledge transfer through contract research

Bilateral contracts: Technological value of 3,2 billion euro per year

TECHNOLOGICAL VALUE OF CONTRACT RESEARCH

(BILLION EURO)

2013	3,149
2014	3,163

Source: IDEA Consult based on RTO data and Knell (2008)

Besides estimating the knowledge transfer in contract research through the total contract amounts, one can also measure the economic value of this knowledge transfer for the receiving organisation. Most commonly, the empirical literature refers to a method based on the input-output tables and using the 'technology multiplier'³¹. The technology multiplier indicates the relationship between total technology intensity and R&D intensity. In other words, the relationship between the total embodied R&D and the intramural R&D, taking into account the direct and indirect technology diffusion in the region. The most recent estimation for the technology multiplier in the Euro zone is 1,98 (Knell, 2008³²). This means that for each euro of intramural R&D expenditures in the Euro zone, 1,98 euro of embodied technology is created. In what follows, we use the above mentioned technology multiplier to present an illustration of the value of the knowledge transfer of the 9 European RTOs through contract research³³.

To estimate the value of the knowledge transfer to European partners, we start from the contract research revenues of the 9 RTOs in the EU28 and Norway, which amount to almost 1,6 billion euro each year. These revenues are an indication of the willingness to pay of European enterprises to access the R&D of RTOs. In line with the results of Knell (2008) we apply the multiplier of 1.98 for the EU to calculate the value of the technology transfer through contract research. In 2014, the value of the 9 RTOs' global technology transfer through contract research in Europe is then estimated around 3,2 billion euro.

The technology multiplier is based on a robust methodology and values are relatively constant over time. In other studies we also see multipliers based on the return on investment principle, based on expert opinions or previous studies on business interaction with academia. The values for these multipliers are diverse and make comparison difficult. Many of the values we find in literature are higher than the technology multiplier estimated in Knell (2008).

³¹ This method is applied by Papaconstantinou et al. (1996) for 10 OECD countries and further refined, extended and updated by Knell (2008) for 25 European countries and the United States and Japan. These studies are based on OECD data (input-output database and ANBERD database).

³² The delay in the data applied (data of 2000 in the 2008 study for example) is caused by the limited frequency (5-annually in most cases) and the delay in publishing of the input-output tables. Because input-output data are relatively constant over time, the value of the multiplier also is.

³³ This multiplier methodology is developed at the level of countries, not institutions. Applying this multiplier to the technology transfer of an institution like imec therefore leads to results that need to be interpreted as illustrations rather than facts.



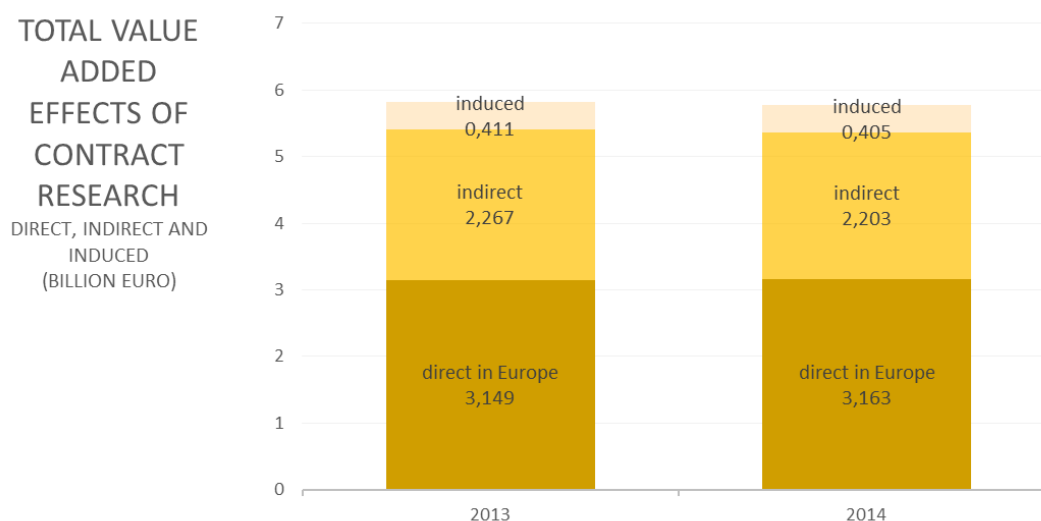
An example is the multiplier used in the report by BIGGAR Economics for LERU on the economic contribution of 21 LERU universities (2015)³⁴. This was based on previous evaluation of the Interface programme through Scottish Universities (2013), and found to be comparable to the value observed by PriceWaterhouseCoopers³⁵ in their study for the Department of Business, Enterprise & Regulatory Reform (2009). The first study found that the direct return to investment for businesses to participate in the programme was 360%. The latter found that interventions in 'Science, R&D and innovation infrastructure' returned a cumulative GVA of 340% of the cost of the project at the businesses. *Applying a multiplier of 3,6 instead of 1,98 to the value of the bilateral contracts (costs) with the 9 European RTOs, results in a total value added creation of 5,7 billion euro in 2013 and 5,8 billion euro in 2014.*

2.2.4 Economic impact of the technological knowledge transfer

Bilateral contracts: 93.000 additional HC jobs (or 80.200 FTE) corresponding to the technological value of contract research in 2014

The value attributed to the knowledge transfer via bilateral contract research was demonstrated in the previous part. Applying the RTO specific economic rates, this value added is translated to estimate the economic importance of the bilateral contract research. This means that we translate the value of the knowledge transfer to turnover and employment according to the specific economic ratios that are calculated for the 9 RTOs³⁶.

The total value added (direct, indirect and induced) that is created by means of knowledge transfer through contract research is estimated at around 5,8 billion euro, the total turnover at around 12,0 billion euro and the total employment at 80.220 FTE or 93.044 HC jobs in 2014. *Applying in the previous step the multiplier of 3,6 instead of 1,98 would result in values almost twice as high: a total value added (direct, indirect and induced) of 10,5 billion euro in 2014, a total turnover of around 21,9 billion euro and a total employment creation of around 146 thousand FTEs.*



³⁴ BiGGAR Economics (2015). Economic Contribution of the LERU Universities.

³⁵ PriceWaterhouseCoopers, Impact of RDA spending – National report – Volume 1 – Main Report, March 2009, DBERR.

³⁶ For example, the total value that is created directly by knowledge transfer is multiplied by the ratio "direct turnover over direct value added" to calculate the direct turnover of knowledge transfer from the RTOs. This direct turnover is in turn multiplied by the ratio "indirect turnover over direct turnover" to calculate the indirect turnover of the knowledge transfer from the RTOs. The induced turnover is then calculated as the "direct+indirect turnover" multiplied by the ratio "induced turnover over direct+indirect turnover".



Source: IDEA Consult based on RTO data

2.2.5 Fiscal return of the technological knowledge transfer

Fiscal and parafiscal impact: almost 2,4 billion euro flow-back to national governments through contract research each year

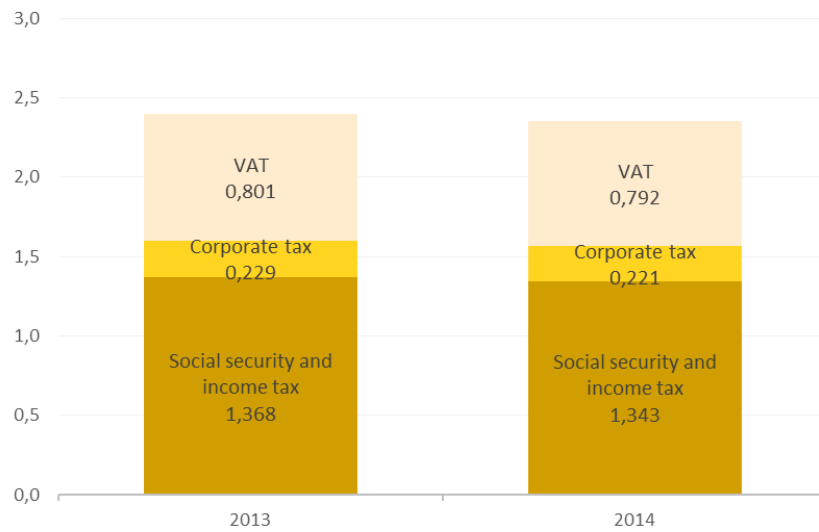
Also the economic effects of the contract research of RTOs lead to fiscal and parafiscal flow-back towards the respective governments of the European countries where the RTOs generate economic effects. The total fiscal return of contract research in the 9 RTOs amounts to 2,4 billion euro in 2014. This is comparable to the 2,5 billion euro of fiscal return from their core activities (cf. section 4.2 in Part2).

The main component of these revenues is labour taxes: 1,3 billion euro. Another 0,792 billion euro stems from the value added creation at the receivers and upstream in their value chain. The corporate tax generates around 0,221 billion euro of fiscal return.

Applying in the previous steps the multiplier of 3,6 instead of 1,98 for the estimation of value added from contract research, would result here in a total fiscal return of 4,3 billion euro in 2014.



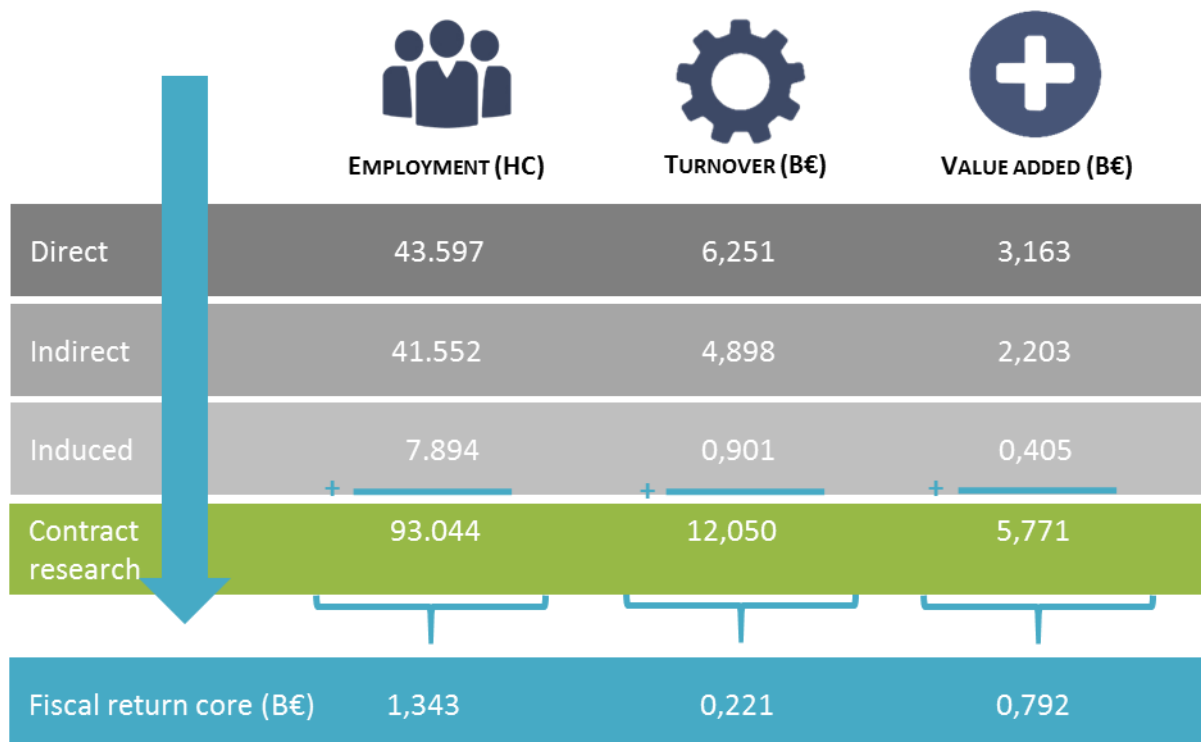
FISCAL AND PARAFISCAL RETURN OF CONTRACT RESEARCH (BILLION EURO)



Source: IDEA Consult based on RTO data

2.2.6 Adding up the economic effects of the RTOs' contract research

► In sum for the 9 RTOs in 2014:



= 2,4 BILLION EURO FISCAL RETURN CONTRACT RESEARCH



3/ Knowledge conversion: Spin-offs

Knowledge conversion refers to the process of converting scientific and technological knowledge to a format that allows for further commercialisation and a wider diffusion within society.

The knowledge conversion process consists of three different phases:

- market intelligence
- go-to-market policy
- implementation

Once a number of potential areas for commercialisation have been explored (market intelligence phase), it is necessary to develop a clear vision on how the potential fields of knowledge application can be translated into specific products (go-to-market policy phase). The creation of spin-offs can be one option to translate technological knowledge into prototypes and marketable products. Also patents can be an efficient instrument.

Finally, the integration of different forms of knowledge and the adoption of newly developed products can be enhanced by frequent interaction with stakeholders and the wider society. The implementation phase allows for the research projects to be evaluated within a specific context and stimulates the integration of new knowledge into the existing knowledge base.

In this study, we focus on spin-off creation to illustrate the importance of this kind of knowledge conversion flows also from an economic point of view. Spin-offs are an important instrument for the translation of scientific research into practical industrial applications and for the client-oriented transfer of applied research towards the interested knowledge receivers. For example, outflow of highly-qualified staff towards industry contributes strongly to the availability and absorption of highly-valued knowledge enterprises and their related industries.

3.1 Methodology

3.1.1 *Technological impact of spin-offs*

The number and size (in terms of FTE) of spin-off companies are reported as indication of the scale of knowledge conversion through this channel. The indicator is based on data delivered by the RTOs.

► Data

The input data for this indicator is a list of spin-off companies from each RTO, that are still active or were active at some point during the period 2013-2014. Spin-offs are defined as those companies with direct links to the RTO, based on knowledge/technology of the RTO. This also means that for instance the exit of people who start their own company or licencing to entrepreneurs, etc. are excluded here.

Two RTOs reported that they do not work with spin-offs on a formal basis as it does not fit their statute or vision. In one other case, the subsidiaries of spin-offs are listed along with the headquarters. In this case the spin-offs are to be considered as 'branches'. Finally, one RTO could not provide the list of all spin-offs still active due to data availability. They provided only the spin-offs that started their activities in 2013 and 2014.

Data on FTE were not always available. In some cases, where 2014 data were missing the 2013 data were also used in this year. But for 42 out of 261 spin-off companies, FTE data were not available in both years.

Both limitations (not all spin-offs counted and not all FTE of the spin-offs available) result in the fact that the indicators are to be considered lower boundaries to the real effect. On the other hand, a coverage of 84% of the FTE is more than sufficient to provide insights in the order of magnitude of the effect.

► Hypotheses for the analysis

Where data were not available for 2014, we have used 2013 data instead. This assumes that the employment in spin-off companies is more or less stable between 2013 and 2014, which is a reasonable assumption to make.

3.1.2 *Economic impact of spin-offs*

Spin-offs not only have an important potential value added in terms of translating basic research into commercial applications. They also create new jobs and have a positive impact on economic growth, just like any other new company. This aspect is considered in the economic impact assessment of the spin-offs.



As mentioned before, we cannot simply add the impact of the spin-offs to the footprint of RTOs (the founding organisation). For, not all accomplishments of these spin-offs can be attributed to the RTO. On the other hand, these spin-offs would not have existed without it. Therefore we calculate their economic impact as an indication of the importance of this kind of knowledge conversion processes for the European economy.

To calculate the economic impact of the spin-offs (direct, indirect and induced), we use the same method as for the calculation of the economic impact of RTOs' core activities. Only, less data are available than for the 9 RTOs so we apply the specific economic ratios found in the detailed calculations for the RTOs:

- Direct turnover spin-offs = direct FTE spin-offs * (direct turnover RTOs/direct FTE RTOs)
- Direct value added spin-offs = direct FTE spin-offs * (direct value added RTOs/direct FTE RTOs)
- For the three units (employment, turnover and value added):
 - Indirect effect spin-offs = direct effect spin-offs * (indirect effect RTOs/direct effect RTOs)
 - Induced effect spin-offs = (direct+indirect) effect spin-offs * [induced effect RTOs/(direct+indirect) effect RTOs]

► Data

For the spin-offs, only the direct employed FTE are available. To calculate the direct turnover and value added, and to estimate the indirect and induced impact, the specific economic ratios of the RTOs are applied (cf. supra).

► Hypotheses for the analysis

By applying the RTO specific ratios of turnover/FTE and value added/FTE in the direct economic impact assessment, we assume that the spin-off has a similar activity profile as the RTO. Also, by applying the RTO rates of indirect and induced impact compared to direct impact, we assume that the purchasing pattern of the spin-offs and the profile of the spin-off employees (average wage and spending) are the same as the purchasing pattern and the profile of employees at the RTO. We remark that the economic effects of spin-offs cannot be fully attributed to the RTOs that supported their startup.

3.1.3 *Fiscal return of the spin-offs*

To calculate the fiscal return of the spin-offs, each type of impact is translated to its specific fiscal return, i.e. turnover to corporate taxes, value added to VAT, employment to social security contributions and wage taxes. For this, the specific fiscal return ratios calculated for the RTOs are applied:

- Fiscal return from turnover knowledge transfer = turnover knowledge transfer * (fiscal return from turnover RTOs/total turnover RTOs)
- Fiscal return from value added knowledge transfer = value added knowledge transfer * (fiscal return from value added RTOs/total value added RTOs)
- Fiscal return from employment knowledge transfer = employment knowledge transfer * (fiscal return from employment RTOs/total employment RTOs)

► Data

The estimation of the economic impacts of spin-offs is available from the previous step. To calculate the fiscal return stemming from each type of impact, the specific ratios of the RTOs are applied (cf. supra).

► Hypotheses for the analysis

By applying the RTO specific ratios we assume that the effects of knowledge transfer have similar fiscal returns as the RTO's core activities. We remark that the fiscal returns of spin-offs cannot be fully attributed to the RTOs that supported their startup.

3.2 Results

3.2.1 *Economic impact of the spin-offs*

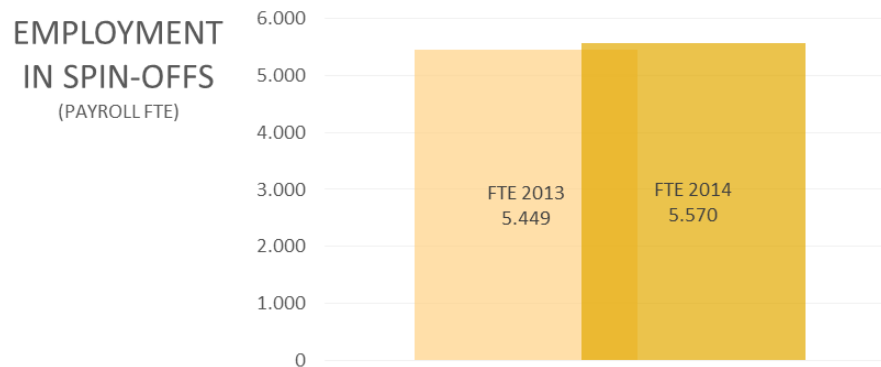
Economic impact of spin-off creation: 257 spin-offs result in around 6.500 HC (or 5.600 FTE) direct and over 7.300 indirect or induced HC (or 6.300 FTE) in the European economy in 2014

The creation of spin-offs is an important way for research intensive organisations to translate their scientific research into commercial or industrial applications and leverage the economic added value of this knowledge. Also, the human capital moving from the 'founding' organisation to the spin-off contributes to the availability and



dispersion of highly qualified knowledge and skills to the local economy and related industries. Several RTOs have an implicit or explicit spin-off strategy, while others indicate that they prefer other strategies to share their knowledge. In what follows, we estimate the economic impact of spin-off creation by the RTOs.

► **Spin-off activities directly employ around 6.500 HC (or 5.600 FTE) in Europe in 2014**



Source: IDEA Consult based on RTO data

Notes:

- This is to be considered an underestimation of the employment, because data are not available for all spin-offs. In the two cases where only 2013 figures are available, these are used as estimates for the employment in 2014.
- In one case, the number of spin-offs includes subsidiaries of spin-offs.
- In one case, the number of spin-offs and the employment only includes spin-offs started in 2013 or 2014. The employment numbers are in head counts instead of FTE for this one case.

The scientific activities of 7 RTOs in this study have led to the creation of many valuable spin-off activities over the years. 257 of their spin-off companies were still active in 2013-2014³⁷, and employed 6.460 HC (or 5.570 FTE) in Europe in 2014. 96% of the spin-off and employment creation is concentrated in the RTOs' respective home countries. Two companies started their activities in another European country than the EU28 or Norway. Eight companies started activities outside Europe.

DIRECT TURNOVER

(BILLION EURO)

2013	0,904
2014	0,926

Under the assumption that the spin-offs have a similar turnover per capita as the RTOs, the spin-offs' direct activities are good for an annual additional turnover of over 926 million euro in Europe.

Source: IDEA Consult based on RTO data

DIRECT VALUE ADDED

(BILLION EURO)

2013	0,447
2014	0,469

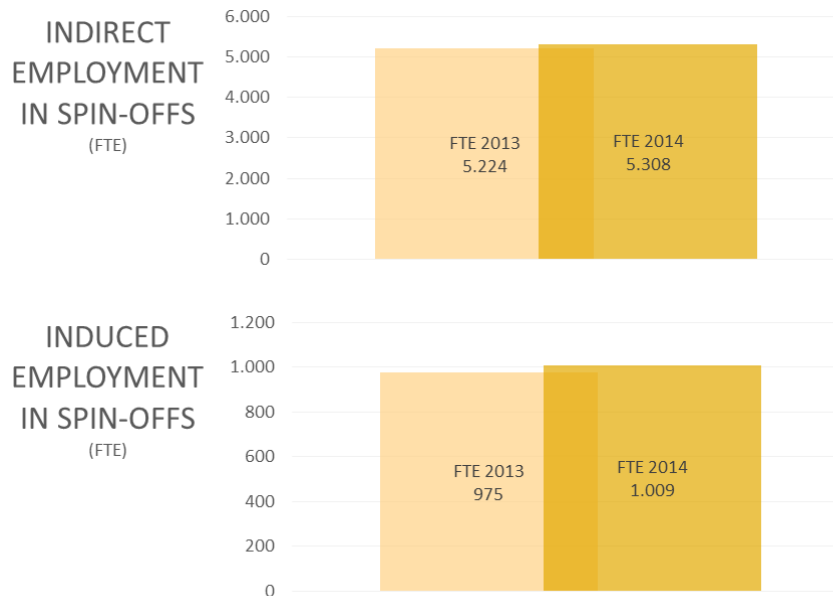
Under the assumption that the spin-offs have a similar value added per capita as the RTOs, the spin-offs direct activities are good for an annual additional value added of almost 470 million euro in Europe.

³⁷ For data feasibility reasons, only spin-offs still active in 2013 and 2014 are included.



Source: IDEA Consult based on RTO data

- ▶ **Spin-off activities created another 7.300 HC (or 6.300 FTE) of indirect and induced full-time jobs in Europe in 2014**



Source: IDEA Consult based on RTO data

INDIRECT TURNOVER (BILLION EURO)

2013	0,717
2014	0,726

INDUCED TURNOVER (BILLION EURO)

2013	0,130
2014	0,133

Source: IDEA Consult based on RTO data

The spin-offs' activities generate around 720 million euro of turnover at the spin-offs' suppliers each year, corresponding to 6.157 HC or 5.308 FTE positions in the European economy. Additionally, the people that are directly (5.570 FTE) and indirectly (5.308 FTE) employed through the spin-off activities consume more in the European economy than if they were not employed. In total an additional consumption of around 133 million euro is estimated each year. This consumption in turn leads to the creation of another 1.170 HC or 1.009 FTE in Europe.

INDIRECT VALUE ADDED (BILLION EURO)

2013	0,322
2014	0,326

INDUCED VALUE ADDED (BILLION EURO)

2013	0,058
2014	0,060

Source: IDEA Consult based on RTO data

The above quoted figures of indirect and induced turnover and employment equally correspond to an additional value added of 387 million euro in 2014 in the European economy that is linked to the spin-off activities of 7 RTOs.



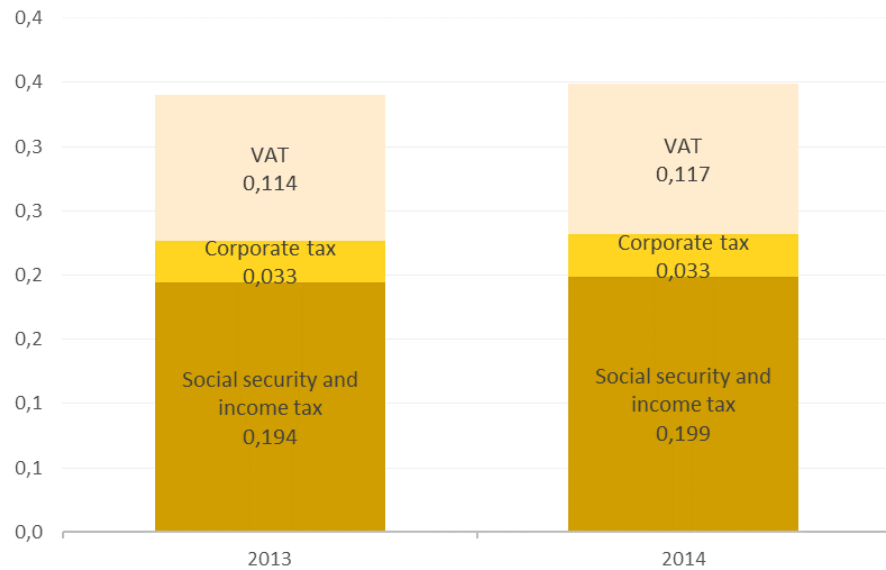
3.2.2 Fiscal return of the spin-offs

Fiscal and parafiscal impact: almost 350 million euro per year flow-back to national governments due to the spin-off activities of 7 RTOs

Also the economic effects of the spin-off activities of RTOs leads to fiscal and parafiscal flow-back towards the respective governments of the European countries where the spin-offs are created and where their economic impact is situated. The total fiscal return of RTOs' spin-offs amounts to 349 million euro in 2014.

More than half of these revenues stem from labour taxes: almost 200 million euro. Another 117 million euro is generated through value added creation at the spin-offs and upstream in their value chain. The corporate tax corresponds to around 33 million euro of fiscal return.

FISCAL AND PARAFISCAL RETURN OF SPIN-OFFS (BILLION EURO)

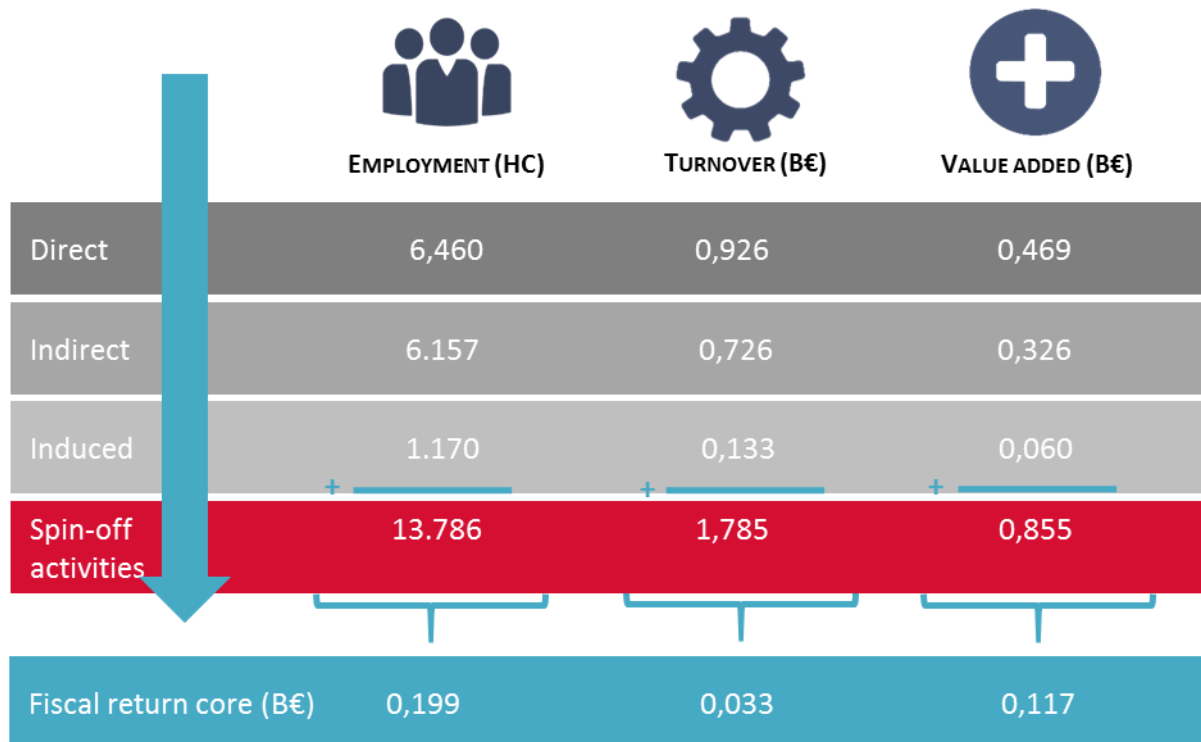


Source: IDEA Consult based on RTO data



3.2.3 Adding up the economic effects of the RTOs' spin-offs

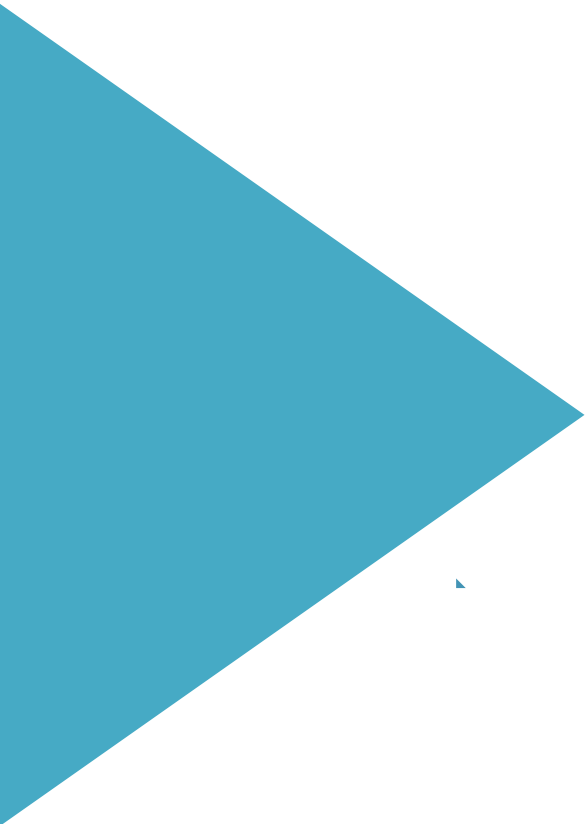
- In sum, for the 9 RTOs' spin-offs in 2014:



= 0,35 BILLION EURO FISCAL RETURN CONTRACT RESEARCH



PART 4: Benchmark





Throughout the report, the reader was guided to interpret the results in the right context and to look for comparable benchmarks. Points of attention are:

- **The scope of the economic footprint.** This study includes the direct, indirect and induced economic effect of 9 RTOs' core activities, and the economic effects of knowledge transfer through bilateral contracts and spin-offs. It however excludes other types of impacts such as:
 - Catalytic impact: The presence of RTOs in Europe is an important element in the location and collaboration decisions of many enterprises. Also the role of RTOs in the international research landscape and the overall ecosystem can be part of a catalytic impact assessment. The attractiveness and specialisation of a region in a specific field, combined with the technological and scientific cooperation of RTOs with both universities and industry, further supports regional (smart) specialisation.
 - Human capital impact: Through employment, training and interaction with higher education, RTOs are expected to have a positive impact on the development of human research capacity in Europe.
 - Social impact: The social impact refers to the role that an RTO plays in supporting and informing the society at large through education, communication, interaction with the broader public, but also by addressing the societal challenges through research.
 - Tourist impact: RTOs organise events, trainings, conferences that attract local but also international visitors to their region, who in turn make consumptions in hotels, restaurants, transport, etc. in the region.
- **The parameters and assumptions specific to the methodology.** Two elements in our methodology affect the results compared to other existing studies. They are both applied in the spirit of 'careful' estimations (to avoid overestimations or duplications) and thus add to the accuracy and robustness of the results.
 - In the economic footprint assessment, we compare the situation 'as is' with the counterfactual that the RTOs would not be active. We thereby assume that employees (direct and indirect) would be unemployed if the RTOs did not exist. The additional effect of an RTO is thus the difference between employment and unemployment of the direct and indirect employees. In this situation, we assume that the unemployed would receive an unemployment benefit, so that their income would not decrease to 0. Many other impact studies³⁸ in the field do assume that the unemployed have zero income in the counterfactual, which leads to an overestimation of the additional effects of the RTOs.
 - For the translation of bilateral contract research to the value added for the receivers, we apply the Knell (2008) technology multiplier, which is only half the parameter used in e.g. the BiGGAR Economics study for this purpose (based on previous studies they carried out). The impact of this parameter on the results is shown throughout the report and demonstrates how these results must be interpreted with care. For reasons of robustness (the Knell (2008) indicator is calculated based on input-output methodology) and carefulness, we prefer to apply the Knell (2008) indicator in our final results.

Nevertheless, for a number of results the methodology does not differ (that much) from other studies and we are able to benchmark them. This is the case for the indirect effects, where the indirect effect of the 9 RTOs can be compared to that generated by universities across Europe. BiGGAR Economics calculated the indirect impact of 21 LERU Universities located in 10 countries (Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the UK) throughout Europe³⁹. They found an indirect employment multiplier of 1,74 compared to the 1,95 of the RTO's (in methodology comparable to the indirect impact calculated for the 9 EARTO members). Similarly, they find an indirect value added multiplier of 1,51 as compared to 1,70 for the RTOs' (cf. Table 3).

³⁸ For example, the study of the Economic Contribution of the LERU Universities by BiGGAR Economics (2015) does not mention a correction for unemployment benefits.

³⁹ BiGGAR Economics (2015). Economic Contribution of the LERU Universities.



Table 3: Employment and value added multiplier of the 9 RTOs compared to universities

2014	9 EARTO RTO's (2014)	21 LERU universities
Employment FTE – direct (A)	48.086	158.335
Employment FTE – indirect (B)	45.831	117.696 ⁴⁰
Employment multiplier type I calculated by (A+B)/A	1,95	1,74
Value added incl. grants billion euro – direct (C)	4,046	12,100
Value added incl. grants billion euro – indirect (D)	2,819	6,200 ⁴¹
Value added multiplier type I calculated by (C+D)/C	1,70	1,51

Source: IDEA Consult and BiGGAR Economics (2015)

Also, to give a sense of magnitude of RTOs' economic leverage effects that were not considered in this study, we can refer to a study on the economic impact of imec (Belgium). Such study demonstrated that:

- imec attracts visitors from all over the world to Leuven and Eindhoven (for joint research activities, conferences, training). These foreign visitors often stay in the region and spend money in local hotels, restaurants, facilities,... A rough estimation of the economic effect of foreign visitors to imec in the Leuven and Eindhoven regions amounts to around 8.4 million euro of additional expenditures (direct, indirect and induced). The direct output (the consumption and expenditures of the visitors) alone corresponds to the turnover of a hotel or restaurant with approximately 50 full-time workers (compared to the 1.262 direct jobs and 290 million euro turnover of imec at that time).
- The knowledge transfer that resulted from imec's contract research, mobility of imec staff to other sectors and training has an economic value for the European economy estimated to 259 million euro in 2010 (of which approximately 84% via contract research).

Finally, the exits of RTO employees to other organisations or sectors also have an important knowledge transfer and economic effect, which we did not measure for the 9 RTOs in this study due to data limitations. Many of the outflowing employees/researchers go to industry, not rarely taking up positions with high levels of responsibility (management, product development, strategic business development, etc.). As such, very well educated people flow from RTOs to industry, having much more knowhow than those leaving the university. The mobility effect is also substantial: 4 of the 9 RTOs that monitor mobility of staff estimate that between 4% and 13% of the total staff leaves the RTOs each year and that between one third and two thirds of these transfer to private companies. A rough extrapolation for the 9 RTOs in the sample thus results in estimations of between 2.200 and 7.300 exits employees flowing from RTOs to industry each year, of which between 740 and 4.800 to private companies. This means that **RTOs are thus responsible for the transfer of on average 2.200 well-educated and experienced employees to private industry each year**. This human capital effect is thus to be taken into account when considering the entire range of effects of RTOs on the European economy.

⁴⁰ Sum of employment related to spending to supplies (90.408) and employment related to capital spending (27.288).

⁴¹ Sum of gross value added related to spending to supplies (4,400 billion euros) and gross value added related to capital spending (1,800 billion euro).



PART 5: Summary and conclusions

The analysis in this report focuses on the economic impact of 9 European RTOs. We acknowledge that the main dimensions in the discussion of the 'value' of RTOs are in science, innovation and society. Nevertheless, although RTOs have a specific profile as an organisation and their mission is not necessarily economic in nature, the results of this study show that RTOs also have an important impact on our European economy. Quantifying these economic effects supports the demonstration of RTOs' and EARTO's value for the economy and society in Europe.

Based on the analysis, we find for the core activities of the 9 RTOs that:

- Over 119.000 HC (or 102.600 FTE) in Europe are linked to the existence and core activities of the 9 largest RTOs, corresponding to a total additional turnover of 15,4 billion euro and a value added creation of around 7,3 billion euro each year (including the operational grant). These also lead to a fiscal and para-fiscal return to government of around 2,4 billion euro each year.

Also two important knowledge transfer mechanisms were included in the analysis: contract research and spin-off activities. Both have an important economic impact and illustrate that also the scientific and technological activities have positive economic effects on the European economy – even if it is not their prime objective.

- The bilateral contracts that RTOs engage in created a total value of over 5,8 billion euro at the side of the receivers of the knowledge transfer. This created value results in another 93.000 HC (or 80.200 FTE) jobs that can be linked to the RTO activities, an additional turnover of around 12 billion euro and a fiscal and para-fiscal return to government of more than 2,4 billion euro.
- Similarly, the spin-offs of 7 RTOs lead to the creation of 13.800 HC (or 11.900 FTE) in Europe, of which partly directly in the spin-offs, partly at their suppliers and partly in the broader economy thanks to additional consumption by the first two groups. This created an additional turnover of 1,8 billion euro, a value-added creation of around 0,8 billion euro, and a fiscal and para-fiscal return to government of more than 0,3 billion euro.

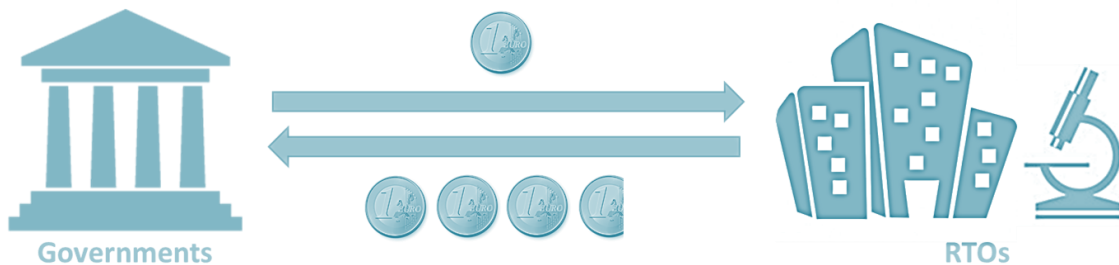
Aggregating the effects from core activities and generated through bilateral contracts and spin-offs, results in **a total of 225.900 HC (or 194.700 FTE) created in the European economy that can be linked to the activities of the 9 RTOs included in this footprint. The total turnover created amounts to more than 29 billion euro, the value-added to 14 billion euro, and the fiscal and para-fiscal return to governments to 5 billion euro in 2014.** This is a lower boundary to the total effect that would take into account all other types of impact (technological, social, tourism, human capital development, etc.).



For each job in these RTOs, another 3 jobs were created elsewhere in the European economy (on top of the 1 direct job in the RTO) in 2014, either at the suppliers

of the RTOs or in the broader economy, thanks to the additional consumption of the employees of both the RTOs and their suppliers, and thanks to the effects of knowledge transfer through bilateral contract research and spin-offs.

The operational grants received by the RTOs in this study, are earned back by national governments through fiscal return mechanisms. **For each 1 euro invested in the form of operational grants, almost 4 euro flow back to the national governments⁴².** In other words, 376% of the amount spent on operational grants for RTOs returns to governments through fiscal revenues.



⁴² Applying the multiplier of 3,6 instead of 1,98, like in the BIGGAR Economics study on LERU universities, would result in a total fiscal return of 5,5 in 2014, thus approaching the result of this study even with only a limited set of impacts measured for the RTOs.



Table 4 below summarises the key results from our economic footprint study of 9 RTOs in Europe.

We also looked into the possibility to extrapolate these findings to the entire RTO sector in Europe. However, very little statistics are available for the European RTO sector. In 2010, Technopolis calculated the size of the sector in a report for EARTO⁴³. The study integrated and analysed existing information from different sources. It estimated a total turnover of European RTOs between 18,5 and 23 billion euro. If we use this range to roughly estimate the total impact of European RTOs⁴⁴, we find a total employment creation of between 275 and 342 thousand jobs in Europe that are generated through the core activities of European RTOs. Including also the effects from bilateral contracts and spin-offs, we find an impressive total of between 522 and 650 thousand jobs in Europe that are related to (a selection of) activities of the European RTOs.

⁴³ Technopolis (2010). Impacts of European RTOS, A Study of Social and Economic Impacts of Research and Technology Organisations. A Report to EARTO.

⁴⁴ Thus assuming that the 9 RTOs in the sample are on average representative for the total population of RTOs.



Table 4: Overview of the economic effects of 9 EARTO members

	2013	2014
CORE ECONOMIC ACTIVITIES OF RTOs		
Direct impact		
Employment creation (HC / FTE)	55.667 / 47.981	55.773 / 48.086
Turnover creation (billion euro, incl. grant)	7,963	7,997
Value added creation (billion euro, incl. grant)	3,935	4,046
Indirect impact (through RTOs suppliers)		
Employment creation (HC / FTE)	53.363 / 45.995	53.157 / 45.831
Turnover creation (billion euro)	6,317	6,266
Value added creation (billion euro)	2,833	2,819
Induced impact		
Employment creation (HC / FTE)	9.958 / 8.583	10.099 / 8.707
Turnover creation (billion euro)	1,146	1,152
Value added creation (billion euro)	0,513	0,519
Fiscal and parafiscal returns		
Through employment (billion euro)	1,710	1,718
Through turnover (billion euro)	0,220	0,218
Through valued added (billion euro)	0,510	0,526
TOTAL impact of core economic activities		
Employment creation (HC / FTE)	118.989 / 102.560	119.030 / 102.624
Turnover creation (billion euro)	15,426	15,415
Value added creation (billion euro)	7,282	7,383
Fiscal and parafiscal return (billion euro)	2,441	2,462
<i>Employment multiplier core activities (total of direct, indirect and induced jobs / jobs directly at an RTO)</i>	<i>2,14</i>	<i>2,13</i> ¹
<i>Fiscal leverage core activities (fiscal return core activities / operational grant)</i>	<i>1,45</i>	<i>1,50</i> ²
TECHNOLOGICAL SPILLOVER EFFECTS		
Knowledge transformation & transfer through contract research		
Total employment creation (HC / FTE)	95.201 / 82.057	93.044 / 80.220
Total turnover creation (billion euro)	12,342	12,050
Total value added creation (billion euro)	5,826	5,771
Fiscal and parafiscal return (billion euro)	2,398	2,356
Spin-off activities		
Total employment creation (HC / FTE)	13.514 / 11.648	13.786 / 11.886
Total turnover creation (billion euro)	1,752	1,785
Total value added creation (billion euro)	0,827	0,855
Fiscal and parafiscal return (billion euro)	0,340	0,349
TOTAL AGREGATED EFFECT		
Total employment creation (HC / FTE)	227.703 / 196.265	225.860 / 194.730
Total turnover creation (billion euro)	29,520	29,251
Total value added creation (billion euro)	13,934	14,010
Fiscal and parafiscal return (billion euro)	5,179	5,167
<i>Overall employment multiplier (FTE core activities, bilateral contracts and spin-offs/FTE employed directly at an RTO)</i>	<i>4,09</i>	<i>4,05</i> ³
<i>Total fiscal leverage (fiscal return core activities, bilateral contracts and spin-offs/operational grant)</i>	<i>3,63</i>	<i>3,76</i> ⁴

Source: IDEA Consult based on RTO data



- ¹ In 2014, for each 1 job in these RTOs, another 1,13 jobs were created elsewhere in Europe due to the core economic activities of RTOs (on top of the 1 direct job in the RTO).
- ² In 2014, for each €1 invested in the form of operational grants, €1,50 flow back to the national governments due to the core economic activities of RTOs.
- ³ In 2014, for each 1 job in these RTOs, another 3,05 jobs were created elsewhere in Europe due to both the core economic activities of RTOs and their technological spillover effects (on top of the 1 direct job in the RTO).
- ⁴ In 2014, for each €1 invested in the form of operational grants, €3,76 flow back to the national governments due to both the core economic activities of RTOs and their technological spillover effects.