

Strategic public/private partnerships in science, technology and innovation

Rationale and objectives

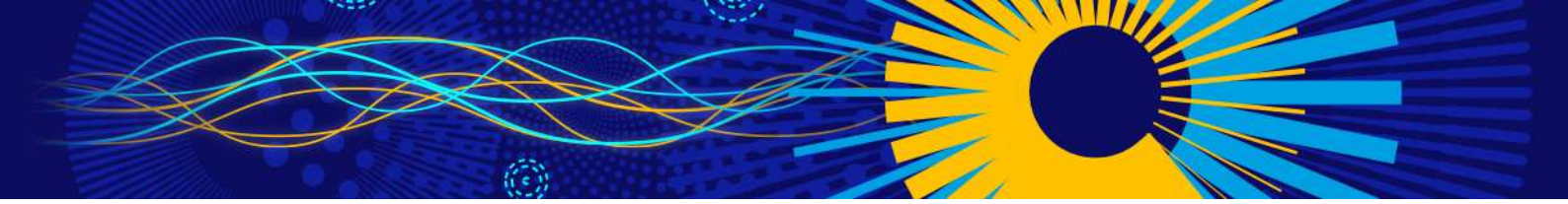
For governments, public-private partnerships (PPPs) in science, technology and innovation (STI) can help make research and innovation policy more responsive to the changing nature of innovation and to social and global challenges. For business, partnering with public research can help solve problems, develop new markets or generate value through co-operation and co-production. For governments, PPPs are an attractive tool to address both market and coordination failures in research and innovation activities and leveraging private investment in STI activities. PPPs are also key instruments in addressing societal challenges of the coming decades -such as climate change, green growth or energy efficiency-.

The modalities of PPPs are diverse: collaborative research programmes, technology/research centres (with public-private funding or other forms of private contributions); innovation procurement, technology extension and commercialization programmes, among others. PPPs in research and innovation go beyond pre-commercial research and may involve joint investments in technological infrastructure, human resource development, technology testing and development activities, as well as commercialization commitments (OECD, 2004, 2012).

In today's economic world, PPPs in research and innovation are conceived as legal relationships or agreements over fixed-term/indefinite period of time, linking public and private actors –e.g. industry, universities, public research/technology institutions, entrepreneurs, etc.- where both sides interact in the decision-making process, and co-invest scarce resources such as money, personnel, facility, and information in order to achieve specific joint objectives in research and innovation. In other words, PPPs provide a legal structure to pool resources and gather critical mass, which enables a scale of effort that individual firms would not be able to achieve –in spite of strong funding for firm innovation. The partners share risk, reward, and responsibility for shared investments.

The fundamental rationale of most PPPs in research and innovation is to leverage broader economic and social benefits from joint investments to accelerate innovation and technological solutions to address key challenges of the economy and societal wellbeing. PPPs help build new innovation capabilities, improve connectivity between national innovation systems and provide compatible incentives to all stakeholders (OECD, 2015). Above all, PPPs help create a collaborative environment to maximize cross-disciplinary expertise among government, academic, and industry researchers. The main *a priori* conditions for forming a rational partnership are common objectives, mutual benefits, and complementarity of human and financial resources. There are other motivations such as:

- i. Optimizing the use of resources by sharing costs and risks in addressing specific necessities of the productive sector and societal challenges;
- ii. Capitalising on the respective strengths of the partners as well as interdisciplinary cooperation;
- iii. Economies of scale (e.g. reaching a critical mass in research) and scope (cross-discipline and cross-sectorial benefits);
- iv. Internalize knowledge spillovers and overcome informational and behavioural barriers typically limiting the interactions between public research and the business sector, and
- v. Securing higher-quality contributions from the private sector to government mission-oriented R&D and increasing opportunities for commercialization of public research.



PPPs are a key component tool of innovation programmes in priority areas defined in national innovation or growth strategies and regional strategies. In their implementation, PPPs follow a top-down approach. The identification of research and innovation needs and goals are jointly defined by PPP's members (innovation actors) –and these are in turn supported by public resources under the umbrella of legally-binding contractual PPPs. In this sense, PPPs are more adaptive and flexible policy instruments than subsidies and tax credits in addressing specific needs of industries and sectors at a larger scale. By better targeting innovation needs (bottom-up approach) and allowing more flexibility in the organisation of innovation activities, PPPs are a useful tool in demand-side innovation policy.

In most countries, PPPs follow a competitive process for government funding which evaluates contributions by participants (e.g. often matching funding ratios are required), programme feasibility and evidence of complementarities, governance of the association, sustainability prospects, and quality of the proposed research/innovation agenda –e.g. issued from a roadmap exercise and a broad stakeholder consultation process. For a PPP to be supported under Horizon 2020, it must prove that the results will provide added value at EU level and boost both industrial competitiveness and sustainable growth. It must also have a convincing long-term roadmap for research and innovation activities.

Evolution of the concept and practice

PPPs in STI are not new and there is a long history of OECD countries providing incentives for firms and other actors to engage in co-operative research efforts. Public-private collaboration has historically been one of the most important tools in industrial policies to foster business innovation in OECD countries. In post-war Japan, partnerships were an integral part of large government-sponsored industrial technology programmes (e.g. the Very Large Scale Integrated Circuit project between 1975 and 1985) to help Japan catch up in specific sectors. In the United States, the Cooperative Research and Development Agreements (CRADAS) introduced in 1986 has been a leading example of technology transfer initiative linking federal government with private firms to optimize the use of resources through the sharing of research personnel, equipment, and intellectual property rights in joint government-industry research.

In recent years, novel forms of PPPs in STI, which appear to be more “strategic”, have emerged in OECD countries. Strategic PPPs address specific challenges in industries or technology sectors and have longer-term horizons than traditional instruments for public-private collaboration –e.g. at least four years of funding support. These PPPs usually involve a minimum of three partners and tend to require large funding commitments from partners over the project lifetime. Thus strategic PPPs help reduce uncertainties in research and innovation by allowing for more long-lasting and large-scale commitments (European Commission, 2013a). Projects outcomes are specified in a way to support pre-competitive non-generic research and related innovation activities with the aim to address long-standing problems, generate new knowledge/technology with the strong potential to strengthen a countries industrial base, create employment and/or influence areas of strategic importance (OECD, 2014).

Strategic PPPs revolve around specific problematics in industries or technology sectors (e.g. Canada's large cooperative programmes in the aerospace sector, the United States' National Additive Manufacturing Innovation Institute, Netherlands' Top-Sector policy), or in emerging scientific and technological fields, such as nanotechnology and climate change related technologies. They are usually aligned with national innovation and industrial strategies (e.g. re-industrialisation, Green Growth and Competitiveness Strategies). Selected examples include China's Industry-Research Strategic Alliances, Canada's Strategic Network Grants, the Netherlands' Top Sectors, Germany's Innovation Alliances, Israel's Magnet Consortium, and France's Strategic Industrial Innovation Programme (ISI).

At the European level, large-scale research-based PPPs programmes were launched in 2008 as part of the European Economic Recovery Plan --three strategic PPPs were launched in areas particularly affected by the crisis: Factories of the Future, Energy-efficient Buildings and Green Cars. These PPPs have proved useful in strengthening European value chains and in particular giving a role to SMEs (which accounted on average for 25 % of project partners in the Seventh Framework). An evaluation showed that research PPPs have been inclusive – integrating organisations other than industrial research associations (European Commission, 2013b). In the current EU research framework programme Horizon 2020, PPPs play a key role to foster research and innovation in key strategic areas.

Increasingly, PPPs are more inter-disciplinary (e.g. gather experts from different research and technology disciplines) and have a wider variety of industry actors than in the past (entrepreneurs, large firms, SMEs, private financial institutions, private technology intermediaries). PPPs have a governing constituency (board of representatives), a managing director, and are periodically evaluated following a results agreement framework. They are required to report performance results following commitments and milestones jointly defined in the contract agreements. They are deemed to be autonomous organizations, with a physical or





virtual space (e.g. within universities or in clusters/industries, or as a new entity) having supportive and transparent legal frameworks.

They may also work through a network model with several organizations and research laboratories participating and interacting through digital technology platforms (hubs) –e.g. the Knowledge and Innovation Communities (KICs) programme of the European Institute of Technology. Organisationally, although PPPs may be small-scale (temporary) projects, the international tendency is towards large-scale, longer-term joint legal agreements (including consortia or joint ventures) with multiple (public and private) members and stakeholders.

Contractual PPPs need a strong and clear legal framework (or supportive guidelines) for their articulation and accountability. When launching contractual-based PPPs for STI activities, authorities must address a number of issues that arise when merging public and private interests in a common STI initiative. These issues can be tackled through general principles or rules for PPPs formation and the types of contributions (and partners), their monitoring and evaluation, partner roles/accountability and task assignments, membership equality, conflicts of interest, academic/civil society inclusion, flexibility and transparency rules, and consideration of a third-party convener to ensure rule compliance. Agreements should also consider a set of warranties and disclaimers allocating risk between the parties.

In view of their benefits, some governments have put in place a policy and regulatory environment, including financing mechanisms and Intellectual Property (IP) protection, to facilitate the development of PPPs for research and innovation. The European Commission, for instance, is building up a specific legal framework to facilitate the creation of PPPs and ensure that risks and responsibilities are shared among members (Europa, 2012).

The different modalities


PPPs in research and innovation encompass a diverse set of modalities. There are many forms of PPPs, depending on the type and number of partners, and the purpose, scope and time-length of the project. Public/private partnerships in research and innovation can also be classified according to the functional objectives and goals of governments, such as support for strategic research and technology development or commercialization; by type of financing mechanisms and timeframe, or per thematic.

PPPs can involve the creation of joint organizations (long run engagements) for research and innovation development. These can take the form of centres of excellence, technology consortiums or competence centres –e.g. which typically involve education or research institutes and a consortium of industrial partners. The timeframe for these commitments may cover 4-10 years (or beyond) and requires participants to establish a formal (type of joint venture) partnership. PPP can also take the form of project-oriented collaboration with medium or short-run timeframes (between 2 and 4 years) and this includes collaborative research projects, mobility programs (e.g. PhDs in industry; industry employees in science), joint MSC and PhD programs in science and technology, training, and R&D and technology services contracting.

There are many examples of long-term PPPs programs in OECD countries. Technology centres involving public-private partnerships are the Research Centres Programme of Ireland, the Competence Centres for Excellent Technologies (COMET) of Austria and the Competence Centres programme of the Czech Republic. Examples of programs supporting long-term collaboration between the public and private sectors on R&D and innovation include:

- Since 1997, the leading technological institutes (LTI) in the Netherlands) aim at stimulating R&D cooperation between public and private partners in areas of importance for the economy and society. There are currently several LTIs in operation: the Dutch Polymer Institute, the Materials Innovation Institute, the Top Institute Food and Nutrition, the Novay (service innovation and ICT) Institute, the Top Institute Pharma, the Center for Translational Molecular Medicine, the BioMedical Materials Programme, among others.
- The Center of Innovation (COI) Programme of Japan supports industry-academia collaborative teams to tackle fundamental, multi- and interdisciplinary R&D in topics of high risk but with high societal relevance. Funding of projects cover a horizon of 10 years. Firms make appropriate contributions in terms of financial, human and other in-kind resources, and the structure of collaboration is flexible and can be modified in light of the circumstances.
- In Norway, the Centres for Environment-friendly Energy Research (FME) scheme gives time-limited support to research centres which conduct concentrated, focused and long-term research of high





international quality in order to solve specific challenges in the energy sector (renewable energy, energy efficiency, CO2 capture and storage). The scheme awards funding for collaborative research centres for a period of 5+3 years (depending on a mid-term evaluation).

Examples of short and medium-run schemes for public-private collaboration include:

- The Industrial Chairs Programme of France and the Industrial Collective Research Scheme (IGF Research Scheme) of Germany are examples of project-level collaborative R&D between industry and public research organisation. In the Case of the IGF scheme, R&D performed should respond to necessities of broad target group of firms, especially SMEs.
- In Greece, the programme Co-operation 2009 supports co-operative projects between business and research and technological organisations in all the 11 priority areas of the National Strategic Reference Framework (NSRF) (based on a top-down approach). It finances collaborative R&D projects which must be characterised by commercial potential in the short to medium term.
- The Adaptable and Seamless Technology Transfer Programme (A-Step) from Japan, in addition to co-fund collaborative industry-academia R&D, supports pre and seed development (Stage II) and transition of academic research outcomes to the market place (Stage III).
- The Innovative Doctoral Training schemes in Italy (joint projects linking a company -mainly SMEs- with a university and jointly funded by the company, the university and an administration (e.g. a Region) or the Industrial Phd Scheme in Norway and Sweden are examples of joint training programmes in advanced human capital formation.

Factors of Success

Whilst there is no one-size fits all model for PPPs, several factors recurrently appear as fundamental in the design and implementation of successful PPPs schemes. In particular, good governance and public leadership are key factors ensuring the success of PPPs. These include setting clear objectives and activities/responsibilities well defined for each participant, operational rules and implementing regular monitoring and evaluation, transparency, consultation with stakeholders and the establishment of dispute settlement and exit strategies (OECD, 2015).

Other important factors are: (i) a clear identification of systematic failures to tackle; (ii) long term (open-ended) stable commitment by the government; (iii) careful selection of participants and definition of their alignment/complementarity; (iv) appropriate planning, task/responsibility definition, and information \sharing mechanisms; (v) inclusion of an education objective and equal emphasis on all four majors objectives (research, collaboration , education and outcome application); (vi) a clear management structure; (viii) a board of stakeholders chaired by an independent industry/research sector actor; (ix) partnership scale and resources; and (x) personnel stability; among others.

The success of PPPs in many cases also depends on complementary regulatory frameworks shaping interactions between public organizations (e.g. academia) and industry. Examples of regulatory measures to incentive PPPs in innovation include tax incentives, performance-based funding (and metrics), rewards systems for researchers, and intellectual property legislation (e.g. Bayh Dole Act). Recently, Belgium increased the wage withholding tax credit for highly qualified researchers involved in industry-science research collaboration. In 2013, the Netherlands introduced “Rules of Play for Public-Private collaboration” jointly defined by a large number of STI actors. The code of practice seeks to make the connection between fundamental research and the top sectors more transparent, among other things. Starting in 2017, Norway will introduce a “third party” indicator in funding metrics of higher education institutions (HEIs). This indicator will help define performance-based component in block grant funding.



Recent policy trends

Most countries have seen a rise in PPPs in the STI area that are strategic, long-term, large-scale, high-risk and multidisciplinary and involve diverse stakeholders (government, business, universities, non-governmental organisations). Examples of recent initiatives launched in the last few years include:

- The Research Centres Programme of Ireland, which aims to develop a set of world-leading, large-scale research centres on a themed basis in order to align this major investment to areas which can generate maximum economic and societal benefit for Ireland. Over a six-year funding, the programme link scientists and engineers in partnerships across academia and industry to address **crucial research questions, foster innovation relevant to Ireland's economy**. A minimum of 30% of the Centre budget must be secured from industry.
- The Research Campus Programme from Germany is a competitive funding scheme under the High-Tech Strategy to strengthen the cooperation between science and industry. A Research Campus comprises three criteria: it merges private and public research competences at a single location; it has a medium to long-term perspective and builds on a reliable PPP. R&D project funding focuses on application-oriented basic research with a funding perspective up to 15 years.
- In Spain, Feder-Innterconecta is a programme for the financing of large-scale experimental development integrated projects in less favored regions aimed at promoting industry and public-private partnerships in the domain of grand challenges. **Feder-Innterconecta's purpose is the development of new technologies in forward-looking technological areas with economic and commercial prospects at the international level that represent a significant technological and industrial leap in those regions.**

PPPs are increasingly a popular instrument in vertical innovation policies (sector/cluster approach) –which have been expanded in recent years in many OECD countries. PPPs typically take part of wider policy packages supporting smart specialization strategies and sector innovation agendas such as cluster-specific programmes and regional innovation programmes. Examples of vertical policies having PPPs approaches include the Innovation Cluster programme of Sweden or the Greentic Program of Wallonia (Belgium). In France, the Institutes for Technological Research (ITRs)–selected world-class research campuses in cutting-edge sectors- were recently launched to strengthen ecosystems of main clusters. The ITRs are expected to foster long-term partnerships between HEIs and research-performing firms to reach a critical mass of resources and expertise in the same location.

Another important trend across OECD countries is SMEs inclusion in PPPs. Increasingly, PPPs schemes require the involvement of SMEs or directly target SMEs for collaboration with public institutions. For instance, Denmark has recently introduced pilot schemes to support highly qualified labour in small and medium size enterprises and long-term projects/partnerships on R&D and experimentation for SMEs and **entrepreneurs**. In 2015, Spain introduced the program “CIEN Strategic Business Research Consortia” which finances large projects of industrial research and experimental development activities lead by medium and large enterprises - requires including at least one SME as part of the consortium , as well as a significant participation (of at least 15%) of a public research performing organisation. In Wallonia, the *CWAllity Programme* funds collaborative projects between SMEs and public research organisations. The PROINNOVA programme from Mexico targets micro-firms and SMEs and supports projects presented by firms that integrate at least one higher education institution or public research organisation.

There is also a revival of public-private technology centres to support industry-specific innovation agendas. Recent initiatives following a PPP scheme include:

- In the United Kingdom, Catapult centres have been established to help bridge the gap between the ambitions of the high growth businesses and the outputs of the research base. The centres are established in technology or market areas where there are large global opportunities and where the UK has the industrial and academic capability to take advantage of the opportunity.
- In New Zealand, the Callaghan Innovation Agency was created to support high tech businesses and promote cross-institutional linkages that provide scale for research and commercialization activities. The agency also delivers testing services and access to facilities.

- In Australia, the Industry Growth Centres Initiative addresses sector-wide impediments to productivity and competitiveness in five growth sector areas. Based on business-led consortia, the centres encourage organisations to work closely together to conduct joint commercial research and development activities (within industry and with the research sector) and unlock commercial opportunities.

The International Dimension

PPPs have increasingly an international dimension. Initiatives for cross-border collaboration in STI are multiplying and this touches a wide range of innovation themes from ICT and digitalization of STI activities and sector/industry focus PPPs (e.g. automobile, nanotechnology..) to global health concerns (e.g. neurocognitive diseases such as Alzheimer) and great challenges such as green growth and energy efficiency. There are many advantages in fostering international cooperation in PPPs—in addition to knowledge complementarities across different geographical regions and organisations. For instance, international collaboration at the development stage enables testing in different context conditions (e.g. pharmaceutical clinical trials), broad sharing of results and standard settings. International cooperation in biotechnology

At the European level, various mechanisms exist to promote international partnerships in R&D and technology development. The KICs –Knowledge and Innovation Communities- are an interesting example of bringing together leading players from the different sectors to work in specific innovation agenda at the international scale. Each of the KICs operates across a number of hubs called ‘co-location centres’ and there are currently 19 co-location centres spread across Europe. KICs carry out a whole range of activities, covering the entire innovation chain – including training and education programmes and business incubators. Each KIC has been set up as a legal entity and has appointed a CEO to run its operations. The European Institute of Technology (funding authority) provides the KICs with a great degree of autonomy to define their legal status, internal organisation and working methods.

Table 1. Types of PPPs in research and innovation and examples of programmes

Criteria	Types	Examples Modalities	Country Examples
Time Frame	Short and Medium term (1-5 years)	<i>R&D projects</i>	<i>Industrial Collective Research Scheme (Germany)</i> <i>TIP (Czech Republic)</i> <i>Co-operation 2011 (Greece)</i> <i>Industrial Partnership Research supplement Programme (Ireland)</i> <i>Cooperative innovation network (Flanders)</i>
		<i>Training and Mobility Programmes</i>	<ul style="list-style-type: none"> • The Innovative Doctoral Training and Project PhD Italents (Italy) • The Industrial Phd Scheme (Norway and Sweden)
	Long-term (5-10 years or permanent)	Large scale collaborative R&D projects	<ul style="list-style-type: none"> • CIEN Strategic Business Research Consortia (Spain) • Technology Consortia (Chile) • Industry-Research Strategic Alliances (China) • Grand Solutions (Denmark)
		<i>Centres of Excellence (Research/Technology Institutes)</i>	<ul style="list-style-type: none"> • Vinn Excellence Centres (Sweden) • Networks of Centres of Excellence (Canada) • Centres of Excellence (Sweden, Slovenia) • Formula-C (Peru)

		<i>Collaborative Research Centres (applied research)</i>	<ul style="list-style-type: none"> • Joint R&D Corporations (South Korea) • Competence Centres for Excellent Technologies (COMET) (Austria) • Competence Centres programme (Czech-Republic) • Centre of Innovation (Japan) • Research Campus Programme (Germany) • Carnot Institutes (France)
Thematic	<i>Industry/Cluster oriented</i>	<i>Collaborative R&D/R&D Consortia</i>	<ul style="list-style-type: none"> • ICT of the Future (Austria) • Magnet Consortium (Israel) • Co-operation 2009 (Greece) • Greentic Program (Wallonia)
		<i>Technology/Competence Centres (Cluster or Technology focused)</i>	<ul style="list-style-type: none"> • Leading Technology Institutes (Netherlands) • Research Centres Programme (Ireland) • Catapult Centres (UK) • Industry Growth Centres (Australia)
		<i>Technology Commercialization</i>	<ul style="list-style-type: none"> • Biomedical Catalyst (UK) • The Adaptable and Seamless Technology Transfer Programme (A-Step) (Japan)
	<i>Societal and Global Challenges</i>	<i>Collaborative R&D projects or Research Centres/Institutes</i>	<ul style="list-style-type: none"> • Retos Colaboracion (Spain) • Societal Innovation Partnerships (Denmark) • Societal Top Institutes (MTIs) (Netherlands) • Centres for Environment-friendly Energy Research (FME) (Norway)

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