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The role of RTOs in developing, and fostering market & societal uptake and scale-up of critical technologies

Key highlights from the RTOs International Network (RIN) Benchmarking report 2022-2024

Paper for EARTO

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Executive summary

This report presents some of the highlights from the **Research and Technology Organisations (RTOs) International Benchmarking report 2022–2024**, a collaborative exercise run through the RTO International Network (RIN) under the European Association of Research and Technology Organisations (EARTO) and implemented by Technopolis Group. This latest edition brought together nine prominent RTOs across Europe, Asia, and North America, sharing strategic insights and best practices, while fostering a global community of practice and informing policymakers on emerging trends.

As shown in the figure below, RTOs are instrumental in **developing critical and emerging technologies** and ensuring their wide **market and societal uptake and scale-up**. They manage and provide access to **research and technology infrastructures**, enable **ecosystem consolidation** and value-chain integration, and support the **upskilling and reskilling** of the workforce.

To do so:

- RTOs collaborate with academia and universities to **leverage cutting-edge scientific developments**, thereby accelerating the research-to-market process. They also **work closely with deep-tech industries** (the early adopters) and non-tech market players to foster the effective uptake and scale-up of innovation.

- Operating with both **public and private funding**, highly **skilled talent**, and **intellectual property**, RTOs **public mission is to deliver impact**, boosting the sustainable competitiveness and technological transformation of industry, yielding societal benefits through broader technology adoption, and providing policy advice to public authorities.

Figure 1 The role of RTOs in the RD&I Ecosystem
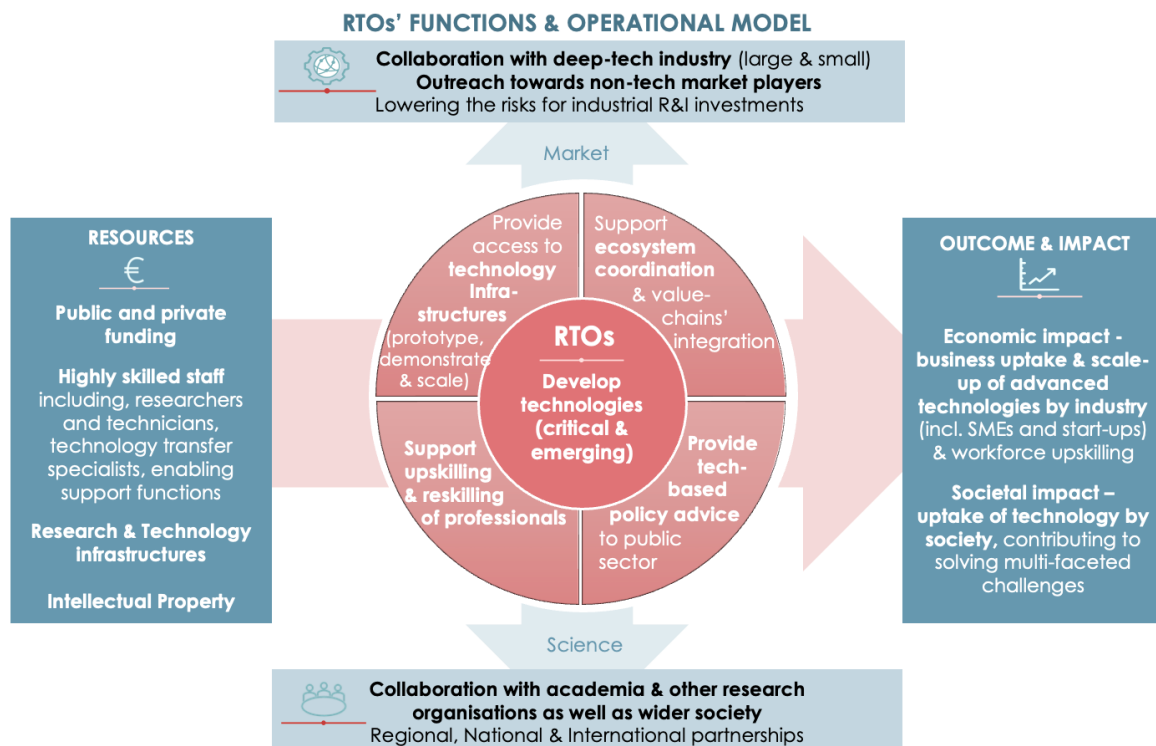
Source: Technopolis Group 2025

Key findings

Part 1 - RTOs' profile: rooted to deliver impact

- Despite the diversity of their legal statuses and national contexts, RTOs share many **similarities in their public missions** and service delivery models.

- RTOs vary in size but share a **three-fold public-private funding mix** relying on institutionalised, competitive and private funding to deliver their mission.

- **Attracting talents and upskilling** are at the core of RTOs' modus operandi, and most RTOs have adopted diversity and inclusiveness policies.

- RTOs manage and provide access to their portfolio of **research & technology Infrastructures** to support the development and upscaling of technology, lowering the risks for industry RD&I investments.

Part 2 - RTOs' role in developing advanced and disruptive technologies

- RTOs adopt a **collaborative model** to develop technologies in close collaboration with public & private partners.

- **Technology development adapted to industry's needs** is enshrined in RTOs' mandates, with specific collaboration models dedicated to SMEs.

- RTOs facilitate the **cross-fertilisation between technologies and across application sectors** to drive innovative and integrated solutions.

- RTOs support the twin transition by **integrating digital transformation with environmental sustainability** to foster competitive and resilient industries.

- RTOs drive the **digital transformation of RD&I processes** and activities, for instance through the strategic use of AI and harvesting the power of data.

Part 3 - RTOs' public mission: fostering the market and societal uptake and scale-up of advanced technologies

- RTOs' **play a "convenor" role** in RD&I ecosystems at regional, national and EU/international levels, seeking to build a sustainable and resilient industry and society through targeted initiatives.

- Many RTOs have put (new) processes in place to foster **interdisciplinary research and participatory approaches** with a wide range of stakeholders and citizens.

- While shaped by recent global events and economic security concerns, **strategic internationalisation remains deeply rooted within RTOs' mission** and yields significant added value

- **Knowledge valorisation and technology diffusion** are key elements of RTOs' mission delivery, including patenting and spin-off creation.

- RTOs provide support for the **re-skilling and up-skilling** of industry.

Acknowledgements

Introduction

This report highlights the main findings from the Research and Technology Organisations (RTOs)' International Benchmarking 2022-2024 report.

The **RTO International Benchmarking exercise** has been ongoing since 2012 and was originally managed by the participating RTOs. It has been conducted through the RTO International Network (RIN) within the European Association of Research and Technology Organisations (EARTO) since 2021. The 2022-2024 edition has been implemented by Technopolis Group.

The **nine participating RTOs** involved in this benchmarking round 2022-2024 include: AIST (Japan), CEA (France), Fraunhofer (Germany), ITRI (Taiwan), NRC (Canada), RISE (Sweden), SINTEF (Norway), TNO (Netherlands), and VTT (Finland). A Core Team constituted of representatives from NRC (Chair), ITRI and VTT has played an important role in steering the study.

The **objectives** of the RIN Benchmarking exercise are rooted in the sharing of data and strategic insights, challenges, good practices and new approaches, providing visibility on the participating RTOs' relative positioning with their global counterparts. Beyond the analysis itself, the continuity of the exercise over time also led to the creation of an International RTOs' Community of Practice, nurturing an agile network of experts for peer-learning, with different compositions adapted to the topics discussed. Another important outcome of the exercise relates to the enhancement of internal data collection processes within the participating RTOs. It also enables the identification of (emerging) trends and approaches to common challenges by RTOs across the globe, feeding discussions with policymakers.

Regarding the **methodology**, the findings presented in this report are based on a limited subset of the quantitative and qualitative data collected from the 9 participating RTOs through dedicated questionnaires. This was supplemented by interviews and workshop sessions, along with secondary data analysis, including bibliometrics and patents. The final benchmarking report and its annexes remain confidential and for the internal use of the participating RTOs only, under the terms of non-disclosure agreements (NDA), while an anonymised version enable these RTOs to spark conversations with a selected set of governing bodies.

This public paper highlights a limited subset of key trends and findings from such analysis. It provides elements on the functioning of an RTO and aims at profiling this initiative towards new RTOs for its next edition. With regard to its structure, the paper is divided into three sections:

- **The first section** outlines the public mission, funding mix, human resources, research and technology infrastructures' capabilities, and international dimension that shape RTOs' capacity to deliver impact.

- **The second section** focuses on RTOs' model for the development of advanced and disruptive technologies, highlighting their interdisciplinary, cross-fertilisation of technology and cross-sectoral approaches, as well as their contribution to the sustainable transition and digital transformation of industry.

- **The third section** examines how RTOs contribute to the consolidation of ecosystems at regional, national and EU levels with a global outreach, supporting market and societal uptake of advanced technologies through knowledge valorisation, technology diffusion, spin-off creation, and re-skilling and up-skilling initiatives for the industrial workforce.

Finally, the report concludes with a short synthesis of the main findings, drawing together the key insights and recommendations from the benchmarking exercise.

1 RTOs' profile rooted to deliver impact

1.1 RTOs' mission – deliver impact

RTOs have very **diverse legal statuses,** often depending on their national context and historical development. Despite this apparent diversity, RTOs share many similarities **in their public missions** and service delivery models.

- RTOs' **research remit** is strongly focused on applied research, with some RTOs also covering closer-to-market experimental development activities, or encompassing some basic research, to a lesser extent.

- **RTOs' public mission** mainly focuses on supporting industry and creating value for society by contributing to solving multi-faceted challenges, while many RTOs also provide research-based policy advice to their governments.

- RTOs directly **report to their national government**, typically to the Ministry in charge of Industry/Economic development or the Ministry of Research and Education.

- RTOs are **mostly not-for-profit**, and any profit is usually reinvested into research or competence-building activities.

Figure 2 RTOs' three-fold mission: delivering impact for industry, society & public bodies
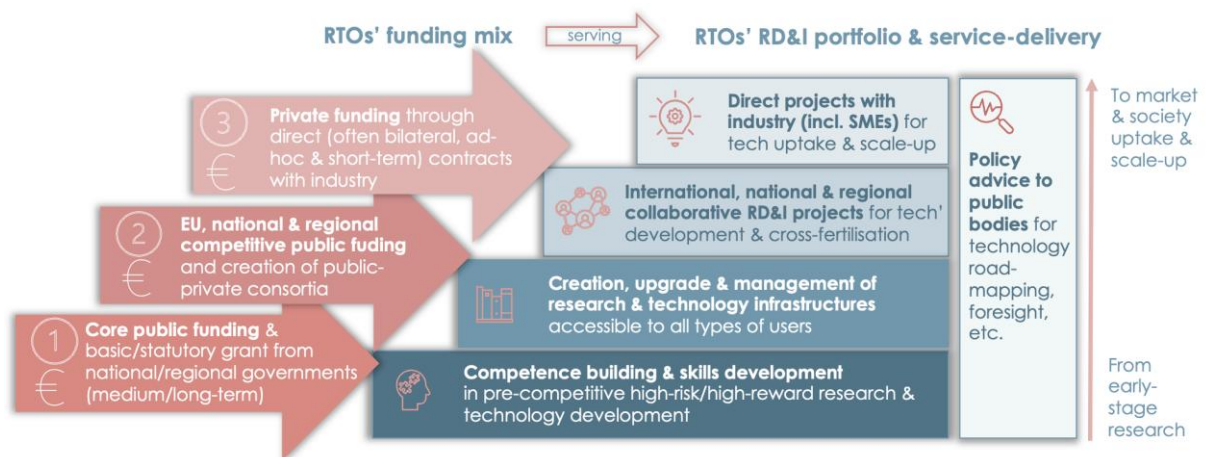

Source: Technopolis Group 2025

1.2 RTOs' three-fold funding mix

The **size of RTOs** varies considerably in terms of staffing volume and total revenues, with very large RTOs of up to €3.5bn annual revenue encompassing all technology fields, down to specialised small-scale RTOs, mostly active locally.

RTOs share a **three-fold public-private funding mix,** but the split between institutionalised/government base funding, competitive public funding, and private funding sources differs. A balanced "three-thirds" funding mix is not common across RTOs, even though it remains the targeted model for some.

Figure 3 RTOs' funding mix and RD&I portfolio

Source: Technopolis Group 2025

- **Government-base funding** provides long-term, stable public budgets that support strategic high-risk research and capacity building, including investments in research and technology infrastructures and in-house competence development, often in collaboration with universities and research institutions. It is an essential part of RTOs' financial mix to overcome the lack of RD&I investments by the private sector (market failure) and support the development of relevant state-of-the-art RD&I to address future technology needs and challenges**.** This funding is typically fixed over several years and may be tied to specific public missions. The size and composition of the public funding source of revenues depend strongly on the RTO's national context.

- **Competitive publicly funded RD&I** finances medium-term, pre-competitive technology development projects that address key societal and industrial challenges. These collaborative initiatives, usually funded by International/European, national, or regional competitive programmes, leverage RTOs' own resources to yield medium-term returns and drive impactful innovation in collaboration with the whole R&I ecosystem actors, including industry. RTOs' reliance on such funding stream, often varies depending on the scale of support they receive through government-base funding, and their success in leveraging revenues directly from industry.

- **Revenues from direct collaboration/contract with industry** enables short-term, market-focused knowledge and technology application through collaborative and contract-

based projects, enabling the testing, validation, and scale-up of technologies. The immediate value generated is reinvested into subsequent innovation cycles, supporting ongoing technology diffusion and competence-building needs. For the RTOs that rely the most on funding from industry (often higher TRL, shorter-term R&I), it is even more critical to ensure that they remain competitive in the longer-term.

RTOs' core challenge remains to find the right balance between these sources of funding, heavily influenced by their national context, including government and business' RD&I expenditures.

1.3   Skilled workforce and key enabling functions

Attracting talents and upskilling are at the core of RTOs' modus operandi, and most RTOs have adopted diversity and inclusiveness policies. Most of RTOs' staff are research and technical professionals, many holding advanced degrees and PhDs in technological fields, and some holding adjunct professorships at universities. A smaller share of staff carries out administrative or technology transfer functions, including IPR management, business development, and process digitalisation.

With regard to **skills development**, continuous training and close ties with academia help RTOs address skills shortages. Hosting academic students further strengthens their research capacity and talent pipeline. On **talent attraction and retention**, RTOs place high priority on recruiting skilled personnel and maintaining a relatively low turnover rate. They also attract a significant share of international staff.

Most RTOs also have formal policies to promote **diversity and inclusiveness** in their workforce, seen as a driving force for innovation. For many RTOs, the share of women is rising, as a notable proportion of the workforce – heavily depending on the technology field. The age profile varies, partly influenced by national context and strategies for staff rotation.

1.4   The role of research & technology Infrastructures to support market uptake

RTOs **manage, maintain and provide access to state-of-the-art (large-scale) research and technology infrastructures.** These are **sometimes maintained on behalf of the nation**, directly in the scope of RTOs' public mandate.

Based on European definitions[1], **technology infrastructures** (TIs) are physical or virtual facilities and sets of equipment and related support services that can be referred to as testbeds, pilot lines, testing and experimentation facilities, etc. They aim to develop, mature, test, demonstrate and upscale innovative technologies, from validation in a lab up to competitive market entry, for their integration into new products, processes and services. TIs primarily serve the needs of industry, supporting technology transfer and industry's uptake of research results, thereby reducing the risks of private R&I investments. They deliver a wide range of technology and business-oriented services that are openly accessible to all types of users, mainly from various industries, including SMEs, start-ups, and large enterprises.

A considerable share of RTOs' **capital expenditures** (CapEx) is dedicated to the **creation or upgrade** of those Infrastructures (e.g., quantum computers, electric transport testbed, cleanrooms, biologic manufacturing centre, etc.). Operational costs (OpEx) are a non-negligible item in TIs' funding mix, often representing 10-15% of CapEx investments over the TIs'

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[1] European Commission, Technology Infrastructures, https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/technology-infrastructures_en

lifecycle. The operational costs for using these infrastructures are typically partly covered within RTOs' contracts with public and private partners, including through competitive funding, and complemented with statutory funding.

2   RTOs' role in developing advanced and disruptive technologies

2.1   Development of advanced technologies through a co-creation model

RTOs collaborate with other research partners, public and private, for joint knowledge and technology generation, development and maturation, through a collaborative approach thereby accelerating the research-to-market process. This is shown for instance by their high share of co-patenting and co-publication, and their important role leading and contributing to public-private consortia in competitively funded R&I programmes. Further to that, RTOs also collaborate with NGOs and civil society to foster societal adoption of new technologies, as well as with public governments through policy advising.

2.1.1   RTOs collaborate with industry to develop technology solutions best adapted to their needs

Collaboration with industry is at the core of all RTOs' activities, and it is therefore essential for RTOs to ensure the relevance of their R&I portfolio to best serve industry's needs. Further to this, the benchmarked RTOs are regularly putting in place new initiatives to **further deepen and extend those collaborations,** in line with their core mission to support industry's uptake of technology. This includes the establishment of new divisions, targeted initiatives to address the needs of specific sectors, contribution to public-private partnerships, new collaboration structures, new or upgraded technology infrastructures, etc.

Competitively funded RD&I collaborative projects, including those under the EU R&I Framework Programmes, also serve to reinforce RTO's collaboration with industry at both national and international levels. They often **focus on higher-risk pre-competitive research**, where public funding is necessary to address the lack of private RD&I investments (market failure). These projects often lead to direct contracts or collaboration agreements between RTOs and industry, further advancing technologies towards adoption and scale-up.

These direct collaboration mechanisms between RTOs and industry can **take various forms at different Technology Readiness Levels (TRLs)**, from collaborative agreements to direct commissioned contracts, but also testing and technical services, and to a lesser extent certification and other quality assurance services, or IP licencing. The size and duration of RTOs' contracts with industry varies considerably, from multi-year contracts and long-term memoranda of understandings (MoU) often with large enterprises, to smaller ad-hoc contracts including with SMEs and start-ups. Many RTOs seek to further develop long-term relations with their industrial partners, also to improve their ability for longer-term capacity planning.

RTOs' collaboration with the private sector often correlates with **national Business Expenditure on R&D.** In most countries, **the limited flow of Business Enterprise R&D expenditure (BERD) to non-business sectors** showcases the difficulty for research organisations like RTOs to attract additional private funding. This also highlights to role of R&I programmes and other measures such as tax incentives to incentivise such investments.

Most RTOs especially target **technology-oriented SMEs** and start-ups, including their own spin-offs, and often provide a dedicated set of support services to foster SMEs' uptake of innovative solutions. Those mostly enable speed and agility in the response provided to SMEs' challenges,

best serving their needs. Some RTOs also address the needs of non-tech SMEs in specific sectors. The limited financial capacity of SMEs not matching their high-level ambitions is a key challenge, but many RTOs have set up specific measures to attract and support them nonetheless, often as part of a wider regional ecosystem (see section below).

2.1.2 *RTOs collaborate with academia and research-intensive universities to advance frontier technologies*

At the lower end of the technology maturity scale, RTOs work closely with **research-intensive universities and non-profit organisations** to harness cutting-edge scientific developments and drive the creation of potentially disruptive technologies. On the other hand, universities benefit from the collaboration with RTOs as well, as it enables them to better understand the needs from industry and novel innovation practices.

While building their own researchers' **skills** and **upgrading their research & technology infrastructures** for emerging technologies, RTOs draw on their proximity to industry to anticipate new needs and orientate pre-competitive research. They contribute to **advancing frontier technologies**, emerging from the intersection of radical scientific breakthroughs and practical, real-world implementation.

To that end, **collaboration with universities and other research-performing institutions** is an essential component of RTOs' service delivery model. It can entail ad hoc collaboration, including through competitively funded projects, but also dedicated initiatives such as the establishment of joint laboratories or Research and Technology infrastructures, or the development of dedicated, challenge-based joint research programmes leveraging RTOs' statutory public funding.

2.1.3 *RTOs collaborate with NGOs and civil society to foster societal uptake of technology*

RTOs are also developing new forms of collaboration with NGOs and civil society. They are increasingly aiming to strengthen the involvement of end users in their research activities, often on a case-by-case basis, with the objective to increase the societal acceptance of technology.

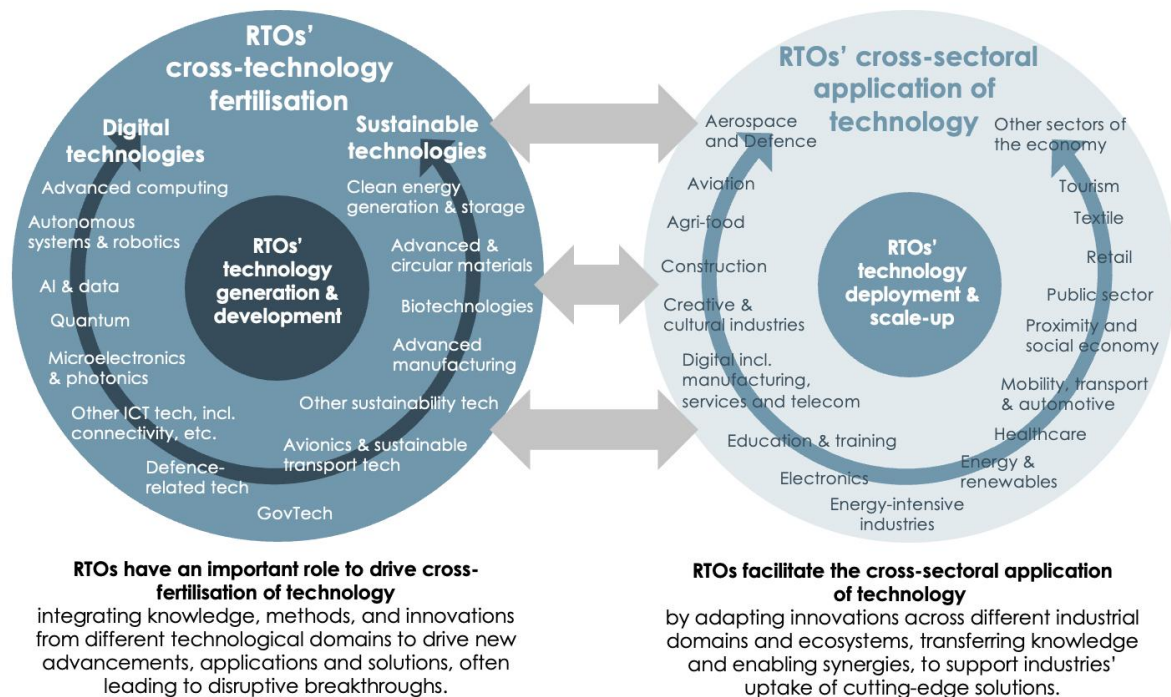### 2.1.4 *RTOs collaborate with the public sector through policy advising and science diplomacy*

Most RTOs also have an important policy advising role towards their government, sometimes to various ministries (permanently or punctually) to support policy making through foresight, technology roadmapping, contribution to national (RD&I and industrial) strategies, science diplomacy, etc.

2.2 Fostering cross-technology fertilisation and cross-sectoral application

As illustrated in the figure below, **RTOs have an important role to drive the cross-fertilisation of technologies,** integrating knowledge, methods, and innovations from different technological domains to drive new advancements, applications and solutions, often leading to disruptive breakthroughs. They create direct links between sustainable and digital technologies. These innovations include both those creating entirely new markets and those addressing specific industry needs through incremental improvements, crucial for Europe's future competitiveness.

In addition, RTOs help apply these technologies across different sectors by tailoring innovations to diverse industrial settings. They facilitate the **cross-sectoral application of technologies**, by adapting innovations, transferring knowledge and enabling synergies, to support industries' uptake of cutting-edge solutions. Their strong industry focus ensures effective technology diffusion, sometimes extending well beyond the original scope of research.

Figure 4 RTOs' role in the cross-fertilisation of advanced technologies

RTOs have an important role to drive cross-fertilisation of technology
integrating knowledge, methods, and innovations from different technological domains to drive new advancements, applications and solutions, often leading to disruptive breakthroughs.

RTOs facilitate the cross-sectoral application of technology
by adapting innovations across different industrial domains and ecosystems, transferring knowledge and enabling synergies, to support industries' uptake of cutting-edge solutions.

Source: Technopolis Group 2025

Further to this, most benchmarked RTOs also seek to expand the **integration of Social Science and Humanities** throughout their technology development activities. In addition, many RTOs have put (new) processes in place to foster **interdisciplinary research** and participatory approaches with society and foster. Several initiatives have been further discussed and analysed during the frame of the study.

2.3   Supporting the sustainable transition

Further to their cross-fertilisation capability, the **role of RTOs in RD&I ecosystems**, connecting research to industry, as well as their international dimension, place them as key actors to deliver on the twin transition objectives.

RTOs' role to deliver on the sustainable transition has become central to RTOs' missions and is often embedded as horizontal priority into their corporate strategies. These are directly aligned with policy initiatives, frameworks and roadmaps at national, European and international levels, such as the United Nations' Sustainable Development Goals (SDGs), the Paris Agreement, or the European Corporate Sustainability Reporting Directive (CSRD).

Most RTOs have adopted **internal initiatives and policies driving the sustainable transition,** from the allocation of RTOs' statutory funding, the maintenance and upgrade of existing infrastructures with greening considerations, but also the use of low carbon energy sources, measures to increase energy efficiency and foster recycling and waste management, specific home office and travel policies considerations, etc.

RTOs actively engage with other stakeholders in that domain and often have leading roles in public-private partnerships, networks, and associations, at national, European and international levels, focusing on building a sustainable and resilient society. RTOs lead large multi-stakeholder R&I initiatives, (co)host RD&I units, labs and infrastructures, provide dedicated

services to support the **sustainable competitiveness of industry and SMEs**, and foster participatory approaches with society.

2.4   Support the digital transformation

RTOs' activities support the twin transition and drive the **digital transformation of RD&I processes** and activities, for instance through the strategic use of AI and harvesting the power of data.

RTOs play a key role in **supporting the digital transformation of industry**, driving advance digital technology developments in all fields from Artificial Intelligence, data and robotics to semiconductors and photonics, including quantum, advanced computing, connectivity, cybersecurity, etc. They manage cutting-edge technology infrastructures, making them accessible to diverse user groups to foster technology maturation and uptake. In parallel, they help address the shortage of advanced digital skills by supporting specialised training, ensuring that industry can absorb and benefit from digital innovations.

On top of supporting industry's uptake of digital technologies, **RTOs invest significantly in the digitalisation of RD&I processes,** creating dynamic digital roadmaps that keep pace with fast-evolving technologies. By investing in these transformations of research and innovation processes, they aim to build capacity, boost productivity, and attract talent, ultimately helping to address complex societal and industrial challenges. Many RTOs are implementing novel approaches in line with national guidelines and use a broad range of advanced digital tools beyond AI and data analytics, including advanced computing infrastructures and communication technologies, as well as cutting-edge cybersecurity solutions. Data governance frameworks play a key role in harvesting the full potential of these technologies, covering data management plans, secure storage, privacy standards, and responsible RD&I practices. The level of digitalisation of RD&I activities vary significantly across research fields. As part of this transformation, RTOs are also prioritising digital skills development among their workforce through dedicated training programmes.

As for the wider digital transformation of industry and society, striking a balance between flexibility and agility in the adoption of digital technologies on the one hand, and compliance with regulations, ethics, data protection, and security on the other, often proves challenging.

Most RTOs also **consider environmental factors when digitalising** their RD&I activities, for instance by recycling or reusing equipment, lowering energy usage, embedding sustainability criteria in procurement, and reflecting on ways to minimise the ecological footprint of their digital infrastructures.

3   RTOs' mission: fostering the market and societal uptake of advanced technologies

3.1   Specific collaboration models to foster uptake and consolidate ecosystems

RTOs' **play a "convenor" role** in building a sustainable and resilient society through targeted initiatives and capacity building.

- At local/regional level, **RTOs have an orchestration role**, interconnecting a wide range of ecosystem actors with the aim of supporting local/regional SMEs and start-ups, in line with regional smart specialisation strategies, and integrating nodes of higher-level initiatives including industrial clusters, digital innovation hubs, etc.

- At national level, **RTOs connect regional ecosystems together** by fostering cross-technological and cross-sectoral collaboration, enabling knowledge exchange and bridging gaps across regions, ensuring synergies.

- At European and global levels, RTOs **collaborate with European actors and selected global leaders** to build competences and enhance resilience and economic security, leveraging complementary expertise, capabilities and infrastructures, integrating into key networks and public-private partnershipsand supporting the internationalisation of regional market actors, facilitating their integration into global value chains.

Figure 5 RTOs' role in consolidating ecosystems at regional, national and international levels, with global outreach
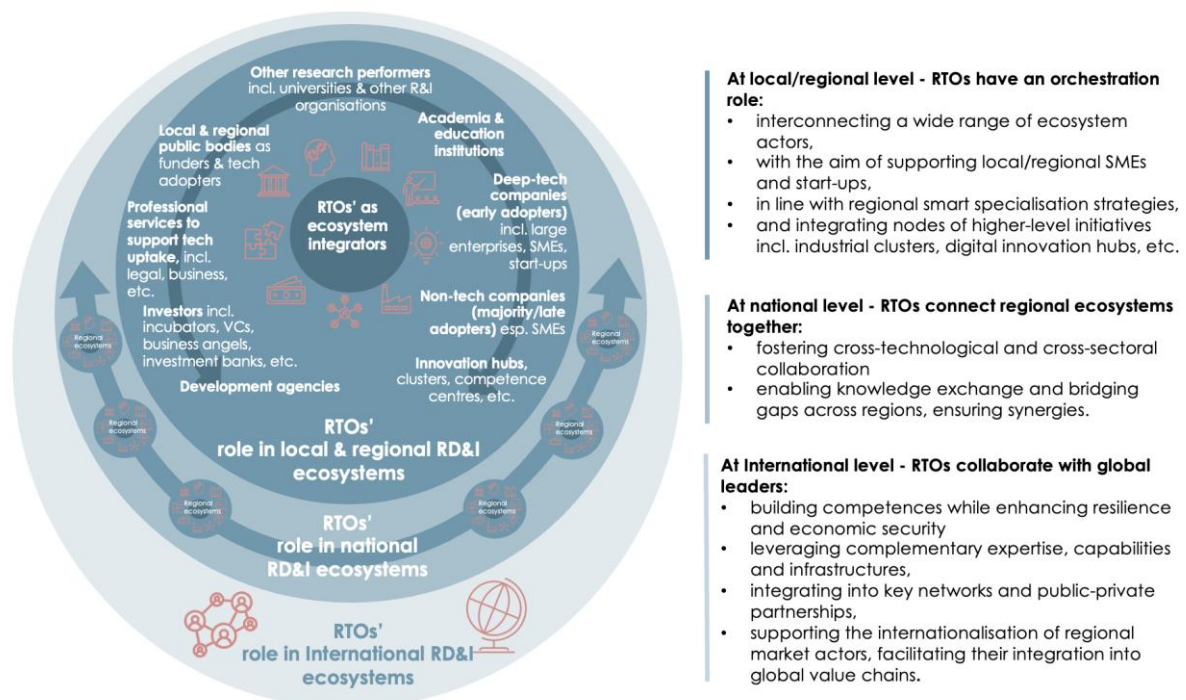
Source: Technopolis Group 2025

3.2   RTOs' International dimension

While shaped by recent global events and economic security concerns, **strategic internationalisation remains deeply rooted within RTOs' mission** and yields significant added value. RTOs pursue global collaboration through international programmes, networks, and consortia, as well as through dedicated branch offices and support for government-led initiatives (incl. science diplomacy).

These international activities offer **access to complementary capabilities with world leaders in specific fields**, funding sources, and broader partnerships, enhancing RTOs' competitiveness and excellence. International engagement enables RTOs to contribute to standardisation processes, expand their research portfolios, and boost both their own global reach towards new partners and opportunities, and the one of their domestic private partners. From some of the indicators collected in the study, one can note that:

- RTOs' share of international revenues (including beyond the EU for European one) is not negligible, and can be significant for some, depending on the focus and ambition of their international strategy.

- International clients often account for a considerable share of total RTOs' users.

- Many RTOs have branch offices abroad of various size and holding different functions.

- For most RTOs, the majority of publications are co-authored with international partners.

On recent trends, compliance with evolving regulations, geopolitical considerations, and due diligence processes have prompted a **focus on "like-minded" collaborations** and strengthened **internal procedures to ensure research security**. Yet the international dimension remains essential to most of the large RTOs' activities.

3.3   Knowledge valorisation & technology diffusion

Knowledge valorisation and technology diffusion are integral to RTOs' mission, enabling the transformation of research into societal and economic impact. RTOs employ various mechanisms, including patents, publications, and spin-offs, to ensure knowledge transfer and foster innovation.

- **Publications** remain an important channel for knowledge dissemination by RTOs, and often driven by strategic considerations, visibility, and internal incentive systems. The level of publications by RTOs' researchers is also dependant on their role in researchers' reward systems. In general, publication rates remain stable over time, yet an increasing share is available in open access. RTOs' publications consistently receive higher citation rates than the field average, with a strong presence in high-impact journals, highlighting their influence on research and innovation.

- **Patents** are also an important means of technology diffusion used by RTOs, not only as assets to license out, but also as enablers of broader societal benefits. Patents signal the quality of organisations, disclose critical information that fosters spillovers and minimises duplication, and facilitate markets for technology beyond physical products. Reflecting these diverse benefits, RTOs pursue different patenting strategies: some focus on a smaller portfolio of high-value patents to balance the often-substantial patenting costs (which may not be fully recouped through licensing), whereas others file a broader range of applications. Many RTOs have internal IP policies and incentives to encourage patenting, and those more actively engaged in patenting tend to see a higher proportion of cited patents, highlighting RTOs' contribution to technological progress.

- **Spin-offs** are another critical mechanism for technology transfer used by many of the large RTOs, particularly in developing market-creating innovations. RTOs actively support spin-off creation through licensing agreements, venture capital facilitation, and early-stage development assistance. Many benchmarked RTOs launch a moderate number of spin-offs annually, with notably high survival rates over time. Beyond survival, their impact is reflected in the venture capital raised and the number of jobs created, demonstrating the broader economic contributions of RTOs' innovation activities.

3.4   RTOs' support to industry re-skilling and up-skilling

European industry faces a growing global shortage of skilled professionals in advanced technologies, leading to intense competition for talent. In this context, and alongside investing in their own workforce's skills, RTOs play a crucial role in re-skilling and up-skilling, bridging gaps between academia and industry. This is illustrated by the often dynamic "transfers of heads," where top researchers move between RTOs and industry while retaining university positions. RTOs also help academia by providing insights for new curricula to tackle emerging skills gaps. Their highly specialised training and on-the-job development programmes—tailored to both large enterprises and SMEs—facilitate the effective uptake of advanced technologies across different industrial settings.

4 Conclusions

In conclusion, the findings from this benchmarking exercise confirm RTOs' essential role in orchestrating RD&I ecosystems and interconnecting academic research and industry, driving the development of advanced and disruptive technologies, and fostering the widespread uptake of innovation to address pressing societal and industrial needs. By leveraging diverse and complementary funding streams and fostering cross-fertilisation between technologies and across sectors, RTOs sustain their public mission of delivering impact and policy advice, while enhancing industrial competitiveness and advancing sustainable transformations.

To build on these strengths in the current geopolitical context, and beyond the benchmarking exercise itself, recommendations stemming from this analysis include:

1. **Strengthening the long-term sustainability of RTOs' public–private funding mix** to reduce uncertainty and guide high-impact R&I, underpinned by a robust competence base and a cutting-edge portfolio of research and technology infrastructures. This includes expanding pre-competitive technology development through competitively funded consortia and encouraging direct engagement with both large and small enterprises to effectively address their technology needs.

2. **Stepping up collaboration between RTOs, industry, and universities** as well as other ecosystem actors at national and international levels, as key driver for knowledge exchange, accelerated innovation and to achieve the digital and sustainable transformation. To do so, novel collaboration arrangements could be leveraged, and private RD&I investments further incentivised to mitigate risk-aversion.

3. **Expanding RTOs' role to support re-skilling and up-skilling initiatives**, particularly for SMEs, to keep pace with emerging technologies and support market adoption of new solutions.

4. **Building on RTOs' technology and market knowledge** to anticipate industry needs and align them with frontier technology development, providing robust input for public policymakers.

5. **Leveraging networks like RIN to strengthen RTOs' competence building** through an agile structure, fostering the exchange of good practices among RTOs facing similar challenges and seeking to optimise technology development and diffusion while ensuring responsible RD&I practices.

Appendix   Methodology

The study relied upon an extensive methodological toolbox and a wide range of data collection processes. It combined primary data, gathered through a quantitative indicator framework co-developed with RTOs (covering human resources, financial models, and knowledge/technology transfer), with secondary data directly collected and analysed by Technopolis Group, such as bibliometrics, intellectual property, and contextual data mainly from OECD and Eurostat. These inputs were then linked to qualitative data, including a qualitative questionnaire to define RTOs' profiles, a series of four thematic workshops, and "clinics" interviews with experts within RTOs on a selected set of five indicators to provide deeper insights into key focus areas and ensure a comprehensive analysis.

Figure 6 Diverse data sources to inform the analysis
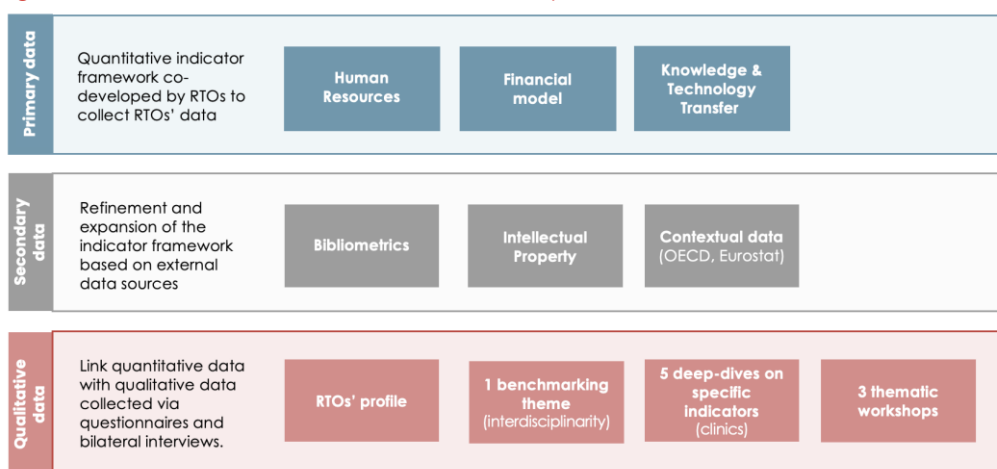
Source: Technopolis Group 2024

The figure below illustrates the key elements of the analytical framework used in this benchmarking exercise. It begins by examining each RTO's internal context and inputs, covering their funding models, human resources, and governance. It then looks at the RTOs' activities, including their type of research, collaboration with public and private sectors, technology infrastructures, and internationalisation. Next, the study entailed an analysis focused on outputs and outcomes, including intellectual property, bibliometrics, and spin-off creation. Finally, it provides some assessment of impact, particularly in addressing societal challenges, boosting industry competitiveness, and informing evidence-based policymaking.

Figure 7 Analytical framework of the 2022-2024 RIN Benchmarking study
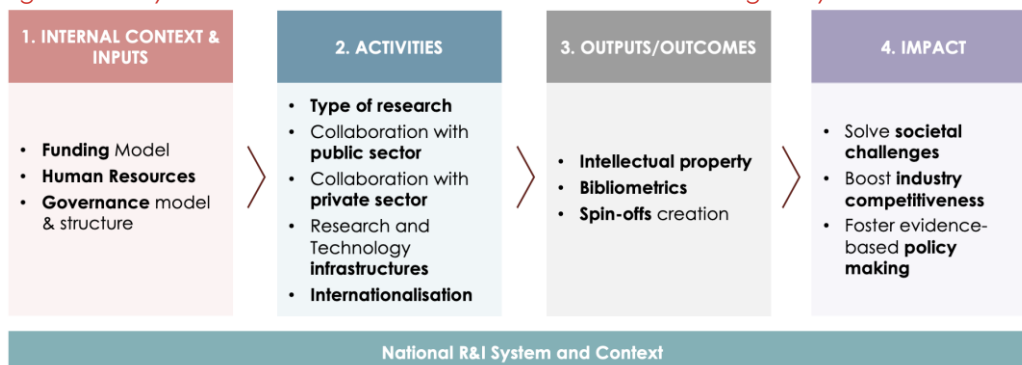
Source: Technopolis Group 2024

The figure below presents the RTOs which participated to the RIN Benchmarking exercise 2022-2024.

Figure 8 Participating RTOs in the 2022-2024 RIN Benchmarking study

AIST
National Institute of Advanced
Industrial Science and Technology
Japan

cea
French Alternative Energies and
Atomic Energy Commission
France

Fraunhofer
Fraunhofer-Gesellschaft zur
Förderung der angewandten
Forschung e.V.
Germany

ITRI Industrial Technology Research Institute
Industrial Technology Research
Institute of Taiwan
Taiwan

National Research Council Canada   Conseil national de recherches Canada
National Research Council of
Canada
Canada

RI.SE
Research Institutes of Sweden
Sweden

SINTEF
SINTEF
Norway

TNO innovation for life
The Netherlands Organisation for
Applied Scientific Research
The Netherlands

VTT
Technical Research Centre of
Finland Ltd
Finland

technopolis group

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