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STRATEGIC PUBLIC/PRIVATE PARTNERSHIPS IN SCIENCE, TECHNOLOGY AND INNOVATION - FINAL REPORT

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Delegates are invited to discuss and approve the final report on public/private partnerships with a view to its declassification.

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FOREWORD

This report presents the draft final report of the TIP activity on "Public/Private Partnerships in STI", selected on the basis of priorities of the TIP and of the CSTP itself for its work programme in 2013-2014. The paper examines the role of strategic P/PPs as an instrument of STI policy in relation to traditional P/PPs in STI. Based on the literature and case studies commissioned for the project, it identifies the critical factors for their success including governance arrangements, programme design, financial arrangements, IPRs and evaluation.

The report has been prepared by members of the Secretariat (Tomomi Watanabe, Daniel Kupka, Mario Cervantes, Jin Joo Ham, and Daehyun Oh) under the guidance and supervision of Dominique Guellec. The draft also benefited from inputs and comments from members of its Steering Group comprised of representatives from Israel, Japan, Malaysia, Netherlands, Norway, Russian Federation, United States of America, BIAC and European Commission. The Secretariat would like to thank members of the steering group and countries who participated in the country case study for this collective effort and for their fruitful contribution to the project. In addition, the voluntary and in-kind contributions in the form of staff secondments from the Chinese Ministry of Science and Technology to the Secretariat (Xiaoyong Shi and Yu Shi) are gratefully acknowledged.

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EXECUTIVE SUMMARY

P/PPs in STI are increasingly used to promote science, technology and innovation

1. Public-private partnerships (P/PPs) in STI have become a particularly important tool in the policy mix of ministries and innovation agencies in OECD and non-member economies such as China, Russia and Malaysia. Broadly defined as collaborative research and innovation efforts that are carried out jointly, co-financed by public and private partners, and which may or may not be institutionalised in a designated entity, public-private partnerships in STI are distinct from contract research and development or public procurement of innovation. Relative to tax credits or subsidies, P/PPs are perceived as a flexible and adaptive instrument to foster collaboration in science, technology and innovation.

P/PPs in STI are becoming more "strategic"; beyond the goal of linking science to industry

2. P/PPs 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. Among the first government initiatives were the so-called Collective Research Centres (CRCs), which were created in most European countries after the Second World War to stimulate the technological development of business in the major industrial sectors through collective and collaborative research (Wright et al., 2008). These have been driven mostly by a desire to turn research into socio-economic results. Today, policies to foster co-operation among actors represent a significant part of the portfolio of innovation policy support in many OECD countries and range from grants and vouchers to support co-operation between SMEs and universities, R&D tax credits to spur collaborative research between industry and science (e.g. in France, Hungary) and industrial networks (e.g. Ireland, United Kingdom) to formal P/PPs.

3. In recent years, novel forms of P/PPs in STI, which appear to be more "strategic", have emerged in OECD countries. Strategic P/PPs, in contrast to generic P/PPs and other collaborative support measures can be characterised by public support that is longer term ranging from more than 4 years duration. These P/PPs usually involve a minimum of three partners and tend to require large funding commitments from partners over the project lifetime. Projects outcomes are specified in a way to support pre-competitive non-generic research 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.

Strategic P/PPs take a functional approach to meeting their goals

4. Strategic PP/Ps tend to have a stronger top-down orientation and revolve around emerging scientific and technological fields, such as nanotechnology or manufacturing. 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 Netherland´s Top Sectors, Germany´s Innovation Alliances, Israel´s Magnet Consortium, and France´s Strategic Industrial Innovation Programme (ISI).

5. There is no single definition of what constitutes a "strategic" P/PP but a common characteristic the P/PPs covered in the TIP case studies is that 'function' of the partnership is 'strategic' such as

maintaining or achieving leadership at the technological frontier (e.g. the United States' National Additive Manufacturing Innovation Institute). For other countries, the "strategic" function of the P/PP is to address the lack of core technological competences and long-standing problems involving the use and application of general purpose technologies for innovation (e.g. biotechnologies in health and ICTs in industry and services). In some countries, maintaining a comparative advantage in certain areas of innovation (e.g. Israel's track record in generating high tech start-ups) is considered strategic from a functional perspective.

6. Case study evidence also indicates that these particular forms of P/PPs are also increasing in Asia in line with general economic development. Of interest in this regard is the series of P/PPs that have emerged first in Japan and more recently in Korea, China, Singapore and Malaysia. The "strategic" function in these cases has been less on the joint creation of new knowledge, than on the efficient dissemination of existing knowledge to firms that can utilise such knowledge for integrating into global value chains and competing on world markets.

The drivers behind the rise of strategic P/PPs include the need for business to reduce risk and uncertainty in cutting edge technologies and for governments to achieve more from research investments at times of budgetary constraints.

7. There are several drivers behind the rise of strategic P/PPs in STI that go beyond the desire to link public and private research, or to orient public research closer to application fields, or to address deficiencies in financial markets that prevent firms from capitalising on public research. From the public side, the most important driver is the shift in STI policies towards addressing social, environmental and economic challenges. Many of the grand challenges exist in areas that lie in the public sphere or at the intersection of the public-private sectors. Examples include the delivery of healthcare; social services for ageing populations; sustainable transport, environmental pollution, etc. In this context, strategic P/PP in STI offers a way to harness the creative capabilities of the private sector to achieve productivity gains and service improvements. For business, the strategic P/PPs grant firms access to the tacit knowledge as well as research infrastructures in public research, helping to reduce technological and financial risks upstream (e.g. in the development of new materials for example).

There are important principles for P/PP design and implementation.

8. Strategic P/PPs for STI may be a good way to address a complex challenge but they are themselves a complex challenge to establish, both for major investors such as governments and business as well as for actors directly involved in pursuing research and innovation activities. Literature on the evaluation of both traditional and strategic P/PPs and case study analysis reveal that the following principles are considered important for the design and implementation of P/PPs in STI:

Project selection and design

9. Success of P/PPs in STI depends in no small way on the choice and design of the partnership. Well-designed partnerships between the public and the private sector can have clear and positive impacts. They provide efficiency gains in research and closer ties to application, and help partners manage technological and financial risks effectively. Misalignment of partner goals and timelines can be a barrier to successful partnerships.

10. Clarifying issues such as ownership, access, decision and control in the partnerships is important. New tools such as the visualisation of contractual information in contracts can help reduce friction and avoid contentious conflict later in the partnerships. However, as contracts and agreements are by nature incomplete due to information asymmetries, allowing for terms of renegotiation is important. An additional challenge is that many of the selected partners will naturally be incumbents or come from existing

industries, raising the risk of clientelisme. In this context, encouraging the participation of new young firms in public-partnerships, including through grants and prizes is important.

Eco-system and value-chain perspective

11. By design or by lack of awareness and foresight, P/PPs often miss opportunities for integrating cluster dynamics and a value-chain approach. Integrating technological roadmaps and regional/cluster foresight in partnerships can help identify opportunities for broader application of research and technological outputs from the partnerships.

Public finance

12. A variety of financing sources can be mobilised based on the nature of partnerships and the level of risk associated. On the government side, grant schemes are the most common financing mechanism in P/PP programmes. A conditional grant can help to prevent or mitigate moral hazard, which might occur under a collaborative programme. Conditional grants can impose detailed quality-related performance requirements. But compliance is costly to monitor and difficult to measure.

Private finance

13. The provision of equity or debt finance by the private sector explicitly builds into the P/PP a mechanism for managing the cost of funds and associated risks. This is in contrast to public sector funding where project risks can be transferred to tax payers or end users. Private finance also brings effective management tools against the risk of additional capital needs arising from unforeseen changes. However, excessive shifting of risk to the private sector will require private partners to build up reserves to meet them, thereby potentially reducing their incentives to participate in the P/PP. In general, a well-established financial and business infrastructure (re-insurance, contract resolution and renegotiation) plays a catalytic role in increasing the success of the partnerships.

Governance

14. Successful P/PPs require strong governance arrangements, especially when they involve a wide number of actors. Governments can act as leader and orchestrate processes in support of the overall goal of the partnerships. Complex and strategic P/PPs may also require the commitment and active involvement of more than one ministry to achieve desired outcomes. Therefore, aligning the various goals of different government ministries is important and may require not only adjusting incentives but even some restructuring of functions within ministries.

Managing Intellectual Property (IP)

15. The establishment of contractual mechanisms that define knowledge and IP sharing, including access to research data and infrastructure, during and after the partnership, are crucial for the success and longevity of such collaborative arrangements. Sharing of intellectual property rights in P/PPs is a common tool but more so in upstream research processes rather than in downstream commercialisation. In fact, the assignment of exclusive residual rights to the private sector provides incentives for firms to continue to control costs in the development of new technologies throughout the partnership. In the absence of residual rights, a private firm would tend to under-invest.

Openness to participation

16. Small and medium-sized firms face particular difficulties in connecting with other actors in innovation eco-systems given the shortage of finance, co-ordinating costs, legal costs of IPR arrangements

etc. Because of their diversity - some SMEs are closer to research, while others are closer to commercial activities - they can play an important brokerage role in translating high level government objectives and the commercial objectives of larger firms. Participation of SMEs in large scale and strategic STI partnerships can also expand their networks, improve brand name recognition and enhance access to financing. A key issue for innovation policy concerns heterogeneity among SMEs and ensuring effective targeting of participation schemes.

Internationalisation

17. International P/PPs have increased in the context of cross-border EU programmes (FP7, Horizon 2020) whereas national P/PP programmes tend to be focused on national actors. At the same time, private foundations (e.g. Gates Foundation) are establishing international P/PPs around global challenges like health. Differences in legislation, rules and procedures for P/PPs in OECD and non-member countries may make the establishment of cross-border P/PPs difficult at best given the lack of standards. These differences make the management of P/PPs in the STI area more complex than in other areas and deserve particular attention from policy makers. At the EU level, where the scale of investments required for certain large projects is beyond the means of individual member states, P/PPs represent a promising approach to research and innovation policy. P/PPs in fact feature prominently in the toolbox of Horizon 2020 programmes.

Evaluation and impacts

18. Complete and independent evaluation is important in the area of government policy interventions. There is a political need to know what leads to success or value added. In terms of approaches to evaluation there is a trend to focus on performance indicators but this raises the issue of how to capture the complexity of partnership models when most performance measures presume a linear model of innovation. The evaluation of P/PPs requires new perspectives on the additionality of government funding to supplement the traditional private-social returns model. New thinking in evaluation places a greater focus on building new capabilities and new networks which break out of sectoral and supply-chain patterns, and on how partnership modifies behaviour to create persistent effects. Indeed, in the STI area, value for money may not always be the main criteria for evaluating the impact of P/PPs; improving health or the environment, creating new knowledge, human capital building or building new networks may be equally important impacts. Such a shift in mind-set also calls for new indicators and metrics. The US Manufacturing Extension Programme for example is using both qualitative as well as quantitative metrics. In addition, it is also difficult to distinguish the effects of a P/PP from the effects of other policies to the extent that most actors are probably engaged in multiple policy interventions (e.g. R&D tax credits).

Conclusions

19. In conclusion, the space in which P/PPs operate is one where neither government nor the private sector can achieve their objectives without the active participation of the other. In today's innovation policy landscape, characterised by globalisation, the extension of innovation policies beyond R&D and technology, there is a need for co-development of knowledge in a partnership which stretches into areas which traditionally have been the sole territory of either the public or the private sector. In fact, the public sector is also innovating and mutual learning could help both firms and governments address internal deficiencies in meeting social and global challenges. The existing literature on P/PPs in STI and the case studies annexed to this report [DSTI/STP/TIP(2014)15/ANN) suggest the following key issues are important in designing strategic P/PPs:

1. **Co-ordination** across different ministries and individual STI policy instruments can:
- ✓ shape interdepartmental innovation governance; and

- ✓ help align P/PP goals and instruments based on priorities.

2. **Inclusive governance of partnerships**
- ✓ New modes of governance that share the leadership and oversight between representatives from industry, public research and government can help maintain commitment from stakeholders.

3. **Adaptability** of partnerships should be ensured to reflect changes in framework conditions, policy landscape or policy priorities and:
- ✓ set the phase of commitment
- ✓ help mitigate the bureaucracy in management

4. **Financial sustainability** is important for the success of P/PPs. It is important financing can
- ✓ incentivise participants to achieve the goals;
- ✓ develop clearer measures of outcomes to justify investment;
- ✓ stimulate adaptive efficiency which targets the enhancement of technological superiority and the sustainable economic growth, rather than allocative efficiency of existing resources.

5. **Evaluation of P/PPs in STI is difficult but important.** Some tools that can improve relevance and impact include:
- ✓ Regular monitoring;
- ✓ Ensuring evaluation techniques match policy objectives;
- ✓ Using multiple methods to increase the reliability of evaluation;
- ✓ Longer-time horizons;
- ✓ Assessing the social, technological and economic impacts, including human capital.

STRATEGIC PUBLIC/PRIVATE PARTNERSHIPS IN SCIENCE TECHNOLOGY AND INNOVATION

1. Introduction

20. In today's changing innovation policy landscape, P/PPs have a particularly important function of reducing the uncertainly and complexity inherent in business innovation processes. P/PPs can help to reduce the technical and financial risk associated with emerging technologies and applications (Meissner, Roud and Cervantes 2013). In fact, co-operative innovation efforts have become a dominant strategic alternative in many high-tech knowledge intensive industries. For governments, P/PPs can help make research and innovation policy more responsive to the changing nature of innovation and to social and global challenges.

21. Traditionally used for physical infrastructure, P/PPs are increasingly popular in R&D and innovation policy because they are perceived as a more adaptive tool than traditional subsidies for achieving such objectives in an environment in which the nature of R&D and innovation processes is changing (e.g. increased user-centred content, higher dependency on external sources of knowledge and know-how, as illustrated by open innovation approaches), and business R&D strategies and social needs are rapidly evolving (e.g. Ageing population, the environment, sustainable cities). Finally, P/PPs are a useful policy tool in demand-side innovation policy such as public procurement of innovation or in efforts to foster smart specialisation strategies in regions.

22. In addition to the rationales mentioned above, the current financial crisis in OECD countries and consequent budget austerity in some countries has fuelled interest in P/PPs as a possible way to meet growing demand for finance of innovation by leveraging limited public funds. The recent OECD's STI Outlook shows that policy-makers increasingly view public-private partnerships (P/PPs) in STI as an important tool in their innovation policy mixes (OECD, 2014e).

23. For instance, Austria´s "Christian Doppler Research Association", Germany´s newly created "Forschungscampus" initiative, Japan's "Center of Innovation Programme", or Netherlands' "Top sector" approach are designed, financed and governed around the P/PP concept. Indeed, the Netherland's top sectors policy exemplifies the change of course in innovation policies towards a more collaborative approach with strong steering by government. Companies, public authorities and public research institutions jointly determine which strategic knowledge themes are prioritised and jointly programme research in the top sectors. Such P/PPs were previously fragmented and were financed on a temporary, ad hoc basis. With the introduction of the top sectors policy the number of research programmes has been reduced and co-operation between the business sector and research establishment has been embedded in the normal knowledge system (L. Hessels, 2014).

2. Public-private partnerships for STI: a brief summary of conceptual foundations

24. P/PPs can be seen as a response to a changing environment for innovation addressing particular needs in the innovation system. In an attempt to define and understand the importance of P/PPs in the area of science, technology and innovation (STI), OECD TIP defined P/PPs in 2005 as "any formal relationship or arrangement over fixed-term/indefinite period of time, between public and private actors, 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 objectives in the area of science, technology, and innovation " (OECD, 2005). These collaborative research and innovation efforts are carried out jointly, co-financed by public and private partners, and may or may not be institutionalised in a designated entity. These characteristics distinguish P/PPs from pure contract research.

25. Despite a common understanding around the definition of P/PPs in STI, the conceptual foundations merit additional reflection (Box 1). According to the OECD's 2005 definition, P/PPs for STI can take broad range forms for different purposes. The definition does not address what degree of interaction between the state and industry constitutes a partnership. In general terms, partnership implies some sharing of cost, risk and benefits between participants. Is flow of cash in one direction, as in a granting scheme for industrial R&D, sufficient to qualify? In practice it emerges that many such schemes involve two way flows at various stages, in setting programme strategy and, once R&D is under way, in producing social benefits beyond the private returns to the firm. Finally although the government is a full partner (and not a catalyst) it often has an explicit *structuring* or *co-ordinating* role with regard to the local or national innovation system. The structuring could also involve building new relationships in the innovation system.

Box 1. P/PPs for STI: Narrowing the scope of definitions

The most general agreement in P/PP literature seems to be that the concept is broad and ill-defined, and many scholars have tried to address this by dividing P/PP literature into different approaches (Weihe, 2006, 2008) or families (Hodge and Greve, 2007). While different forms of collaboration or "mixes" between public and private actors have a long history, the partnership term has in modern times been used mostly to describe public and private co-operation such as urban renewal and regional development projects, long-term infrastructure contracts in various forms and partnerships for development in developing countries (Greve, 2009; Weihe, 2006, 2008). Innovation in this regard has been mostly considered as a by-product of public-private cooperation.

P/PPs involve the supply by the private sector of infrastructure and services deriving from infrastructure assets which have traditionally been supplied by the public sector (Sadka, 2006). In the broadest terms P/PPs can be defined as "co-operative institutional arrangements between public and private sector actors" (Hodge and Greve, 2009). The OECD (2012) defines P/PPs as "long term agreements between the government and a private partner whereby the private partner delivers and funds public services using a capital asset, sharing the associated risks. P/PPs may deliver public services both with regards to infrastructure assets (such as bridges, roads) and social assets (such as hospitals, utilities, prisons)". As such, P/PPs are contractual arrangements between public and private actors in a range of policy areas from transport infrastructure to health services. OECD (2008) provides a more detailed definition, and presents definitions used in other (international) organisations.

In the area of STI, the definition of P/PPs is equally broad. While there is a wide variety in the form and nature of P/PPs in the area of STI, the lack of a clear comprehensive framework for the design and implementation of P/PPs reflects the adaption of such a tool to different contexts but it can also be an obstacle to communication between policy makers and business partners. In that sense, the OECD (2005) definition in its simplicity leaves much for interpretation and covers a whole range of collaborative activities for STI. In line with the broad OECD (2005) definition for P/PPs in STI, the multitude and diversity of arrangements that are called P/PPs are immense. One major type of conceptual ambiguity in P/PPs for STI is easily dispensed with differences in the level of analysis.

It could, for example, be argued that joint commitment is used to describe relationships between individuals but also relationships between organisations (as well as relationships of individuals with organisations, e.g. academic consulting to industry, placement of students). Organisationally, these relationships may be defined as small-scale (temporary/short term) projects or large-scale and longer term joint ventures with multiple (public and private) members and stakeholders. Providing funding support to a start-up incubator or an inter-firm R&D consortium or a cluster and/or research centre falls also under the current definition. Hence, the OECD (2005) definition has different meanings and leaves room for interpretation and, thus, there is some degree of conceptual ambiguity that has implications for policy design and evaluation.

It is therefore clearly necessary to limit the scope, even though this means that only a limited selection of the arrangements that could be included in the term PPP will be dealt with. It is essential to work out just exactly what is new. Some academic and policy studies have acknowledged this challenge by limiting their object of study to a narrower subset within the broad space; they focus, for example, exclusively on R&D alliances, joint ventures,

international alliances, open innovation networks, buyer–supplier alliances; inter-firm consortia, collaboration between competitors (i.e. co-opetition), industry-science relationships (i.e. contract research, academic consulting), science parks, clusters, collective research centres, amongst other forms of collaboration arrangements.

2.1 Strategic P/PPs: a specific form of P/PPs for STI or a directional focus?

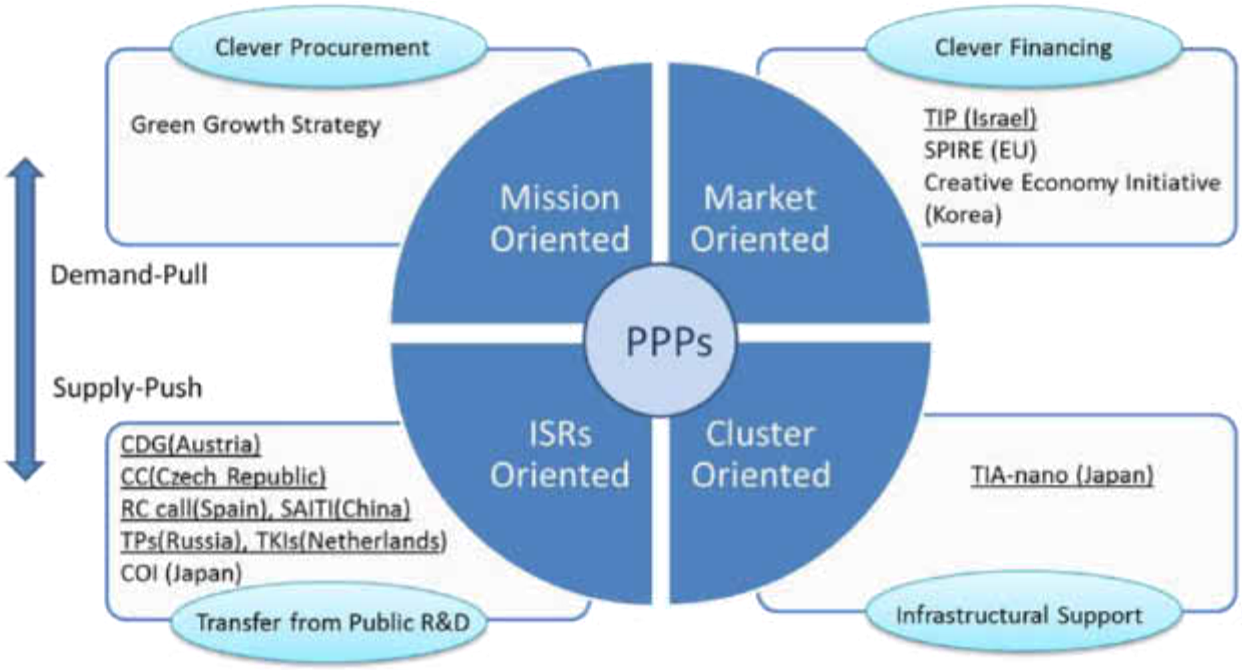
26. There is a novel form of P/PPs in STI that has emerged in OECD countries: large-scale, high-risk, multidisciplinary P/PPs, involving a multiple and diverse number of stakeholders (i.e. government, public research institutions [PRIs], universities, business firms, NGOs, foundations, customers). The question arises whether they actually represent a new form of P/PPs or merely a strategic focus to existing forms of P/PPs whether they are market oriented, mission oriented or transfer oriented (see figure 1).

One thing is clear is that these strategic P/PPs revolve around emerging scientific and technological fields, such as nanotechnology or manufacturing, and are initiated by the government and usually aligned with national and ministerial innovation strategies (e.g. re-industrialisation or re-shoring strategies, Green Growth and Competitiveness Strategies). These P/PPs typically have to deal with a broad network of actors, and require large investments with a high uncertainty of economic return.

27. Hereafter referred as "strategic P/PPs for STI", these public and private collaborative partnerships add a layer of complexity to the traditional definition of P/PPs in innovation both in terms of vertical and horizontal collaboration including co-operation with competing firms, NGOs, philanthropic organisations, and other stakeholders. They may play roles in developing new technologies, setting standards or norms, or generating interoperability parameters (Proskuryakova, Meissner and Rudnik 2014). Strategic P/PPs are therefore conceptually, organisationally and operationally close to what in policy and research circles are known as technology-/R&D-based consortia/alliances. Examples include Germany's National Platform for Electric Mobility, Japan's global nanotechnology complex Tsukuba Innovation Arena (TIA), China's industry-research strategic alliances and Belgium's Interuniversity Microelectronics Centre (IMEC), France´s Strategic Industrial Innovation Programme, United States' National Additive Manufacturing Innovation Institute and Netherland's Top-Sector partnerships, to name just a few.

28. The "strategic" objective can vary according to the policy context. For some countries, the "strategic" objective may be to address the lack of core technological competences and long-standing problems involving the use and application of general purpose technologies for innovation (e.g. biotechnologies in health and ICTs in industry and services).Reflecting on the achievement of thematic objectives, ministries themselves may also have a strategic goal, namely to push the technology frontier in mission-oriented/thematic research fields. For others, the strategic focus can be on using the capability of private sector to detect and meet market demands for innovation or it may be encouraging the introduction of new services and goods by procurement. Based on case studies and previous work of OECD in 2005, the major applications of strategic P/PPs can be classified in four categories depending on the direction and the main driver of innovation: mission-oriented, market-oriented, ISRs-oriented, and cluster-oriented.

Figure 1. Typology of P/PPs



Source: OECD 2014; ISRs: Industry-Science Relations

29. For private actors, the "strategic" objective is long-term and profit optimising. They attempt to enhance the value of the firm's assets or to minimise its net cost, or as in the case of SMEs, to alleviate resource constraints. Similarly, in strategic P/PPs the relationship between public and private partners is characterised by the pursuit of strategic goals on a longer term basis in contrast to more intermittent and arms-length relationships. These partnerships may receive some level of support from a public institution (e.g. ministry) or may have a public actor or institution (e.g. PRI, university, NGOs, foundations) as a direct or indirect member. For the purpose of this report, strategic P/PPs for STI can be defined as:

> *a strategic co-operative and (equity or non-equity) contractual agreement between three or more private and public stakeholders, involving substantial long-term public and private investment commitments in high-risk projects that revolve around broad, emerging scientific and technological fields, which are primarily initiated by the government and aligned with industrial and innovation strategies.*

30. Box 2 outlines the main characteristics of strategic P/PPs. It notes that variations clearly exist among the cases the Secretariat identified. The mapping and classification of strategic P/PPs, however, proves to be more difficult to illustrate and to map in OECD countries because of their multidimensionality, and because a number of strategic P/PPs are rather heterogeneous in nature. This stems from the complex settings in which some of the identified strategic P/PPs have emerged (see Chapter 2.2). In addition, since national policy-makers are constrained by different institutional structures, they might adopt different approaches to the same issue, even in a context of international interdependencies.

Box 2. characteristics of strategic P/PPs

As our starting point and for the sake of simplicity, we argue that strategic P/PPs are distinguishable by their initial strategic intent, their long term and multi-partner nature and are bounded by a unifying goal and governed by a single overarching contract. In some instances, strategic P/PPs have a strong multi- and interdisciplinary S&T character.

Strategic: For some countries, the "strategic" objective for which a strategic PPP in STI may have been launched is to maintain or achieve leadership at the technological/research frontier (e.g. Canada´s large cooperative programmes in the aerospace sector, the United States' National Additive Manufacturing Innovation Institute, Netherland's Top-Sector policy,). For other countries, the "strategic" objective may be to address the lack of core technological competences and long-standing problems involving the use and application of general purpose technologies for innovation (e.g. biotechnologies in health and ICTs in industry and services). Reflecting on the achievement of thematic objectives, ministries and agencies themselves may also have a strategic goal, namely to push the technology frontier in mission-oriented/thematic research fields. These partnerships may receive some level of support from a public institution (e.g. ministry) or may have a public actor or institution (e.g. PRI, university, NGOs, foundations) as a direct or indirect member.

For private actors with strong strategic intent, the objective is long-term profit optimisation by attempting to enhance the value of the firm's assets or to minimise its net cost by limiting internal R&D investment, or as in the case of SMEs, to alleviate resource and financial constraints.

Long-term: In strategic P/PPs the relationship between public and private partners is characterised by the pursuit of strategic goals on a longer term basis in contrast to more intermittent and arms-length relationships. The longer-term perspective is required in the promotion of cutting edge or "breakthrough" research.

Multi-partner and large-scale: Whereas the simplest collaborative structures involve two partners, multi-partner collaborations can be particularly effective for completing large-scale development projects requiring the coordination and resources of multiple actors. Multi-partner collaborations differ substantially from two partner collaborations in their governance and innovation processes (Das and Teng, 2002). They are formed to bring together the diverse resources needed for the novel recombination of knowledge. Such collaborations have the potential to earn greater returns than two-partner alliances, because larger pools of diverse resources can lead to the development of particularly unique research and innovation outcomes (Beamish and Kachra, 2004). Because actors in multi-partner collaborations are bound together by one overriding contract and goal, they depend on each other's contributions to achieve objectives. Strategic P/PPs in this context can help disseminate, embed and integrate knowledge across the actors in the value chain, both upstream (R&D activities) as well as downstream closer to the market (marketing and services).; the collaboration with suppliers and clients is one of important sources for innovation

Contractual: A Strategic PPP is a single cooperative agreement involving three or more actors bounded by a unifying goal and governed by a single overarching contract. It is a single formal legal document, agreed and signed by all the parties to a project, and which imposes a set of standard conditions on those signatories. These conditions would include, amongst other things, agreements as to ownership and exploitation of intellectual property rights (IPRs), and a set of warranties and disclaimers allocating risk between the parties. Such contractual collaborative agreements are distinct from loosely networks comprising relatively autonomous ties established through independent contracts for a diverse array of goals (e.g. start-up incubators or cluster members).

Multi-and inter-disciplinarily: The coming together of different fields of S&T through collaboration among actors and the integration of approaches originally viewed as distinct can facilitate radical or "breakthrough" innovations as it opens up new avenues for technology development. Thus, Strategic P/PPs that further the frontiers of knowledge through interaction across disciplines may have the ability to address key societal and economic challenges.

2.2 Strategic P/PPs and public policy

Policy rationale for intervention

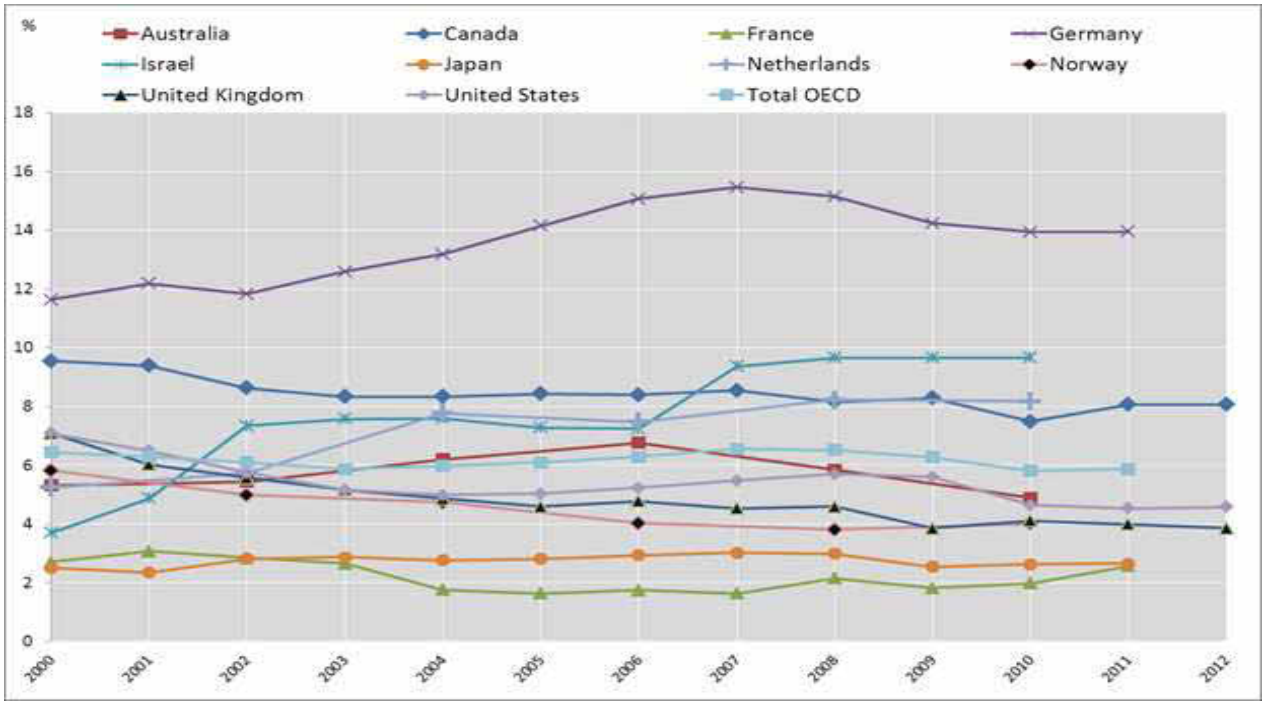
31. The globalisation of economies and innovation processes, among other contextual changes, has put pressure on firms to meet the needs of global and local markets, while the active role of triggering entities (e.g. national and local governments via funding and other support measures) has provided them with the necessary economic and non-economic incentives to reduce innovation and research risks (Pinto, Hine, and Knights, 2011; Meissner 2014).

32. In the context of this report, strategic P/PPs have been introduced as a new setup to promote public-private collaboration in STI. At a general level, collaboration is important to bridge the boundaries within innovation systems and to allow the various actors to share their knowledge, skills, capabilities and competencies in order to promote innovation and drive competitiveness. The main rationale of policies to support collaboration is based on well-known empirical evidence that stress the value of collaborations for both triggering additional R&D and innovation spending and enhancing R&D and innovation productivity (e.g. Gackstatter, Kotsemir and Meissner 2014; Van Leeuwen, 2002; Janz, Lööf and Peters, 2004; Sakakibara, 1997; Hagedoorn, 2002; Belderbos, Carree and Lokshin, 2004; Cassiman and Veugelers, 2002, 2005, Hottenrott and Lopes-Bento, 2014; Proskuryakova, Meissner and Rudnik, 2014a).

33. In addition, collaborative efforts, as illustrated for the case of strategic P/PPs, may be also a powerful mechanism to restore socially optimal levels of investments by overcoming the fragmentation of efforts, to define a common vision and mobilise resources to achieve breakthroughs in areas for strategic importance to countries more rapidly (Gokhberg, Meissner 2014). These incentives involve the strategic decision of the actors, including governments to exchange expertise and interact with each other.

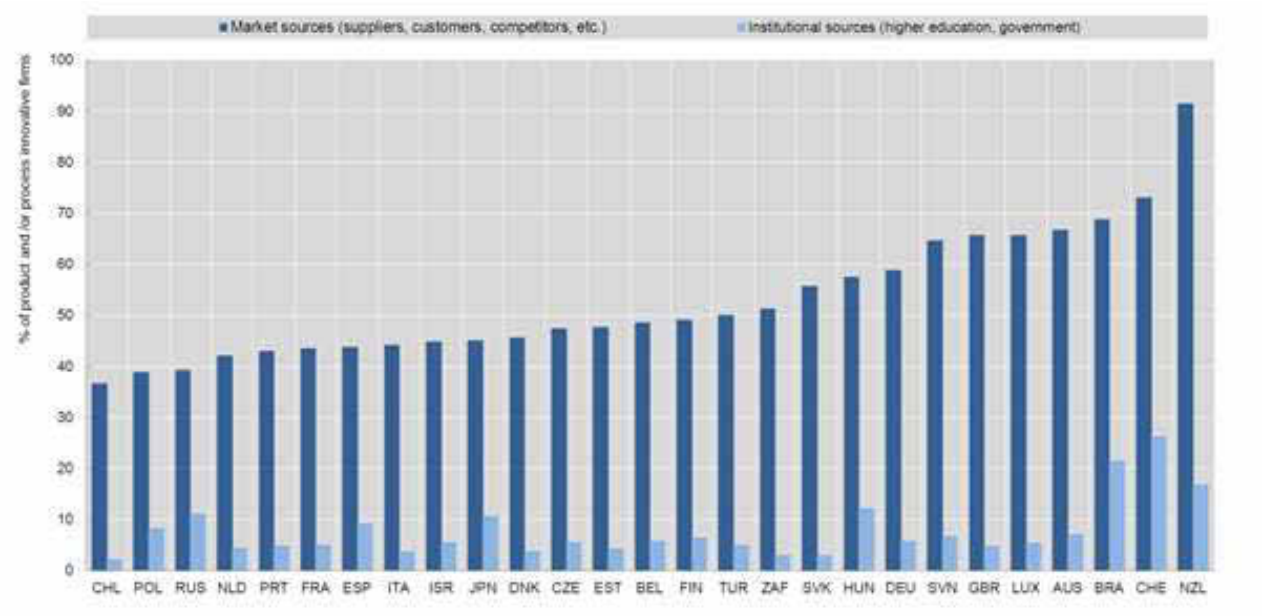
34. On the other hand, policy rationale for encouraging collaboration can be also based on the observation that the interaction between actors has not been flourished despite the large recognition of the value of collaboration. The share of business-funded R&D in universities is one proxy indicator of the intensity of the knowledge flows between the two sectors. The share of business-funded R&D in the higher education has somehow flattened at low level for most OECD countries since 2000 (Figure 3). Evidence from innovation surveys (the 2010 Community Innovation Survey [CIS] in Europe) also shows that universities and PRIs only play a small role as the sources of knowledge for innovation in firms (Figure 4); which is more typical to small firms with weak innovation capabilities (Figure 5).

Figure 3. Business-funded R&D in the higher education sectors, 2000-12



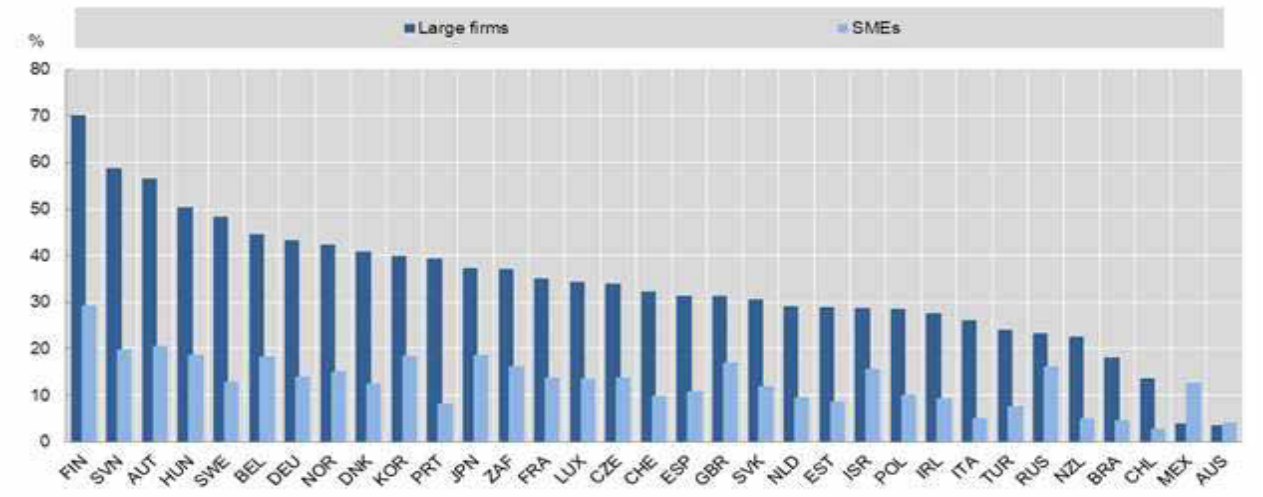
Source: OECD, Main Science and Technology Indicators (MSTI) Database, March 2014.

Figure 4. External sources of knowledge for innovation, by type, 2008-10
Percentage of product and/or process innovative firms citing source as "highly important"



Source: OECD 2013 based on Eurostat (CIS-2010) and national data sources, June 2013.

Figure 5. Firms collaborating on innovation with higher education or public research institutions, by firm size, 2008-10, *as a percentage of product and/or process innovative firms in each size category*



Source: OECD 2013 based on Eurostat (CIS-2010) and national data sources, June 2013.

35. However, it is not the intention of the report to outline a comprehensive list of rationales derived from policies fostering collaborative innovation activities. Rather, the aim is to showcase the portfolio of instruments targeted at forming or triggering the establishment of strategic P/PPs. We illustrate this with respect to a precise sub-rationale of the "strengthen linkages within innovation systems rationale", which can be stated as promoting co-operation in innovation activities among firms and other actors. The advantage of starting from a rationale and identifying the relevant instruments is that it is much easier to

spot the synergies, complementarities and overlaps between instruments that share a rationale as in most cases multiple instruments are targeting a specific rationale.

What policies or drivers may trigger strategic P/PPs?

36. The main trend in innovation policies during the last two decades is characterised by fostering co-operation among sectors - industry, government and research - and among rival or vertically related actors. Public policy, conscious of the potential of collaborative activities, provides economic and non-economic incentives to the setting up of collaborations, through a range of instruments and framework conditions, many explicitly focused on fostering R&D co-operation (Meissner and Schramek, 2007).

37. There are a range of instruments and policies pursued by governments to bring together partners around a common subject and to encourage collaborative endeavours. On the supply-side, four different policy domains can be identified where policies may be relevant for the establishment of strategic P/PPs: co-operative R&D grants, R&D tax credits for cooperation, support to co-operative research centres and cluster/network policies. All of these four policy domains are in one way or the other oriented towards promoting collaboration.

38. Strategic P/PPs may also interact with demand-side policies such as public procurement of innovation, user-driven innovation initiatives, standardisation bodies as well as regulation agencies. Demand-side polices are closely related to strategic P/PPs, as in the case for large-scale public sector procurement projects such in the defence or energy sector (Kutsenko and Meissner, 2014). However, whereas procurement aims to achieve very specific goals with respect to demand for innovation, strategic P/PPs aim to embed demand-side impulses with supply-side response through collaborative arrangements.

39. Strategic P/PPs may be not only triggered by the growing number of government initiatives to promote collaboration, but also by budgetary constraints, new public management ethos, changing legislative environments (e.g. eased antitrust policies), new policy approaches to spatial and/or thematic concentration (e.g. regional smart specialisation) and industrial policy. For instance, in response to the financial and economic crisis, many governments announced recovery packages including substantial measures in support of strategic sectors and industries, which in turn facilitated the coming together of key actors through the creation of a shared national objective. The smart specialisation concept with a focus on "entrepreneurial discovery processes" embraces closer (regional) public-private interactions between industry and government at various stages and levels. Netherland´s top sector approach has many characteristics of modern approaches to industrial policy, especially in terms on the emphasis on co-ordination and alignment (OECD, 2014a).

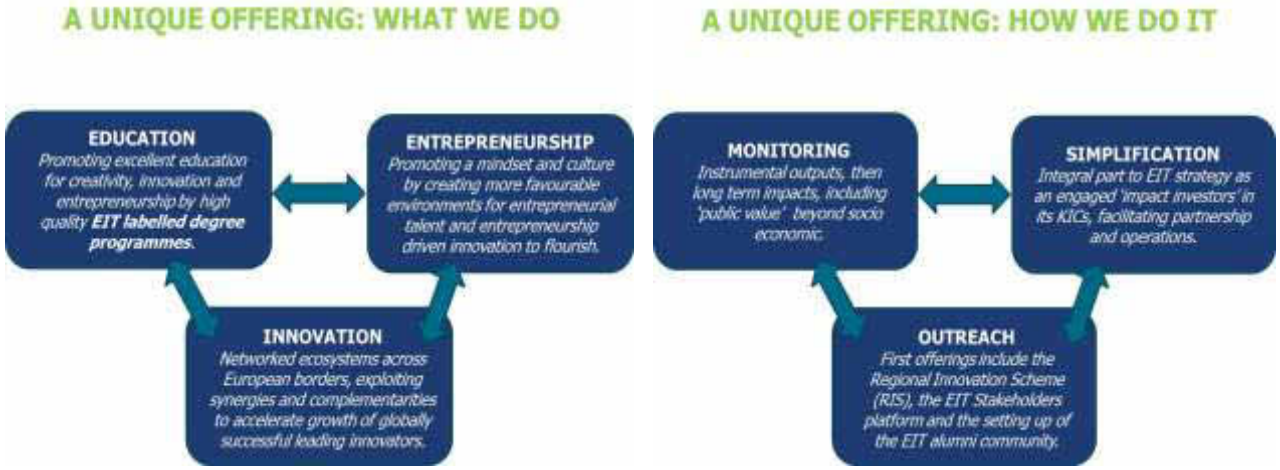
40. The fact that innovation has increasingly become a co-operative and networked based activity may have spurred Strategic P/PPs, whether supported by government policies or not. Business is pursuing open innovation approaches to R&D and innovation, collaborating with universities, PRIs and other business partners. This trend is especially pronounced in knowledge and R&D-intensive sectors, and is accentuated due to technological convergence, declining transaction costs of acquiring external R&D and knowledge inputs and shortening product cycle times.

41. In Europe, another example of what could be termed as strategic P/PP with a focus on entrepreneurs as a driver of P/PPs is the European Institute of Innovation & Technology (EIT). The EIT achieves this mission by fully integrating all three sides of the 'knowledge triangle', i.e. higher education, research and business, in Knowledge and Innovation Communities (KICs).

Box 3. The features of Knowledge and Innovation Communities (KICs)

The European Institute of Technology (EIT) aims to approach innovation by integrating all three side of the knowledge triangle in Knowledge and Innovation Communities (KICs). The features of KICs are **1) high degree of integration**: each KIC is an independent legal entity, gathering world-class KIC partners from the knowledge triangle based on a contractual relationship/partnership with the EIT. **2)Long-term strategic approach**: each KIC is set up for a minimum of 7 years to eventually become self-sustainable.**3) Sufficient autonomy and flexibility**: to determine organisational structure and activities governed by a Board of KIC partner organisations.**4) Effective governance**: run by a CEO and a lean management team at central and co-location level.

Moreover, as for an investment, there are logics which are **1) Smart funding & high degree of commitment of partners**: EIT funding to KICs is 25% (maximum) of their total budget over time with 75% to be attracted from other sources, both public and private. **2) The co-location model**: Each KIC consists of 5-6 world class innovation hotspots building and leveraging on existing European capacities. **3) Results & high impact oriented activities**: KICs implement a Business Plan with measurable deliverables, results and impact. **4) Culture**: KICs are shaped by strong entrepreneurial mind-set and cultures. The following figures show how EIT work for KICs



Source: EIT presentation on the TIP thematic workshop in June 2014.

Does the recent policy landscape encourage the formation of strategic P/PPs?

42. There is a comparatively long history of OECD countries providing incentives for firms and other actors to engage in co-operative research efforts. Among the first government initiatives were the so-called Collective Research Centres (CRCs), which were created in most European countries after the Second World War to stimulate the technological development of business in the major industrial sectors through collective and collaborative research (Wright et al., 2008). These have been driven mostly by a desire to turn research into socio-economic results.

43. Today, policies to foster co-operation among actors represent a significant part of the portfolio of innovation policy support in many OECD countries. Policy-makers in a number of countries have sought to promote collaboration by intervening with multiple instruments simultaneously. Therefore instruments (regardless of instrument and/or policy taxonomies) should not be seen in isolation but as a set of interacting policies.

44. Table 1 presents instruments for selected OECD countries drawn from responses to the STI Outlook policy questionnaire. Complementary to the qualitative information provided in Table 1, additional information was gathered and collected through desk research and correspondence with national delegates.

45. Support for co-operation can encompass a diverse set of modalities of action. Several general observations can be made:

- **Domain 1**: Most instruments support collaborative short-term research projects of less than 1 year to maximum 4 year's duration. These instruments are designed to target one business partner (with preference sometimes to two) and one university or PRI (department, research group or unit). Researchers and students employed in a public institution can benefit from inter-sectorial mobility schemes as part of the instrument. Key selection criteria tend to put emphasis to favour incremental improvements/innovation that are of intrinsic commercial value to the partner firm. These projects typically source financial support from two government streams:

  - *Direct R&D grants (including voucher-type instruments):* Most OECD countries in one or the other way have direct R&D grant schemes in place to support business innovation. While in some OECD countries the collaboration element is embedded into the broader funding instrument or are a condition of grant allocation (e.g. Belgium, Norway), some have set-up stand-alone collaboration schemes with own allocated budgets (e.g. Australia, Canada, United Kingdom, United States). Costs tend to be fully covered for universities or PRIs (or individuals) while business partners tend to pay their own costs or the government covers a share of their total R&D project costs. Elsewhere innovation voucher instruments have sprung up to provide SMEs with small credits that can be used with a university or PRI within a 1-2 years period to purchase access to facilities or know-how.

  - *Belgium*: One specific design feature of the grant scheme of the agency for Innovation by Science and Technology in Flanders is to support SME collaboration. If an SME collaborates with a university/PRI or an international partner, it can submit a proposal of a maximum of EUR 250.000 (which usually constitutes EUR 200.000 if the SME does not intend to collaborate). If it collaborates with another firm (nationally), it can get a 10% top-up on the subsidy rate.

  - *Canada*: The Engage Grant, operated as a stand-alone programme, supports well-defined projects undertaken by eligible university researchers and their business partners. A maximum grant of CAD 25.000 over a period not exceeding six months will be awarded to the academic researcher to cover the direct project costs associated with the research activities needed to address the identified firm-specific problem.

  - *Tax incentives*: R&D tax incentives have proliferated and become more generous. Some countries have fine-tuned their R&D tax schemes to spur collaborative research between industry and science (e.g. France, Hungary) and industrial networks (e.g. Ireland, United Kingdom) (OECD, 2014b forthcoming).

- **Domain 2**: Some instruments support the creation of collaborative research centres that are physically located at universities or PRIs; they tend to focus on specific and strategically important sectoral areas of applied research; they often closely engage leading firms within their governing bodies and/or in the definition of their strategies and/or receive research funding or assistance from business partners (e.g. Australia's IBM Laboratory). They are often established for a diversity of types of interaction, exchange and activities. Projects may range from short-term staff placements to longer-term and highly interactive research arrangements. Such collective research centres may go by many names including Centres of competence (Czech Republic´s Competence Centre Programme), Centres of excellence (Canada´s Networks of Centres of Excellence program) and borderline institutes (France´s Carnot institutes).

- **Domain 3**: Government support is also provided to long-term research projects ranging from more than 4 years duration. Proposals to be eligible for funding usually need a minimum of three network partners and tend to require large funding commitments from partners over the project lifetime. Projects outcomes are specified in a way to support pre-competitive non-generic research 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. Selected examples include China´s Industry-Research Strategic Alliances, Canada´s Strategic Network Grants, Netherland´s Top Sectors, Germany´s Innovation Alliances, Israel´s Magnet Consortium, and France´s Strategic Industrial Innovation Programme (ISI) (see Table 1).

46. This portfolio analysis, even though based on limited qualitative evidence, suggests that policy domain 3 fits best into the proposed definition of strategic P/PPs. Policy domain 2 exhibits operational elements of strategic P/PPs, but recent OECD work found that these institutionalised designed centres, whether coined collective research centres, centres of competence or excellence, are diverse and thus difficult to match to a pre-defined taxonomy system (OECD, 2011, 2014c).

47. It is to note that there are clear overlaps and/or complementarities between theses identified domains responding to the selected rationale. For example, collaboration beneficiaries may be situated in an (existing) research centre (or even in a cluster-type location), profit from R&D grants and tax incentives, while at the same time receiving consortium-related support. This indicates that there is no-single policy programme or instrument that can be identified for being crucial in the creation of Strategic P/PPs.

48. One difficulty when faced with the analysis and the identification of strategic P/PPs outside government instrument frameworks was the government practice of diverting project funds in form of contracts to national performers and actors to collaborative efforts of large-scale. These domestic (commissioned) contracts may be part of a national innovation/industrial strategy or R&D contributions to the national funding agencies by government who then distribute technological funds and contracts to collaboration beneficiaries as part of their internal strategy/mission. In addition, strategic P/PPs may also receive international public project funding (e.g. projects financed by the EU Framework Programme) or from joint programmes which are jointly managed by more than one country. Those issues do not only pose challenges for identifying strategic P/PPs, but also limits to assess the size of funding that is allocated to collaboration.

49. Table 2 in contrast, presents descriptions of ‘strategic’ PPP as identified by countries taking part in the TIP project. A comparison of two tables suggests that the categorisation of strategic P/PPs is very similar to those that correspond to Domain 3 in Table 1 .

Table 1. Portfolio of instruments to promote collaboration: Examples from selected OECD countries

Country	
Australia	*Linkage Projects (ARC)* [SO: "Initiate and/or develop long-term strategic research alliances and to enhance the scale and focus of research in Strategic Research Priorities"], [SF: Partner organisations are required to enter into arrangements with the university regarding intellectual property and may use the research findings] [F: AUD 101m in funding for projects commencing in 2013], [TP: Australian universities, industry and end-users], [**Link**]
	Cooperative Research Centres (CRC) Program [SO: "CRCs are designed to create a more collaborative research culture between Australian business and other end users of research and the higher education sector."], [SF: average number of partners being above 20, funding up to a maximum of 15 years], [F: AUD 622.2m over 2011-12 to 2014-15 government investment: AUD 166m in 2011-12], [TP: must comprise at least one Australian end-user (either from the private, public or community sector) and one Australian higher education institution], [**Link**]
	Joint Research Engagement (JRE) [SO: "JRE aims to give greater emphasis to end-user research by encouraging and supporting collaborative research activities between Australian universities, industry and end-users, beyond those specifically supported by Australian competitive grants."], [SF: The JRE may be used to fund any activity related to research], [F: block grants to higher education providers, USD 296.8m PPP in 2013-14], [TP: Australian universities, industry and end-users], [**Link**]
	Flagship Collaboration Fund [SO: "The Flagship Collaboration Fund is a contestable funding pool and is designed to further strengthen collaboration between the CSIRO Flagships, universities and other publicly-funded research institutions (national and international)."], [SF: 22% of the partner institutions/universities are international], [F: since ´05: AUD 124m, annual budget: AUD 17m], [TP.: nat. and intern. universities, PRIs and cooperative research centers], [**Link**]
	IBM R&D Laboratory [SO: "IBM R&D Laboratory will engage with the University, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and National ICT Australia (NICTA) and industry to foster open and collaborative research partnerships and strengthen linkages between private and public research"], [SF: the laboratory will draw on the global capacity of IBM Research], [F: government funding of AUD 22m over six years from 2010], [TP: universities, Commonwealth Scientific and Industrial Research Organisations (CSIRO) and National ICT Australia (NICTA) and industry]
	Connecting Australian European Science and Innovation Excellence (CAESIE) [SO: "CAESIE aims to strengthen and expand the existing formal Australian-EU science relationship to promote innovation and research engagement with industry - particularly small-to-medium enterprises (SMEs)."], [SF: sectoral focus: 'Clean energy', 'Sustainable cities' and Healthy ageing], [F: jointly by the EC and the Australian Government: EUR 2.4m from Oct. 2012-15], [TP: SMEs in Europe and Australia to collaborate with counterparts], , [**Link**]

Canada	*College and Community Innovation Program* [SO: "support collaboration between colleges and industry on research and development projects that focus on company needs"], [SF: there are six types of grants; four priority areas: environmental technologies, natural resources and energy health, related life sciences and technologies and ICTs] [F: CAD 50m per year], [TP: n.a.], [**Link**]
	Strategic Network Grants (SNGs) [SO: "The objective of Strategic Network Grants (SNG) is to increase research and training in targeted areas that could strongly enhance Canada's economy, society and/or environment within the next 10 years."], [SF: funds large-scale, complex research proposals that involve multi-sectoral collaborations in targeted areas] [F: n.a.], [TP: n.a.], [**Link**]
	Collaborative Research and Development Grants [SO: "The Collaborative Research and Development (CRD) Grants are intended to give companies that operate from a Canadian base access to the unique knowledge, expertise, and educational resources available at Canadian postsecondary institutions and to train students in essential technical skills required by industry."], [SF: support well-defined projects undertaken by university researchers and their private-sector partners], [F: awards cover up to half of the total eligible direct project costs, with the industrial partner(s) providing the balance in cash and in kind], [TP: n.a.], [**Link**]
	Engage Grants [SO: "Engage grants are intended to foster the development of new research partnerships between academic researchers and companies, that have never collaborated before, by supporting short-term research and development projects aimed at addressing a company-specific problem"], [SF: there can be no existing or past relationship between the person applying for funding and the company whose problem is being investigated through the project.], [F: project awards cover up to CAD 25k for up to six months], [TP: n.a.], [**Link**]
	Networks of Centres of Excellence program [SO: "to support large-scale academically led research networks that harness the creativity and inventiveness of Canadian health, natural, and social scientists and engineers"], [SF: In 2011-12, network activities involved the participation of more than 2,000 public and private sector organizations in Canada and abroad], [F: Partners from industry, government and not-for-profit organizations contribute additional expertise and contribute nearly $90 million per year of cash and in kind support], [TP: n.a.], [**Link**]
China	*Industry-Research Strategic Alliances (case study)* [SO: "address long-standing problems related to the low level and dispersal of innovation capabilities, the inadequate supply of generic technologies and the lack of core technological competencies in [specific] sectors"], [SF: each Industry-Research Strategic Alliance has its own form, adapted to the specific industrial structure and technological problems of the industrial sector; there are now 146 Industry-Research Technology Strategic Alliances, and there are more than 1200 IRTSAs at the regional level across the country by the end of 2013.], [F: n.a.], [TP: n.a.], [**Link**]
France	*Strategic Industrial Innovation Programme (ISI)* [SO: "The ISI supports collaborative innovative projects in order to create or strengthen new European or world industrial champions."], [SF: Sectoral distribution of ISI funded projects: Biotech / health: 35%; Industry/Environment: 34%; ICTs: 31%], [F: 2008 – 2010: EUR 779m ; 2012: EUR 109m; grants between EUR 3m and EUR 10m per ISI project], [TP: The ISI programme supports collaborative innovative projects conducted by businesses and involving at least two firms and a public or private research laboratory], [**Link**]

	Blue Sky Cooperative R&D Programmes [SO: "The 'Blue-Sky' non-thematic programme ("Blanc") aims to provide a significant stimulus to ambitious projects that are competitive on an international level, are highly original and break away from traditional research paths."], [SF: Starting with the 2014 call, project submitted will be categorized along nine societal challenges.], [F: n.a.], [TP: n.a.]
	Industrial Chairs [SO: "The Industrial Chairs programme aims at consolidating and reinforcing the competitiveness of French companies and is designed to support collaborative R&D between research institutions and industry"], [SF: five industrial chairs have been selected in 2012 for a total amount of EUR 5,4m, five industrial chairs have been selected in 2013 for a total amount of EUR 4,5m], [F: financial support is granted for a period of four years and may be renewed; government contribution amounts to a minimum EUR 600k and may be up to EUR 2m per chair on a 1:1 basis.], [TP: n.a.], [**Link**]
	Carnot Institutes [SO: "The Carnot Label was designed to develop partnership-based research, meaning research efforts conducted by public laboratories in partnership with socio-economic players, primarily enterprises (from SMEs to large corporations), to serve their needs."], [SF: In 2012, the Carnot Institutes encompassed 34 multidisciplinary institutes and 19k research professionals(15% of the French public laboratory workforces)for a EUR 2b annual R&D budget and EUR 420m annual revenues from research contracts directly financed by Companies.], [F: EUR 60m in 2012], [TP: n.a.], [**Link**]
	Institutes for Technology Research (IRT) [SO: n.a.], [SF: IRTs are based on long-term partnerships between higher education institutions and research-performing firms to reach a critical mass of resources and expertise; eight IRT projects have been selected in 2011], [F: USD 2.3b PPP; state funding is of 50% maximum and at least 30% of investments are funded by private partners], [TP: n.a.], [**Link**]
Germany	*Innovation Alliances* [SO: "Innovation alliances are strategic alliances between science and business that aim to exercise a particular economic leverage effect."], [SF: Currently, there are nine Innovation Alliances and a large number of "strategic partnerships" created by the BMBF, the scientific community and industry], [F: USD 750m PPP; innovation alliances are funded on a 1:5 basis], [TP: n.a.]
	Forschungscampus: Public Private Partnership to Foster Innovation [SO: "Research Campus is a competitive funding scheme under the High Tech Strategy to strengthen the cooperation between science and industry"], [SF: R&D project funding is focusing on application-oriented basic research with a funding perspective up to 15 years.], [F: Up to EUR 2m per year per Research Campus. Summing up to a total of EUR 200m taking into account the ten Research Campuses], [TP: n.a.]
	Industrial Collective Research [SO: "Industrial Collective Research is R&D performed for the benefit of a broad target group of firms, especially of SMEs. The objectives of collective research are pre-competitive and often pre-normative."], [SF: Collective research is typically initiated by groupings of enterprises with common interests, such as associations, professional federations, clusters, and trade associations. It is frequently carried out by specialised research institutes or technological centres which work on behalf of a particular industrial sector.], [F: In 2013, about 1,500 projects have been funded with EUR 140m], [TP: SMEs], [**Link**]

Israel	*MAGNET* [SO: "The Magnet programme is intended to provide a competitive position for Israel's industry with regard to state of the art technologies of worldwide interest."], [SF: Magnet supports pre-competitive generic research through the formation of consortia made up of a number of commercial companies together with research personnel from at least one academic or research institution.], [F: USD 52m PPP in 2011; grants are up to 66% of the approved budget for industry and up to 80% for the academic institution; the duration of a Magnet Consortium is three to five years], [TP: n.a], [**Link**]
	MAGNETON [SO: "Magneton is to further support an already existing relationship between industry and an academic institution."], [SF: any income deriving from an R&D program that has enjoyed government support is liable for the payment of royalties], [F: grants amount to 66% of the approved R&D costs within a maximum project's budget of USD 800k; the programme duration is up to 24 months], [TP: n.a], [**Link**]
Japan	*S-Innovation* [SO: "The Strategic Promotion of Innovative R&D (S-Innovation) programme selects research output from Japan S&T Agency's basic research programmes that is expected to form the foundations of future Japanese industries."], [SF: The main funders of collaborative R&D between academia and industry are reported to be the New Energy Industrial Technology Development Organisation (NEDO) and the Japan Science and Technology Agency (JST)], [F: S-Innovation provides funding up to JPY 70 million per project team.], [TP: n.a], [**Link**]
	Venture Laboratories [SO: "The Venture Laboratories initiate support between academia and business in R&D providing research facilities located in universities with support from companies."] [SF: As of the end 2008, 1953 ventures were established in universities, and 154 in Independent Administrative Institutes], [F: n.a.], [TP: n.a], [**Link**]
	Programme for promoting self-sustained management of industry-academia-government collaboration in universities [SO: "The Programme strives to upgrade the environment to facilitate the self-sustained implementation of industry-academia-government collaboration by universities with the ultimate aim of utilising the outcomes of university research for the benefit of society"] [SF: The Ministry of Education, Culture, Sports, Science & Technology (MEXT) has selected and supported 52 universities for functional reinforcement.], [F: USD 16.4 billion PPP in 2011], [TP: n.a]
Netherlands	*Top Sectors* [SO: "The top sectors sometimes concentrated in a specific geographic areas, are characterised by a strong market and export position, a solid knowledge base, close collaboration between entrepreneurs and knowledge institutes, and the potential to provide input in solving societal challenges."] [SF: The nine current top sectors are: agri-food; horticulture and propagating materials; high-tech systems and materials; energy; logistics; creative industry; life sciences and health; chemicals; water], [F: n.a.], [TP: n.a.]
Norway	*Programme for regional R&D and Innovation (VRI)* [SO: "The VRI-programme is a funding initiative for regional R&D and innovation to strengthen innovative capacity and promote new forms of cooperation within Norwegian regions."] [SF: sectoral focus: environment, tourism, the maritime sector, and the marine sector], [F: NOK 71 million in 2013], [TP: n.a.], [**Link**]
	Centres for environment-friendly energy research (FME) [SO: "FME seek to develop expertise and promote innovation through focus on long-term research in selected areas in order to solve specific

	challenges in the field of energy and the environment."] [SF: In 2009, eight FME centres were established and an additional three in 2011; FME participants must enter into a consortium agreement], [F: Each FME centre is allocated between NOK 7 million and NOK 20 million per year; USD 16 million PPP in 2013], [TP: n.a.], [Link]
Russian Federation	*Government Act N218* [SO: "support the development of cooperation of Russian higher education institutions and enterprises which implement complex projects on establishing high-technology production"] [SF: Federal budget subsidies are allocated to industrial enterprises up to 100b roubles for a project for a term of 1-3 years], [F: competitive funding to industrial enterprises for projects on establishing high-technology production implemented together with a university; overall budget: 19b roubles in 2010-2012; planned budget is 18b roubles for 2013-2015], [TP: n.a.], [Link]
United Kingdom	*Innovation development programs (IDP)* [SO: n.a.] [SF: the Russian Federation has determined a list of 47 companies (13 companies were added to the list in 2012), which should develop IDPs; Cooperation with HEIs in education and R&D is one of the important parts of the IDPs; cooperation with HEIs in education and R&D is one of the important parts of the IDPs], [F: n.a.], [TP: state-owned companies] *Catapult Centres* [SO: "The Technology Strategy Board has also established a network of Catapult Centre. Catapult Centres act as the hubs of clusters and networks and facilitate open innovation through the development of new collaborations between businesses and external partners."], [SF: The first seven centres are now open covering: High Value Manufacturing, Cell Therapies, Offshore Renewable Energy Satellite Applications, Connected Digital Economy, Future Cities, Transport Systems.], [F: Total public and private investment exceeds GBP 1.4b over the first 5 years of Catapult Centre operation], [TP: n.a.]
	Collaborative Research and Development [SO: "Assist the industrial and research communities to work together on R&D projects in strategically important areas of science, engineering and technology"] [SF: The Technology Strategy Board (TSB) holds regular competitions for funding of collaborative R&D projects, and each competition focuses on a distinct technology area], [F: Projects range in value from GBP 10k to over GBP 100m], [TP: industry, higher education institutions, public research institutions], [Link]
United States	*Small Business Technology Transfer Program (STTR)* [SO: "Expansion of the public/private sector partnership to include the joint venture opportunities for small business and the premier non-profit research institutions"] [SF: Each year, five federal departments and agencies are required by STTR to reserve a portion of their R&D funds for award to small business/nonprofit research institution partnerships], [F: Phase I: Max. USD 100k (6 months) to evaluate concept; Phase II: Max. USD 750k (1-2 years) for principal R&D; Phase III: Commercialisation expected by private sector], [TP: SMEs, higher education institutions, public research institutions], [Link]

Notes:

1. Abbreviations: SO: Stated objective; SF: special feature(s) or fact(s); F: Funding, budget estimate or costs; TP: target population or beneficiaries.
2. Schemes targeting individuals (e.g. inter-sectoral mobility of researchers between science and industry) have been omitted.
3. Original terms have been kept according to responses to the STIO 2014 questionnaires.
4. USD in PPP, if provided in STO2014 questionnaires.

Source: On the basis of the responses provided by countries to the STI Outlook policy questionnaires D.7 industry-science collaboration, 2014.

Table 2. Features of "strategic' PPP programmes identified by countries providing case study material

Features / Programme Name	Long-term supports / collaborations	Multi-partners	Revolving around global challenges, emerging scientific and technological fields	Primarily initiated by the government and aligned with their innovation strategy
Christian Doppler Research Association (Austria) [Physical institute]	Supporting application-oriented basic research by strengthening a long-term (a maximum of 7 years), intense cooperation between science and industry.	The composition of the steering elements consists of representatives from ministries, academia and companies to guarantee consideration of financiers' and scientific voices in decision making.	*(Application-oriented basic research)*	The research association can be classified as a measure in the Austrian RTDI policy addressing the improvement of industry-science linkages and promotion of human capital.
Competence Centres programme (Czech Republic) [Public grant]	Supporting the development of long-term collaboration in RDI between the public and private sectors.	Conditions for long-term multilateral collaboration of strategic nature between research organisations and enterprises.	Focus on problem orientation of a Strategic research agenda corresponding to national competitiveness strategy and research priorities, many of them corresponding with global challenges.	The design of the programme is predominantly policy-driven; the collaboration between RDI organizations and industry was addressed in National RDI Policy for 2009-2015, and establishment of a programme supporting strategic long-term science-industry collaboration was one of the proposed measures.
Industrial and Public R&D contracts (Norway) [Public grant]	Launched in 1968 and no end date planed.	The agreements between one or more supplier companies and one or more customer companies. Foreign firms among the partners are allowed. The demand side firm may also be foreign.	Large part of the projects is the health and care sector followed by ICT and defence.	- *(The agency of the Ministry of Trade and Industry, Innovation Norway, administers the programme.)*

Joint Technology Initiatives (EU) [Thematic research consortium]	**Fixed budget for 7 years to leverage more industry investment.** **One of the criteria in Horizon 2020 legislation is the scale and long term nature of industry commitments.**	**The feature is higher level of SMEs participation (30%) than in FP7 and the coverage of longer value chains and interrelated sectors.** **Openness to new participants.** **The collaboration across borders is perceived positively and enthusiastically by both industry and the academic research community.**	**Address strategic technologies that will underpin growth and jobs in globally competitive sectors. All of the sectors involved are already or are fast emerging as strongholds of a knowledge-based European economy.** **The objectives target the development of key enabling technologies, such as electronics, that will underpin the competitiveness of a wide range of European industries.**	**The Commission is presenting legislative proposals for JTIs to be established at the start of Horizon 2020.**
Malaysian Industry-Government Group for High Technology (Malaysia) [Physical institute]	20 years' experience on Smart Partnership between Government, Industry, Academia and the Society.	Coordinating large scale project with multi-stakeholders including big firms, SMEs, relevant ministries, universities and research institutions.	Focus on thematic areas of mobility, energy and emerging technology.	Established by the government. It is the organisation under Prime Minister Department.
Manufacturing Innovation Institutes (USA) [Physical institute]	Launched in 2013 for 5 years	Bringing together companies, universities and community colleges, and Federal agencies.	Focus on "Digital Manufacturing and Design Innovation", "Lightweight and Modern Metals Manufacturing" and "Next Generation Power Electronics Manufacturing".	P/PPs are one of the many policy tools described in A Strategy for American Innovation, the Obama Administration's national innovation strategy. P/PPs are playing an increasing role in STI efforts in key areas including advanced manufacturing and in a science, technology, engineering, or math education because

				manufacturing and education are two sectors where public and private entities are already in close collaboration.
Strategic Alliance for Industrial Technology Innovation (China) [Alliance based on agreement]	- *(The cooperation aimed at the short-term objectives set by national S&T program, which focused on individual technology to be achieved in three to five years.)*	Involving multiple partners with 20 to 30 members, averaging 34 organisations per the Strategic Alliance.	From traditional industries such as steel manufacturing industry and coal industry to emerging industry such as solar thermal industry and biomedical materials industry.	The Ministry of Science and Technology and other five ministries launched the National Technology Innovation Programme (NTIP). The Strategic Alliance becomes an important carrier of implementing NTIP.
Technological Incubators Programme (Israel) [Public grant]	- *(The incubation term of a project in a technological incubator usually lasts two years)*	Bringing together various stake-holders such as venture capital funds, angel investors, national and multinational technological companies.	Focuses on life science, ICT and clean-tech technologies which are in innovative early stage and too risky for private investments.	The Office of the Chief Scientist in the Ministry of Economy who operates the programme is empowered by the Law for the Encouragement of Industrial Research & Development – 1984 and oversees all Government sponsored support of R&D in the Israeli industry.
Technology Platform (Russia) [Thematic research consortium]	One of criteria outlined for TPs is long-term business or social requirements. TP participants have agreed on long-term development perspectives in selected research and development areas.	TP launches a number of large joint projects at the pre-competitive stage of R&D with universities, research organizations, industrial enterprises and state-owned enterprises.	- *(In future all platforms focus on key societal challenges, following the evaluation from TPs evaluators.)*	The research theme matches government priorities.
Top Sectors (Netherlands) [Thematic research consortium]	- *(Since 2010)*	Close collaboration between businesses, knowledge institutes and the government (the 'golden triangle' or 'triple	Cross cutting agendas on ICT, nanotechnology and the bio-based economy. Standing out for potential to	The first nine sectors were established in the 'To the Top' policy document of the Ministry of Economic Affairs,

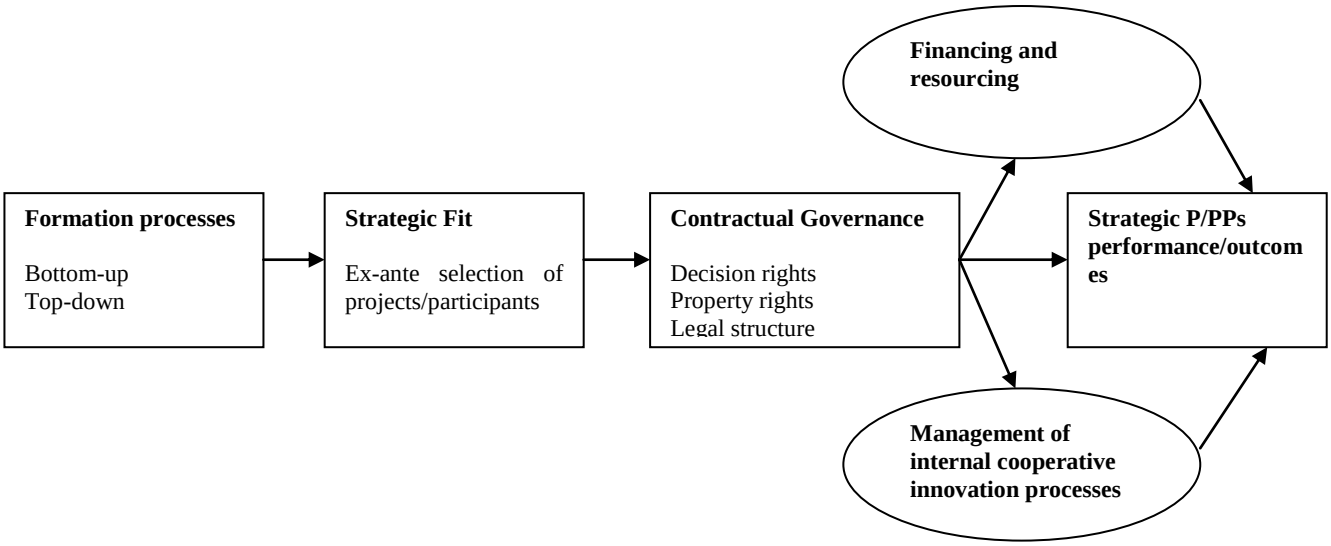
		helix').	contribute to solutions for societal challenges.	Agriculture and Innovation.
Tsukuba Innovation Arena for Nanotechnology (Japan) [Thematic research consortium]	5 years for the First Mid-Term Programme.	Tsukuba Innovation Arena (TIA) grew into a global nanotechnology complex with 26 national projects including more than 100 industrial partners.	Focus on Nanotechnology such as Nano-Electronics, Nano material, Nano instrumentation.	The Ministry of Economy, Trade, and Industry and the Ministry of Education, Culture, Sports, Science and Technology led to established TIA following to the proposal from private party of business leaders. The law of Research & Development Partnership was largely amended to accelerate public-private cooperation.
RETOS-COLABORACION call (Spain) [Public grant]	From 2013 to 2016	At least one research organisation and two partners must participate in the project.	Promoting the development of new technologies, business application of new ideas and techniques, and contribute to the creation of new products and services.	The research category is compatible with those of defined in the Community Framework for State Aid for RDI.

Source: On the basis of the responses provided by countries to the questionnaire and the case study of the strategic P/PPs.

3. Formation processes, strategic fit, and contractual arrangements: selected strategies and tools

50. While the creation of strategic P/PPs via a selected portfolio mix of instruments can be a strategic option for governments, the performance and outcomes of such collaborative structures may be conditioned by two major factors: 1) formation processes and the ex-ante selection of research proposals and 2) contractual design, which specifies internal management activities as well as the allocation and distribution of financial resources, amongst others. Figure 6 illustrates this relationship. In the forthcoming section, each feature will be examined. In addition, this section showcases tools and strategies used in collaborative efforts and instrument designs that could be utilised to design and manage collaborative efforts more effectively.

Figure 6. Process perspective of forming strategic P/PPs



3.1 The creation of P/PPs and the ex-ante evaluation of projects and awardees

The creation of P/PPs

51. While the benefits and motives of actors to join strategic P/PPs are evident (e.g. they allow the co-financing of R&D and innovation efforts so that actors can reduce uncertainty and costs of projects, share skills, and increase their abilities to absorb and integrate external [technological] information and knowledge), actors that intend to collaborate for innovative purposes need first a willing partner in such efforts. They must identify suitable partners who hold complementary competences, and expected returns must outweigh the perceived risk.

52. In principal, the process of identifying potential collaboration partners is enabled by the flow of information in global research and industrial communities, which form around relatively distinct disciplines (e.g. manufacturing, pharmaceuticals) (Moodysson, Coenen and Asheim, 2008). There are two distinct formation processes to collate for collaborative innovation efforts: 1) among actors in an existing network of firms, common suppliers, customers, and science partners etc. who then collectively apply for government funding and support (bottom-up approach) or 2) through triggering entities (e.g. governments, intermediaries) that act as innovator catalysts who actively bring together partners around a common subject and provide initial funding to encourage collaborative endeavours (top-down approach).

53. In the former process, potential collaboration partners will often operate in the same or a related industry and research area. These conditions increase the likelihood that future partners are already aware of one another, even though they may not have directly worked together (e.g. in the case of competitors). Further, the presence of common resource needs and strategic goals increases the likelihood that actors will know about their future partners, and share threats and technological opportunities (Hayton and Olk, 2013). Moreover, collaborations may also be formed by one dominant actor that initially becomes aware of a specific challenge or opportunity, and solicits memberships from other actors as it finds appropriate or uses their own network to identify actors with complementary knowledge competences (Hayton and Olk, 2013).

54. In the latter process, actors are typically unaware of their potential partners, or at least of the relevant capabilities that may be available through collaborative relationships. Because actors may operate in different strategic areas, they likely have fewer common threats, shared interests or network ties. Actors that do not face the same environment, do not come from similar industries and research areas, and do not have high levels of technological relatedness are expected to have difficulty finding one another (Hayton and Olk, 2013). But these factors lead to opportunities for triggering entities, such government agencies or affiliated government agencies to link potential partners as a significant impact in the emergence of collaborative partnerships comes from public funding programmes. Thus governments may end up selecting or approaching actors for a specific P/PPs. Exemplary, Israel´s Magnet Consortium operates both in a top-down and bottom-up manner. Some of the consortia applying for funding are formed on ideas from academia or industry, while others are suggested by the Magnet administration and internal scientific experts.

55. Governments start to recognise that progress within a technology or research trajectory is shaped by a multiplicity of actors. These actors, who include suppliers, users, universities, PRIs, competitors, SMEs, foreign firms and research institutions, communities, and intermediaries, provide varied and complementary responses and resources to move the technology or research field forward that single actors could not achieve on their own. This underscores the importance of collaboration among these actors. The Danish Innovation consortium programme, for instance, requires collaboration actors to be composed of a diversity of actors and allows further project involvement of parties relevant to the project (e.g. interest organisations, industry networks, vocational schools, among others). In addition, the review process will be assessed positively if the consortium includes SMEs or foreign parties among its actors.

Box 4. The example of creation of P/PPs: Horizon 2020

In the new European Union programme for research and innovation, Horizon 2020, there are two types of P/PPs in the programme. One is Contractual P/PPs whose budget is committed on an annual basis through Horizon2020 calls in Work Programmes, The other is Joint technology Initiatives (JTIs) which represent the joining of forces between the EU and industry and provide vital funding for large-scale, longer-term and high risk/reward research. The characteristic of the programmes are following;

Contractual P/PPs: Work Programmesare prepared on the basis of an industry-developed multi-annual roadmap and a contractual arrangement which specifies an indicative 7 years EU funding, and the commitments of industry to match this and to additional investments outside the PPP calls with high leverage factors, but not legally binding. To identified research and innovation priorities on the Horizon 2020 work programmes, private sector partners advise the Commission who has responsibility for implementation of calls which are fully open and addressing enabling industrial technologies.

JTIs: set out commitments, including financial commitments, over a seven year period from both the EU and from the industry partners. They each have clear objectives which need to be achieved by the Partnerships. JTIs bring together companies, universities, research laboratories, innovative SMEs and other groups and organisations around major research and innovation challenges. They establish their own strategic research and innovation agendas and fund projects selected through open and competitive calls for project proposals (EC MEMO, Brussels, 15 April 2014).The legal framework for the JTIs is Joint Undertaking as a new way of realising public-private partnerships at European level in the field of industrial research.

In addition, P/PPs to be supported under Horizon 2020 shall be identified an open, transparent and efficient way based on all of the following criteria:

a) the added value of action at Union level;

b) the scale of impact on industrial competitiveness, job creation, sustainable growth and socio-economic issues, including societal challenges;

c) the long-term commitment from all partners based on a shared vision and clearly defined objectives;

d) the scale of the resources involved and the ability to leverage additional investments in research and innovation;

e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen;

f) Complementarity with other parts of Horizon 2020 and coherence with R&I strategic priorities.

Source: EC presentation on the TIP thematic workshop in June 2014.

56. Actors can identify or search for external sources of innovation by collaborating with a variety of external stakeholders or seeking out specialists with useful knowledge. For example, when a collaborative organisation considers extending its membership to include SMEs in business contexts that are unknown to existing actors, it may seek the help of scouts or intermediaries for the search of adequate partners. Intermediaries or brokers working between actors have a role to play in bringing actors together and facilitating joint activities (Boon et al., 2011). The potential activities, or roles, include articulation of needs and requirements; identification, generation, combination and dissemination of knowledge; identification and selection of partners, management and allocation of financial and human resources; arbitration and brokering; facilitating learning and collaboration within networks of actors; prototyping and piloting, technology assessment and evaluation; accreditation and standard setting; investment appraisal and business planning, and; training, education and communication (Kivimaa, 2014). IDEO is a well-known case of a firm who is engaged in knowledge exchanges with clients, suppliers and the science base in the search for innovative solutions. They offer a broad range of consulting services for applications as diverse as health and medical devices and services, energy, food and beverage, education, mobile and digital technologies, and innovation in the public sector.

57. Government initiatives, including the support of informal networks and forums or supporting programmes to increase awareness (e.g. an institutional platform for all issues around innovation collaboration) could help improve self-selection processes among innovation actors and help to create a common vision. However, to be effective, awareness strategies must go beyond addressing information asymmetries; they should help promote the active experimentation for ways in how to structure and organise collaborative activities.

Ex-ante project/awardee selection

58. A wealth of studies has focused on ex-post evaluating the effectiveness of collaborative programmes and their impact on (firm) R&D and innovation efforts. However, few studies have examined the criteria used by government evaluators to select collaborative projects. Knowledge of these criteria is crucial for two reasons: first they reflect the real objectives of policy-makers and, second they determine the characteristics of those projects that are actually implemented or developed and, consequently, the results obtained (Santamaría, Barge-Gil and Modrego, 2010).

59. In the context of ex-ante R&D and innovation project selection in corporate environments, management is obliged to resolve the issue of adopting proper selection methods to identify those projects that fit with organisational and strategic goals (Santamaría, Barge-Gil and Modrego, 2010).. The selection approaches tend to be either qualitative or quantitative, and range from unstructured peer review to

sophisticated mathematical programming (Hsu, Tzeng and Shyu, 2003). In the process of R&D and innovation project selection, whatever method is used, one of the most important steps is to estimate technical and market risks, a rather infrequent practice in the government ministries and agencies (Bozeman and Rogers, 2001). Hsu et al. (2003) points to two major differences between public and private sponsored projects. Firstly, public funding of R&D projects generally involves strategic and long-term investment (especially in high-risk projects), thus, conventional financial justification approaches are inadequate. Secondly, the allocation of R&D resources in the public sector may be influenced by political factors, governmental strategies and a variety of interest groups.

60. Selecting project proposals by evaluation committees is a difficult task for several reasons related to expected externalities, multiple objectives and multiple stakeholders, some of whom may have conflicting objectives and preferences. These factors determine total budget allocated to funding and support programmes, distribution across industries, ranking criteria or screening rules applied in the selection of projects and actors, and the funding awarded to actors (Blanes and Busom, 2004). One of the questions that arise is how all these factors affect the selection process of both projects and participants.

61. Another challenge lies in either poorly defined or over-stringed selection criteria. This applies not only to project selection mechanisms but also to target beneficiaries. For example, strict applied financial viability criteria would generally rule out weakly profitable but potentially innovative firms, in particular young firms and SMEs.

62. Designing and applying rigorous and systematic ex-ante selection processes involves significant costs. Besides one-time investments such as the necessity to design the process, there are recurring costs for both governments and applicants related to the application of the selection process. One way to reduce red tape and costs is the adaption of pre-filtering approaches, pre-application support, simplified application forms and the evaluation of project ideas before the full application is submitted. The Victorian government in Australia, for instance, designed a Project pitch template for the Technology Innovation Fund. It is intended to provide evaluators with an outline of the project or concept, indicative project value and level of financial support requested, and how the project responds to the assessment criteria. Submissions that do not satisfy the primary assessment criteria will not proceed to the next stage. Selected applicants will be invited to meet with representatives to discuss the project pitch in more detail. Similarly, in some OECD countries such as Poland there is recognition that the high costs of evaluating proposals could be reduced by applying more adequate criteria and conducting a broader consultation with the business sectors.

63. Evaluating research proposals is the most important and demanding task in the selection process. Research evaluation is usually performed in a peer-review process involving experts in the subject matter of the research proposal under review. Given the fundamentally subjective nature of ex-ante research evaluation, careful selection of evaluators can help to reduce subjectivity. Requesting reviews from experts who possess specific knowledge of project applicants, for instance, can be helpful when detecting hidden agendas. In OECD countries it is most common to exclude any experts who are related to the project applicant from the committee for reasons of fairness and transparency, especially in programmes that award grants or credits of small size.

64. In addition, methods for systematic processing of subjective data can prove valuable. Access to a structural database of ex-ante evaluation findings in a searchable format would make it easier for peer-reviewers and experts to ensure which information and factors were relevant for awarding past project applicants.

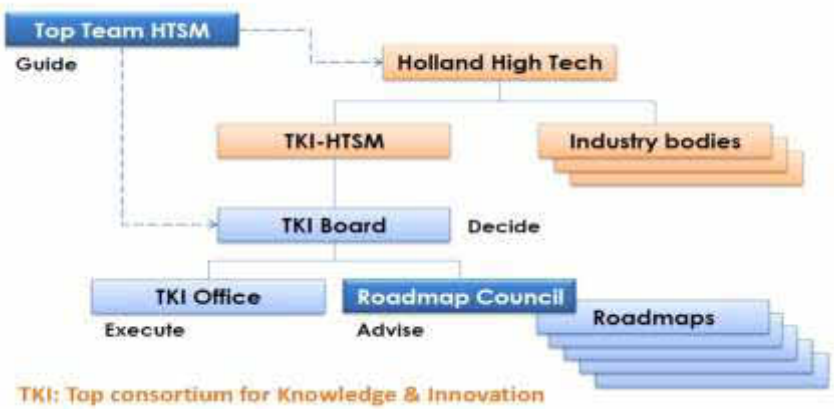
3.2 Business drivers for P/PPs

65. Companies typically have different motivations to engage in P/PPs. These are: 1) Increasingly companies absorb external knowledge and technology, 2) partnerships are recognised to complement company in-house expertise, 3) P/PPs are a suitable instrument to share the uncertainty and risk of R&D and innovation activities. Accordingly companies are pursuing open innovation in R&D and innovation, collaborating with universities and PRIs. This trend is especially pronounced in knowledge and R&D-intensive sectors, and is accentuated due to technological convergence, declining transaction costs of acquiring external R&D and knowledge inputs and shortening product cycle times. In addition, the collaboration is require for SMEs who are key players of high-technology innovation but need an industrial commons to provide help in financing growth, demonstrating prototypes, facilities, expertise and advice from others.(National Research Council and Charles.W.Wessner (2013.)

66. The Netherlands' Top sector High Tech Systems and Materials (HTSM) is executed in P/PPs, driven by industries. HTSM has developed and implemented 16 roadmaps including medium-term plans which outline the possibilities for research and innovation. The roadmaps have been realised bottom-up around specific themes with open discussion between companies and research organisations. The top Consortium for Knowledge and Innovation (TKI) was established in 2012 as the innovative booster of the top sector HTSM, and it coordinates the roadmaps, draws up innovation contract, facilitates the application for and use of the TKI allowance for public-private research and the connection with European programmes like Horizon 2020. Also, TKI specifically focuses on increasing the involvement of university researchers and SMEs in the top sector. The autonomy of industries, openness and a well-functioning network of specialized companies and institution is crucial and make Netherlands' companies and knowledge institutes in the HTSM sector become leaders in their market segments.

67. Figure 7 shows, that this approach involves new forms of governance. So-called "top teams" composed of high-level representatives from industry, public research and government draft knowledge and innovation agendas which they submit to the government for consideration. The government then evaluates each top team's proposed agenda, which includes a strategic plan and suggested instruments relevant to the top sector. The government's evaluation takes into account the level of ambition, the degree of commitment of stakeholders, the degree of openness, the balance between social and economic agendas and the extent to which the objectives can be monitored and evaluated. The relationships and sectoral plans are then formalised in TKIs of which some top sectors have more than one.

Figure 7. Governance of the Netherlands' Top sector High Tech Systems and Materials (HTSM)



Source: Dr ir A J van Roosmalen, Director TKIHTSM, in the seminar on Strategic P/PPs in STI, 2013.

68. The New Manufacturing Innovation Initiative –The National Network for Manufacturing innovation (NNMI) is also one of the major partnership in US, which is a one billion P/PPs programme to commercialise and manufacture US developed technologies. 15 institutes proposed with supporting a regional ecosystem of manufactures, skilled workers and researchers. In the partnerships, industry should take a role of leader. Tools and instruments need to be adapted to the task, resources need to be significant and sustained, and metrics need to be in place from the outset, not post hoc. (National Research Council and Charles.W.Wessner, 2013.)

69. Another aspect related the driver for P/PPs in industry is so called ‘‘re-shoring’’. Re-shoring is the recovery of manufacturing or services which were once transferred to other countries due to the advantages of offshoring such as cost reduction, proximity to clients, financial incentives, etc. (OECD, 2007). As re-shoring of a company is decided based on benefits and costs to the firm, P/PPs offer policy makers with a mechanism to re-attract manufacturers back to OECD countries (Box 5).

Box 5. P/PPs for the re-shoring of industries in EU and the US

P/PPs are regarded as a useful policy tool to accomplish recent policy drive for, so called, “re-shoring’’. Re-shoring is the recovery of manufacturing or services which were once transferred to other countries due to the advantages of offshoring such as cost reduction, proximity to clients, financial incentives, etc. (OECD, 2007). As re-shoring of a company may be decided based on benefits and costs to the firm, the use of P/PPs to re-attract manufacturers is being discussed and implemented in both the EU and the United States.

The European Economic and Social Committee (EESC) recommended that the EU should develop policies-including re-shoring - for increasing innovation and productivity, securing the participation of Europe’s manufacturing industries at the whole value chain, and upgrading relevant infrastructure and skills (EESC, 2014). In this regards, P/PPs is considered as an effective policy instrument to deliver the mixture of policies such as innovation, education, research, taxation, infrastructure, etc.

Recently, a new P/PP, SPIRE (Sustainable Process Industry through Resource and Energy Efficiency) was launched to revitalise the process industry in Europe which represents 20% of the European manufacturing base. SPIRE is the seven-year P/PP receiving the funding of € 900 million under the framework of EU Horizon 2020. A.SPIRE which is the non-profit international association founded by stakeholders in process industries in 2012, requested the establishment of P/PPs to cope with the weakening competitiveness of process industries in Europe against societal challenges recognizing such challenges are too large and complex to tackle by themselves. The presented reasons of the establishment of SPIRE PPP well describe the context demanding strategic P/PPs: the existence of market failures due to early stages of technology development, high risks and long-term investments, the need for long-term cooperation along the value chains, the complexity of and the synergies needed between the new technologies and business models (A.SPIRE, 2013).

The policy makers in the US are also using P/PPs to enhance the re-shoring of the manufacturing industry. Based on series of reports[1] on advanced manufacturing from the Executive Office of the President, the US government launched and developed the Advanced Manufacturing Partnership (AMP) which aims to strengthen the frontier position of the US in emerging technologies and to create high-quality jobs across multiple manufacturing industries. In its strategic plan for advanced manufacturing, the US government emphasises creating and supporting P/PPs in order to enlarge investment and to accelerate the deployment of emerging technologies; the enhancement of P/PPs is presented as one of five objectives in the strategic plan (NSTC, 2012).

The emphasis on P/PPs in promoting advanced manufacturing in the US is based on recognising the context of emerging technologies: on the one hand, individual companies cannot invest solely on the development of new technologies and infrastructure. On the other hand, the results of basic research are difficult to be utilized without the involvement of private sector despite the large investment in R&D (PCAST, 2011, 2012).

In line with the emphasis on P/PPs in the strategic plan, the US government announced the support of $ 20 million for 10 P/PPs to promote advanced manufacturing in the US in 2012. Each P/PP is based on regional clusters

[1]President’s Council of Advisors on Science and Technology (PCAST) provided a couple of reports, “Ensuring American Leadership in Advanced Manufacturing” (2011) and “Capturing Domestic Competitive Advantage in Advanced Manufacturing” (2012) and National Science and Technology Council (NSTC) reported “A National Plan for Advanced Manufacturing” (2012).

across the US which consists of small and large companies, universities, non-profit organizations and other stakeholders in the region. The initiative supports the innovation and job creation of the region by connecting innovative small companies with large ones, commercializing new ideas and technologies and providing skilled workers with training. [2]

3.3 Governance

70. In the context of strategic P/PPs, we refer to both "policy governance" as well as to the governance of strategic P/PP arrangements. Here, the former relates to policy frameworks (e.g. government oversight) as well as to the partnership specifications (e.g. rationale and objectives of the instrument), whereas the latter defines the governance arrangements of the partnership (either formulated and stipulated in programme specifications or negotiated by partners at the outset of the partnership); in other words, it is important to make a distinction between governance of the political decision-making and the operation or implementation.

71. For the operation of a collaborative structure between different actors, governance refers to the distribution of rights, stipulated through contractual means. The distribution of rights among the actors is a central determinant of governance because it affects the possibilities for each actor to control the performance of activities within the boundaries of the collaboration. When entering into a collaborative effort, each actor gives up some of its rights and gains others through either explicit or implicit contracts. The resulting allocation of rights determines the governance structure. Contractual arrangements stipulate how the partners obligate themselves to a specific course of action or establish a general commitment to a specific relationship (Nielsen, 2010).

72. Research on the governance of collaborative structures has provided evidence that the initial contractual design of partnerships can have important value-creation and performance implications. For example, Faems et al. (2008) demonstrate that the content of the contract can have important ramifications in terms of sense making and trust building between partners, which subsequently influence partners' ability to jointly resolve unexpected technological/research problems.

Contractual arrangements

73. Once actors have initiated contact, decided to form collaborative structures and (possibly) been awarded government support, actors face serious challenges of turning their good intentions into a viable undertaking at all levels, from the negotiation of contracts to the management and coordination of activities and to strategic policies. The need to develop efficient governance and management structures in collaborative structures to solve the divergence of interests across different actors becomes paramount to the realisation of successful multi-partner efforts, while preventing instability, tensions and member dissatisfaction. Experience suggests that major reasons for failures or earlier terminations of collaborative innovation efforts are found in the difficulties associated with the management of the innovation related collaboration.

74. A well-developed contract can fulfil multiple purposes within a project that will help to ensure that the process of producing project deliverables and the achievement of project outcomes are made as efficient as possible. If there is no contractual agreement, or is drafted in an unclear or inadequate manner, actors and project units may be unaware of the extent of responsibilities and obligations. Thus the project is likely to lack an effective management structure for its operational and technical aspects.

[2] For further information, refer to http://www.commerce.gov/news/press-releases/2012/10/09/obama-administration-announces-20-million-10-public-private-partnersh

75. An important question is what type of contractual arrangements ensures a strategic focus is maintained, especially for large scale and longer-term partnerships that involve multiple layers of governance? There can be significant differences in the nature and scope of multi-partner efforts. As a result, the precise content of a contractual agreement may need to be varied according to the nature and scope of the project at issue, and the respective roles of the project partners.

76. Generally, actors' contractual preferences are a function of their preferences to acquire access to valuable knowledge and protecting their own resources in the pursuit of innovation. Essential considerations in the bargaining process over contractual clauses include the designing of the overarching legal structure of the partnership (Box 6), as well as the allocation of decision and property rights (Box 7).

Box 6. Designing the overarching legal structure of the partnership

At a general level, collaborative arrangements include the overarching legal structure of the partnership: is it governed purely by contract (non-equity arrangements) or does it include any equity components, such as minority investments by either party or the creation of an autonomous entity (e.g. a joint venture) in which each participant takes up a stake? Classifications have therefore focused on how the relationships among partners are organised/governed. Numerous proposals have been put forward for classifying governance structures, but some consensus has emerged into two basic categories differentiated by the presence or absence of equity (see Brouthers and Hennart 2007 for a comprehensive review of governance mode decisions). An equity partnership refers to any exchange agreement in which the partners share or exchange equity, and includes agreements in which partners create a new entity as well as those in which one partner takes an equity interest in the other (Gulati and Singh, 1998). The second category involves contractual arrangements that cover a relatively large group of partnerships with no equity sharing, such as joint R&D agreements.

The rationale of sharing ownership structure through equity arrangements is that it increases an actor's relative control over the collaboration, reduces uncertainty in transactions, and effectively deters the opportunistic behaviour (Gulati, 1995). In contrast, non-equity structures are agreements to collaborate without having any shared ownership structure between partners, consisting as a formal framework for cooperation.

Since the governance modes such as contract or equity mechanism reflect the risk, reward and control that actors perceive in a relationship, a right choice of governance mode should help tackle the complexities of executing the collaborative task, and the power and competitive dynamics that determine the transaction risk, interdependence, learning, and in turn the performance and stability of the collaboration (Luo and Deng, 2009; Ness, 2009). Even though there are, a priori, many ways of designing the legal structure, but once that decision is taken, the investments made in a specific design itself becomes specific and sometimes irreversible, constraining future decisions.

Box 7. Defining control and property rights

One important set of contractual provisions relates to control and property rights. The parties allocate property rights and, separately, the rights to take decisions during the project or research process.

Collaborations that develop new technologies or push the research frontier tend to be complex and unpredictable, making it difficult to specify all the features of research to be developed ex-ante (Henderson and Cockburn, 1994). Given the associated uncertainties, actors often cannot directly bargain over the distribution of future income streams, but must rather bargain over the ownership and control of activities, decisions, and intermediate outputs related to the creation and distribution of those possible streams. The allocation of these control rights thus has a critical impact on the performance and outcomes created in a strategic PPP.

Contracts specify control rights carefully, especially in research. Examples include the sharing of IPRs, the right to sublicense, warranties and project responsibilities, the right to terminate the collaboration, lead institution and steering committees, allocation of funding and resources (see Section 3.2.3), amongst others (Adegbesan and Higgins, 2010).

An important set of clauses in contracts that relate to control rights concerns property rights (exclusionary market and manufacturing rights, co-marketing agreements and the sharing or division of IPRs). Engaging in collaborative knowledge development entails exposure of proprietary knowledge and may come with uncertainty concerning the

control of the knowledge assets that are developed. This translates into a risk of uncontrolled spill-overs. In a vast amount of cases, the most efficient way to appropriate benefits are contractual agreements and provisions.

Although property rights are addressed in the last step, it is suggested that ownership decisions are often made early in the formation stage of collaborations. Because many firms, especially those in R&D and knowledge-intensive industries (e.g. biotechnology, nanotechnology) consider patents and the associated scientific knowledge their most important assets, it may be the case that they generally focus on these in the negotiations with collaboration partners.

However, effective collaboration depends on mutual trust – that workloads will be shared equitably, that all benefits will be shared and that shared information will remain within the confines of the collaboration. When partners perceive the collaborative potential to go unfulfilled and that collaborative activities set in the contracts are not fair, they usually reduce their commitment to the collaboration (Heidl, Steensma, and Phelps, 2014).

77. Traditional contracting processes and documents do not always offer actors the tools they need to unfold the potential of collaborations. The formal contract that is compiled often fails to be integrated into everyday operations. For example, contract drafters too often seem focused exclusively on the contract itself rather than on facilitating successful relationships between actors. Passera, Haapio and Barton (2013) argue that this produces contracts that are unnecessarily complex and difficult to use.

78. In addition, many opportunities offered by contracts remain unexplored if contracts are seen merely as legal tools needed only in case a dispute arises. Innovative contract designs such as the visualisation of contractual information can help collaborations reach their goal and prevent problems. Visual language can be utilised to explain a variety of concepts, with different goals, both in contracts and in supporting and explanatory materials about contracts (Passera, Haapio and Barton, 2013).

79. Moreover, governments should be aware that there are many reasons for which actors may wish to collaborate – and sometimes advancing innovation activities is not among them. A claw back clause in a contract provision that requires an actor who has received a benefit to return that benefit due to specially arising conditions may help constrain misbehaviour. The Finnish Strategic Centres for Science, Technology and Innovation (SHOK), for example, implemented such a clause. Tekes, the Finnish innovation agency, as the executing actor of the SHOK can issue a decision ordering the discontinuation of payment of funding and the claw-back of funding already paid. In addition, the beneficiary has to repay an annual interest plus 3% on the amount to be repaid or clawed back from the date the funding was paid. Claw back provisions have also become popular in other contexts. For example, the government in New Zealand recently introduced the right to claw back R&D grants from firms if they move overseas within 3 years.

80. Another strategy to recoup government expenditures is to contractually agree that any income derived from technologies/research results that were developed with government monies is liable for the payment of royalties. This practice is, for instance, used by the Israeli Ministry of Economy within their R&D funding programmes. Firms having received government support are obliged to pay royalties on every type of income, including any forms of counselling and guidance services, installation and maintenance services, provision of marketing rights, and the sale of know-how (e.g. patents). The royalty payments are based upon a percentage of sales up to the full repayment of the grant.

81. Focusing on the particular issue of contractual IP arrangements, delineating each party's respective property rights becomes difficult in contract negotiations (see Box 4 above). Drawing on interviews with IP experts, Belderbos et al. (2014) found that collaborations in a two partner setting tend to contractually define the existing knowledge domains of partners based on their current technological expertise and capabilities. In addition, they contractually agree that, when collaborative R&D efforts result in IP in one of the unique knowledge domains, the domain owner will become the sole owner of the patent. At the same time, several interviewees signalled the likely presence of a "gray zone" where it is difficult to determine ex-ante who should be the owner of the IP. For these particular knowledge domains,

interviewees pointed to the relevance of co-patenting arrangements, where partners contractually agree to share the ownership of knowledge jointly generated.

Management

82. Contracting and the provision of incentives are critical for the effective management of cooperative innovation processes, particularly in collaborations which involve novel partnerships, new research topics or where the anticipated research outcome cannot be guaranteed or where the potential for unexpected outcomes is high.

83. In the management process of large-scale collaborative projects, actors are responsible for specific parts of the project vis-a-vis the entire project. Collaborative R&D and innovation projects can be considered as a series of complex and interrelated activities with pre-defined goals and may differ in many respects, such as the type of research that is being pursued or the resources that are available to actors (Grabher, 2004). In this context, project management is the process that is followed by actors to plan, monitor, and control the execution of collaborative R&D and innovation projects, via the adoption of management tools and techniques (Cooper and Kleinschmidt, 1995).

84. To reduce the failure rate of R&D projects and to achieve innovation goals, formal monitoring processes with strict planning and regular reviews, have been put forward as a preferred project management approach (Cooper and Edgett, 2008; Barczak, Griffin and Kahn, 2009). However, recent findings and observations cast doubt on formal management techniques as the universal rule. Adams, Bessant and Phelps (2006) pointed out that product development is complex, and that innovation processes differ to some degree, across organisations and even within organisations on a project-by-project basis.

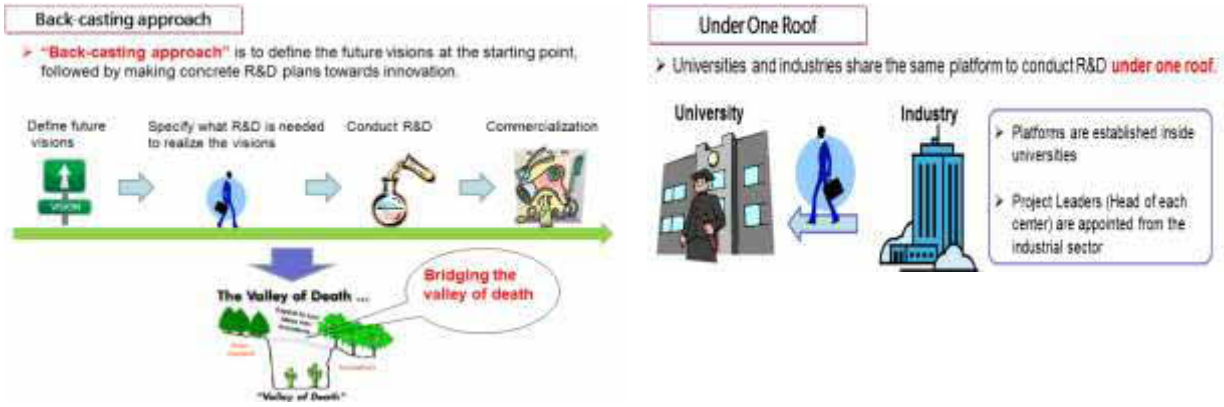
85. Even if multiple actors contractually agree to collaborate at the outset, it does not imply that these necessarily do coordinate their actions. The management and coordination is not only achieved through contractual mechanisms and effective instrument design but, rather, is realised by the day-to-day interaction and project management activities of the employees and researchers involved. As such, knowledge and value creation happens at the interface between projects and the environment in which actors operate (Grabher, 2004). Japan has started "Centre of Innovation Program" to bridge the gap between R&D outcomes and their commercialisation and to create disruptive innovation, which is operated by universities and industries under one roof, not virtually but substantially. The centres are established inside universities and the head of each centre are appointed from the industrial sector, so that the interaction between employees and researchers can be realised effectively and easily.

Box 8. Centre of Innovation (COI) Programme in Japan

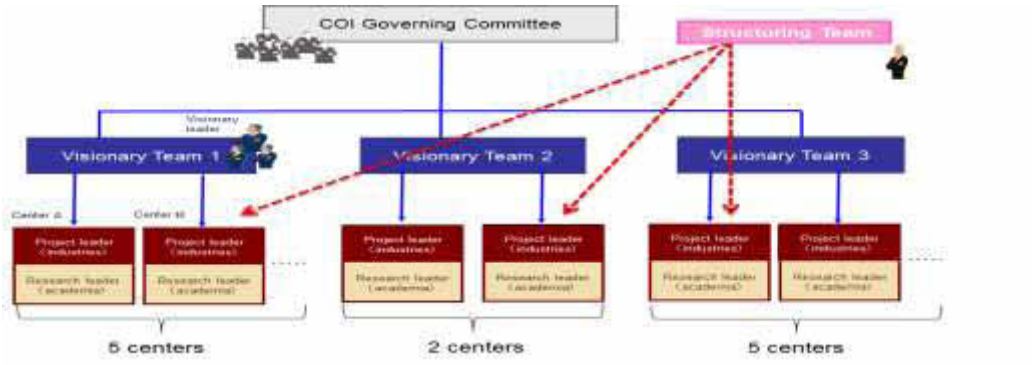
In Japan, University-Industry collaboration plays an important role for commercialization of new technologies, and serves as a key to innovation because Universities are requested to be accountable for R&D investments and to be responsive to market needs, and Industries recognize the importance of "open innovation" and focus on the collaboration in R&D with other sectors.In 2013, the Ministry of education, culture, sports, science and technology (MEXT) established Center of Innovation (COI) Programme which aims at creating disruptive innovation, and supports multi and inter-disciplinary R&D projects carried out under the collaboration between universities and industries. The characteristics of COI Programme are as following:

- Define the three visions for ideal society and lifestyle; 1) Ensure sustainability of the society with addressing challenges of aging populations and declining birth rates, 2) Create a highly-qualified living environment, 3) Build a resilient and sustainable society with vitality.
- Employ "Back-casting approach" instead of usual "forecasting approach".
- Create an innovation platform in which universities and industries collaborate under one roof (not virtually but substantially).

- Encourage establishment of networks between COI centers with an expectation of synergy effects



Each COI center is funded with ranging from 1 million dollars to 10 million dollars annually for up to 9 fiscal years. COI program is managed under the leadership of Governing Committee and Visionary Teams. Furthermore, Structuring Team is also teamed up for detecting and specifying cross-vision or cross-center issues.



Source: MEXT presentation on the TIP thematic workshop in June 2014.

84. Project activities that are created to pool the complementary skills, knowledge, and resources involve a higher level of complexity. Because of the complexity associated with organising multiple actors toward a common goal in a high risk environment with uncertain outcomes, multi-partner collaborations have therefore greater coordination, managing and monitoring challenges compared with two-partner collaborations.

85. One of the challenges relates to each partner´s commitment. For instance, a collaboration involving co-development of research and technologies requires the partners' mutual control over planning and operational activities. This will materialise only when there is a synchronisation of actors' interests and strategies. Each actors´ strategic attachment creates tensions between the goals of collaboration and those of its members: while a programme or project managers must invite all interested parties to provide inputs relevant to the objectives of the collaboration, they must also control for the different needs of each actor (Pinto, Hine, and Knights, 2011). Another source of tension emerges when a collaborative partnership is incapable of successfully readapting its configuration to changes occurring. For example, membership composition changes over time, as certain actors leave and others join (Mothe and Quelin, 2001).

86. Hessels and Deuten (2013) examine Netherlands' top sector co-ordination issues. They find that each sector faces its specific co-ordination issues. For example, whereas the lack of a coherent research agenda may be a problem for universities/PRIs, the problem for firms may be the lack of trust or of

organisational capacity. In addition, co-ordination problems change over time in response to shifts in the composition of participants but also to external developments driven by both market and knowledge dynamics. They observe that most of top-sector co-ordination problems are not new but were already apparent in previous attempts to promote research P/PPs. They observe that the current situation largely reflects contingent circumstances, such as the composition of the initial consortium and personal leadership style of the director.

87. Moreover, there are certain problems associated with exchanging tacit knowledge, because actors generally cannot assess the value of such knowledge related exchanges and thus leading to partners being concerned about opportunism (Das, 2010). For instance, a firm with technical know-how may hesitate to share the information with a partner whose behaviour cannot be directly controlled. Since the effectiveness of formal contracts is thought to be limited, the risk of sharing information is heightened when there is a possibility of easy dissolving of contractual agreements (Muthusamy, 2014).

88. In addition, existing studies on R&D collaboration signal that the willingness of actors, in particular partnering firms to engage in intensive interaction is often limited by ex-ante concerns to appropriate knowledge outcomes. Moreover, the more actors collaborate with external partners, the more difficult it becomes to appropriate the outcomes of such collaborative efforts for the actors involved (Di Minin and Faems, 2013; Henkel, 2006).

89. While international linkages prove to be valuable, there are also challenges in managing these. Coordination costs are likely to rise with cultural differences (including language barriers) and geographical distance (which make face-to-face meetings more costly). Due to the tacit component of knowledge, geographic distance may hamper the transfers of knowledge between partners.

90. Collaborations often include rich communication channels among actors to support knowledge exchange and to ensure projects are managed effectively. As communication and computation costs have declined— via improved technologies and the development of common standards—actors are able to more efficiently communicate both broadly within their own boundaries, and with those collaborating.

91. Co-operative networks and platforms and other idea management solutions are being developed or deployed within R&D and innovation departments and beyond, promoting collaboration and the exchange and share of best practices and research findings between research teams and collaboration partners. This may be combined with the provision of incentives, as with innovation toolkits that include awards distributed based on the quality of the submission or via features like “gamification” (Box 6). Although not applied in multi-partner collaborations, Microsoft and Cisco are already utilising gamification to encourage collaboration and knowledge sharing in their specific environments. Gamification takes the elements of games—fun, play, transparency, design and challenge—and applies it to an organisational setting to design solutions to a range of business functions (e.g. office tasks, training, marketing, sales, customer service). Similarly, the UK's Department for Work and Pensions created an innovation game called Idea Street to decentralise innovation and generate ideas from its 120 000 people across the organisation. In strategic P/PPs, gamification may help deepen engagement and trust, sustain participation and help drive the formation of new habits or behaviours.

Box 9. Innovation management and "gamification": unlocking hidden collaboration potential?

Gamification is a strategy which applies game design techniques to non-game experiences such as innovation, marketing, training, employee performance, health and social change. The goals of gamification are to achieve higher levels of engagement, change behaviours and stimulate innovation.

According to a report of Gartner Research (2011), it is estimated that by 2015, more than 50% of organisations that manage innovation processes will gamify those processes. By 2014, Gartner predicts that over 70% of Global 2000 organisations will have at least one "gamified" application, and that "gamification is positioned to become a significant trend in the coming years.

Gartner Research identified four principal means of driving engagement using gamification:

1. Accelerated feedback cycles: In the real world, feedback loops are slow (e.g. annual performance appraisals) with long periods between milestones. Gamification increases the velocity of feedback loops to maintain engagement.
2. Clear goals and rules of play: In the real world, where goals are fuzzy and rules selectively applied, gamification provides clear goals and well-defined rules of play to ensure players feel empowered to achieve goals.
3. A compelling narrative: While real-world activities are rarely compelling, gamification builds a narrative that engages players to participate and achieve the goals of the activity.
4. Tasks that are challenging but achievable: While there is no shortage of challenges in the real world, they tend to be large and long-term. Gamification provides many short-term, achievable goals to maintain engagement.

Source: http://www.gartner.com/newsroom/id/1629214.

92. At the same time, project collaboration and scheduling tools (tibbr, Asana, Trello, Siasto, LiquidPlanner, AtTask, ProjectManager.com, Wrike, and Gantter) as well as cloud-based collaboration services (Dropbox, SharePoint Online , Google Docs, and Box) provide alternative ways to develop and manage a project schedule and share data collaboratively, instead of disparate instant messaging, document management, and desktop sharing tools. Similarly, this applies to intranet platforms where collaboration partners can assemble a repository of documents, guidelines, manuals and research papers.

Financing.

93. Requiring that the private sector contributes financially to the project and shares risks and benefits over a longer time tends to align the incentives for the private party with the financial success of the project. Financing of PPP in the area of STI is very different from traditional P/PPs due to the "strategic" nature of P/PPs, the longer time horizons and the fact that many of the assets underlying the partnership are intellectual assets such as R&D and skilled workers. P/PPs also focus on creating positive impacts such as technological competencies, global market leadership, and national competitiveness rather than just the pursuit of value for money. Accordingly, financing tends to be oriented towards the creation of synergy effects on a long-term basis.

94. In theory, an optimally designed financing mechanism should help: *i)*ensure efficient selection of private partners; *ii)*secure the desired amount and quality of R&D at least cost to the government; and *iii)* avoid opportunistic behaviour by either the government or the private partners, especially the risk of partnerships attracting second-rate projects and less qualified research teams or a drift in the research agenda towards either pure basic research or off-shore corporate research. In practice cost-sharing ratios among partners differ from country to country and there is room for improvement, especially regarding the rate of subsidisation by the central government (OECD, 2005).

95. There are a number of financing instruments in place depending upon the nature of strategic P/PPs (Table 3). Grant schemes involving the private sector form the most common financing mechanism in PPP programmes. A conditional grant can help to prevent or mitigate moral hazard, which might occur under the collaborative programme. In addition, well-established infrastructure either financial or non-financial plays a catalytic role in increasing R&D and innovation through P/PPs, which allows partners to work closely, share and exchange knowledge, information, and feedbacks very efficiently, thus saving cost and time.

Table 3. Financing modes for strategic P/PPs

Partnership mode	Public sector	Private sector	Case Study
Sharing of technology infrastructure	Provide nano-tech infra & tax incentive	Increase technological innovations	TIA-Nano in Japan
Grant & membership	Provide institutional framework & project-based grants	Match the cost by the participants on an equal basis	SAITI in China
Grant on a 50%:50% basis	Provide budget for a project, equally matched by partners	Match EU's funding for their projects on an equal basis	IMI in EU
Grant on a 70%:30% basis	Provide budget for a project, matched by private partners	Cover 30% of the total project cost and receive more benefits for intensified collaboration	Competence Centre in Czech Republic
Conditional grant on a 85%:15% basis	Provide a conditional grant, which needs to pay it back in case of success	Bear 15% of the total amount by the professional licensees	TIP in Israel
Grants/loans or mix of both	Provide grants, loans, hinging on legal status of participants -Public R&D centre: 100% of grant -Private R&D centre: 75% of a mix of grant and loan -Company: 95% of loan	Co-finance the total cost, based on the pre-determined cost-sharing rate	RETOS-COLABORACION in Spain

Source: OECD, based on TIP case studies, 2013.

96. Funding sources for P/PPs become diversified over time as the socio-economic environment changes rapidly. The traditional PPP funders consists of governments, industry, research institutes, while the emerging funders come from diverse stakeholders organisations such as associations, federations, regulatory agencies, not-for-profit organisations, civil societies, charities, and notably crowd/general public. Stakeholders who represent their interest in the specific areas are increasingly important sources of financing in a context that they can provide finance and take benefits as well in return, thus reinforcing strategic partnership and accelerating technological advances as a whole.

97. The globalisation of funding in strategic P/PPs is well illustrated by the 'ITER'[3] project, an international research and engineering consortium, in which many membership countries take part mainly

[3]ITER (International Thermonuclear Experimental Reactor), which launched in 2007, is an international nuclear fusion research and engineering project. ITER is currently building the world's largest experimental tokamak nuclear fusion reactor adjacent to the Cadarache in France. The project is funded and run by seven member entities such as EU, India, Japan, China, Russia, South Korea, and the United States. The total funding estimate reaches approximately €15 billion, notably funding being made in in-kind contribution rather than cash by membership entities.

through in-kind contribution in order to make great scientific discovery. Instead, private sector partners focus on building technical infrastructure for highly sophisticated scientific experimentation by harnessing their expertise, know-how and experiences. The P/PPs under Joint Technology Initiatives (JTIs) in the EU can be considered in the same context with the EU funding for the P/PPs aiming at the development of strategically-targeted technology.

98. NGOs and non-profit international organisations play an important role in developing medicines and vaccines primarily in the areas of the neglected diseases and Alzheimer disease in the form of a global PPP, which is represented in the Malaria Vaccine Initiative, Global Alliance for anti-TB Drug Development, and Drugs for Neglected Diseases Initiative (OECD, 2014c). Charity funding is also being into medical initiatives through the form of P/PPs, which can motivate the private sector to participate in those projects, leading to increased social value. Finally, crowd-funding is another source of financing for collaborative research with potential implications for P/PPs.

Evaluation

99. As in other areas of public policy, evaluation is a vital to the management of P/PPs; it supports transparency, encourages accountability and legitimises funding decisions. The characteristic features of strategic P/PPs such as multi-disciplinary, multi-domain, multi-actor and multi-instrument tend to add the complexity of evaluating the goals and impacts which is at odds with traditional tools for the evaluation of innovation policy which largely reflect the "linear model" of innovation.

100. It is crucial to design the evaluation framework before P/PPs are launched, or at least at the very early stage of the operation of the P/PP not only for evaluation itself but also for the guidance of participants since the evaluation framework including the disciplines, indicators, methods and timing has significant effects on the behaviour, relationships and outputs of the actors. The clear alignment of evaluation framework with the objectives of P/PPs helps stakeholders to reduce the complexity in the operation of P/PPs.

101. Regarding the long timespan and strategic initiative of P/PPs, periodical evaluation of on-going P/PPs is typically along with monitoring activities. The evaluation of current P/PPs focuses on improving the conduct, quality, responsiveness and effectiveness of a P/PP, and, thus, on aligning various actors and resources with strategic objectives during the duration. Since the availability of data, the measurability of output and the methods to evaluate is limited in the middle of policy implementation, managerial aspects (e.g. the compliance with the technical roadmap, budgetary/investment plan and regulatory rules) tend to be a major discipline of the interim evaluation.

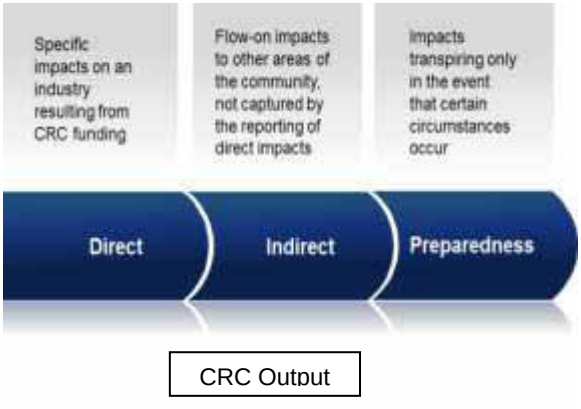
102. Regular monitoring is necessary for relevant evaluation; on the one hand, due to the complexity of P/PPs in their governance and activities, it is difficult for evaluators to collect relevant information from large volume of data and to verify it by singular investigation, hence regular selection and accumulation of information based on monitoring are inevitable. On the other hand, regular monitoring can also ease the burdens of participants by distributing their efforts and costs for the evaluation evenly.

103. The evaluation of outcomes and impacts of P/PPs is also needed for examining the justification of interventions and investments which are necessary for both public and private sector, and providing useful information for policy makers in terms of allocating resources and selecting relevant policy instruments. Although there are greater efforts to evaluate the impacts of STI polices at a variety of levels (e.g. individual/firm/institutional/system level), developing more realistic impact models is a significant challenge. Furthermore, the enlarged scope of impact assessment which broadens its territory from economic impacts to environmental and social impacts increases the difficulty in modelling; for example, Australia uses a Computable General Equilibrium (CGE) model for assessing overall economic impacts of

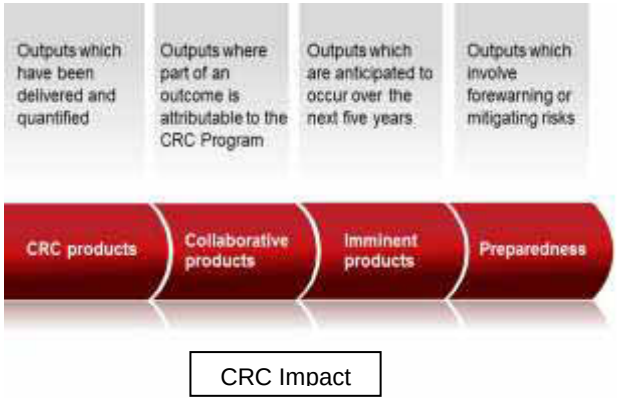
Cooperative Research Centres (CRCs) Program while environmental impacts and social impacts are identified by independent investigations.

Box 10. The evaluation of CRC programme

The CRCs programme was designed to encourage collaboration in research between the private sector and the public sector research bodies, but also to address research concentration for world-class teams and prepare PhD graduates for non-academic careers.CRC outputs were segregated first according to type (economic, social or environmental) and then grouped according to the robustness of their measurement. Consistent with previous analyses, four tiers of robustness were used to classify the outputs. It is also useful to think of the impacts of the CRC program according to the direct impacts which include the direct impacts of CRC's outputs, the indirect impacts which are likely to arise in the nature of R&D investment, and some of the impacts of the CRC program will not materialise except under certain circumstances.



CRC Output



CRC Impact

The evaluation study found a total of $14.45 billion of gross direct economic impacts from the CRC program, net economic benefit of $7.5 billion, annually contribute $278 million - around 0.03% to Australian GDP, and return of $3 to every $1 of Australian Government investment estimated to occur between 1991 and 2017.

The direct impacts of the CRC program are likely to spread throughout the economy in a number of different and unexpected ways. Assessing these impacts and understanding their interconnections requires an economy wide model of the Australian economy. The indirect economic impacts of the program have been assessed using a Computable General Equilibrium (CGE) model of the Australian Economy, the Monash Multi Region Forecasting (MMRF) model. The MMRF model is a high-level representation of the Australian economy. Model captures the economy's sectoral interconnectedness and dependencies, and can test the economy's current state against an alternative CRC free scenario.Conceptually, the impact of the CRC program can be thought of as the difference between two states of the world.

- The current state of the world — in which the CRC program exists, and its impacts on the community have been realised.
- A hypothetical counterfactual — a state of the world in which the CRC program was never commissioned and its outputs never materialised.

The environmental impacts of the CRC program are wide-ranging: from reducing greenhouse gas (GHG) emissions and energy consumption to protecting areas of land and endangered species. As with economic impacts, environmental impacts range from those that have been delivered and directly attributable to the CRC, indirect impacts and those that relate to preparedness.

The CRC program affects a wide range of social outcomes: from the establishment of international collaborations and increasing local business diversity, to improving health and wellbeing and increasing participation in community services.

Environmental Impacts

Social Impacts

Reduced GHG emissions 61,000 tCO2-e saved through improved manufacturing processes	**Reduced energy consumption** Seafood CRC target 40% increase in stock density will reduce fuel use by 39%	Establishment of international collaborations	Business diversity	Improved health and wellbeing
Avoidance of the emission of pollutants Low emission research on gold, nickel, alumina and uranium extraction	**Reduced water consumption** Cotton CRC research provided savings of 24,000 ML/yr	Provision of education and training	Participation in community services	Improved safety
Protection of endangered species Rabbit Haemorrhagic Disease Boost expected to impact on 156 threatened species	**Protection of areas of environment** CRC for Natural Plant Biosecurity's work at Barrow Island	Labor force participation	Change in character of local communities	Social costs saved or avoided

Importantly, the benefits of the CRC program stem well beyond just economic measures. Whereas previous studies have focussed on just the financial contribution of the CRC program, this study has identified significant:

- environmental benefits including impacts on land, ecosystems, pollutants, natural resources, plants, animals and biodiversity; and
- social benefits that affect the Australian community, the health and well-being of individuals and any other social implications.

The unique structure of the program has had a significant influence on the program's ability to produce high quality research and link researchers with industry. In particular:

- long term commitments made by CRC partners, provide CRCs with the capacity to tackle ambitious projects that require more time and resources than normally available; and
- competition for CRC funding and the rigorous application process results in only the most prospective projects receiving support.

The CRC program has proven to be highly important to the Australia R&D scene. By linking researchers with domestic and international end users, the program has delivered significant economic, environmental and social impacts.

Source: Allen Consulting Group 2012, The economic, social and environmental impacts of the Cooperative Research Centres Program, report to the Department of Industry, Innovation, Science, Research and Tertiary Education, Canberra, September.

4. Policy implications and challenges

104. Collaborative efforts, in particular multi-partner constellations have been reported to be unstable and often plagued by several challenges. From the perspective of strategic P/PPs, challenges may also arise in the design, programme management, planning, administration, ex- ante evaluation and the coordination of polices and instruments. We review current policy challenges that may pose challenges for the setting up of Strategic P/PPs in the subsequent section.

4.1 Governance challenges

105. For the purposes of report, the definition of policy governance is limited to the set of institutional arrangements, including incentive structures and norms, that shape the ways in which various public and private actors involved in interact when allocating and managing resources for strengthening collaboration among actors. One attempt of governance arrangement has been seen in Korea. The government launched a blueprint to promote a "creative economy" by combining creativity with "science, technology and ICT to create new industries and markets, and to make existing industries stronger and thus create good jobs". To

realize the creative economy, Korea has arranged the government through public – private and Central – Local Partnership as following Figure 8.

Figure 8. Government for the Creative Economy through P/PPs and Central-Local Partnership

Source: Korea presentation on the TIP thematic workshop in June 2014.

106. The emphasis on interaction naturally raises issues of co-ordination. Co-ordination is a difficult challenge and governments often encounter a mix of imperatives when seeking to co-ordinate innovation-related policies across different ministries and agencies. One potential coordination challenge for Strategic P/PPs may be that programme management is (increasingly) handed on by ministries to innovation agencies to deliver. In the Netherlands the transfer of responsibilities from the first to the latter category is explicitly mentioned, with a more pro-active role for agencies. While agencies may offer more flexible means to deliver novel types of support (e.g. temporary recruitment of specialists to manage delivery, and provide expert support), the original policy goals may become part of agencies own strategy or the lack of know-how in specialist areas. Some countries such as Austria have taken steps to improve the interaction and coordination between ministries and executing agencies.

107. In addition, programmes that target strategic-type P/PPs usually require the commitment and active involvement of more than one ministry to achieve desired outcomes. Therefore, the various goals of different government ministries may pose challenges in initiating a high-investment and high-risk programme, in particular if the technology or research area does not lie in the responsibility of a participating ministry. This may refer to ministries where innovation is a means rather than a goal in itself (e.g. transport ministries). To ensure that interdepartmental innovation governance is shaped, Finland has decided to move the principal innovation agencies - Finnvera, Finpro and Tekes (Team Finland)-, to joint premises in Otaniemi, at the heart of the Nordic countries' largest innovation hub. In Austria, for example, the organisations responsible for innovation support activities were bundled into inter-ministerial working groups that report their results to a common Task Force. This bundling of specific research is expected to create a stronger focus on policy priorities. The Netherlands, with the introduction of its Top Sector Policy, has stimulated more on and co-operation between the Ministries of Economic Affairs, Agriculture and Innovation, together with other sectoral ministries. Also, Latvia has taken steps in this direction by setting up a new national authority, the Prime Minister's Cross-sectoral Coordination Centre. This centre will coordinate national development planning and is expected to eliminate the fragmentation of sectoral policies.

108. Matters may be even further complicated by the growth of international governmental organisations and international regulations that increasingly shape governance regimes. This is especially true in Europe, where the European Commission plays a prominent role in supporting research and innovation agendas, mostly at the European level, but also at the sub-national level.

4.2 Instrument challenges

109. The ultimate goal of an instrument is to realise outcomes and benefits of strategic relevance. To achieve this, an instrument is designed as a temporary flexible organisation structure created to co-ordinate, direct and oversee the implementation of a set of related projects and activities. But the setting up of formal collaborations in the shape of strategic P/PPs may be problematic for project and policy-managers alike, and can be accompanied with certain challenges (based on general observations):

- Application processes tend to be inefficient and unnecessary complicated. Notifications of progress and payment of funding are reported to be slow. In fast moving knowledge environments these challenges may endanger the forming of strategic P/PPs and may complicate planning processes of actors involved. In order to cope with these bottlenecks, in Denmark selection criteria have been simplified and time – to - contract and payment are kept as short as possible. For some instruments the time to contract is a maximum of four weeks.

- Changes in framework conditions, changes in the policy landscape or shifts in policy priorities may become necessary to adjust the underlying rationale and objectives of an instrument. However, there is sometimes little attention to pre-emptive intervention by instrument administrators to manage risks and resolve common issues faced by projects. If managers intervene, intervention logics are poorly codified/communicated and there is little use of models to explore hypothesis about external factors influencing outcomes. Ultimately, this may impact on a wide range of collaboration partners. The involvement of collaboration partners can help alleviate such challenges. As such, collaboration partners should not only be involved at discrete intervals (mid- term review, etc.), but rather as part of on-going re-design.

- Given the fact that each collaboration is managed and organised differently, strict state aid rules and programme management bureaucracy may hinder a degree of flexibility and hence the opportunity to experiment with new forms of collaborative arrangements.

- Governments have yet to take full advantage of the potential of alternative tools and strategies for designing instruments (e.g. innovative contractual clauses, more diverse composition of partners), possibly through pilot experiences. Increasing the capacity of instrument administrators to be aware of an available "toolbox" can help improve project outcomes as well.

- "Beautiful ideas meet hard reality": Some ideas have no practical application to form or to support strategic P/PPs. This ranges from limitations and weaknesses of policy approaches to equity-based crowd investments and external contributors to enable organisations to access knowledge held by people other than internal employees. For example, Dahlander and Piezunka (2014) found most organisations attempting to receive suggestions from external contributors (such as users or communities) will not be successful in doing so: "most of the initiatives wither and die". They caution to draw any implications for innovation processes when studying only the successful cases.

- The complexity of innovation policy is a growing challenge for instrument administrators. In many countries, innovation policies, from grants, to R&D tax credits and general P/PPs for research or innovation tend to be fragmented, which creates a high degree of overlap; instruments are often chosen on an individual basis, meaning, on the basis of their individual features alone. For governments, large-scale Strategic P/PPs can also provoke a streamlining in the policy mix of instruments or establish connections that were not previously apparent. Strategic P/PPs may bring a process of rationalisation to policy making by enhancing stakeholder co-operation in the governance of policy making itself. In fact, one of the recommendations that emerged from

evaluation of traditional policies in UK to enhance collaboration between industry and research has been to target efforts to promote collaboration on "priority partnerships that generate the greatest impacts and returns" (Cunningham and Gök, 2012).

- Collaborative activities do not proceed in isolation. Their tangible outputs (new ventures, follow-up projects, scientific discoveries, new prototypes or products, trained personnel, graduate students, etc.) may lead to further demands of partners. Thus, it is important to potentially offer support instruments or services which partners can capitalise on their joint outcomes (both tangible and intangible).

- In theory, P/PPs can enlarge the collaborative networks among various stakeholders and encourage open innovation. However, in practice P/PPs are by nature limited partnerships. A key player in the value chain may be excluded in the formation of the P/PPs for anit-competiveness reasons. Furthermore, once the partnership is established, it can be used as a barrier against new entrants rather than a promoter since incumbent participants tend to maintain current contractual arrangements. In this regards, it is important that the design of P/PPs maintains flexibility in the entry and exit of partners.

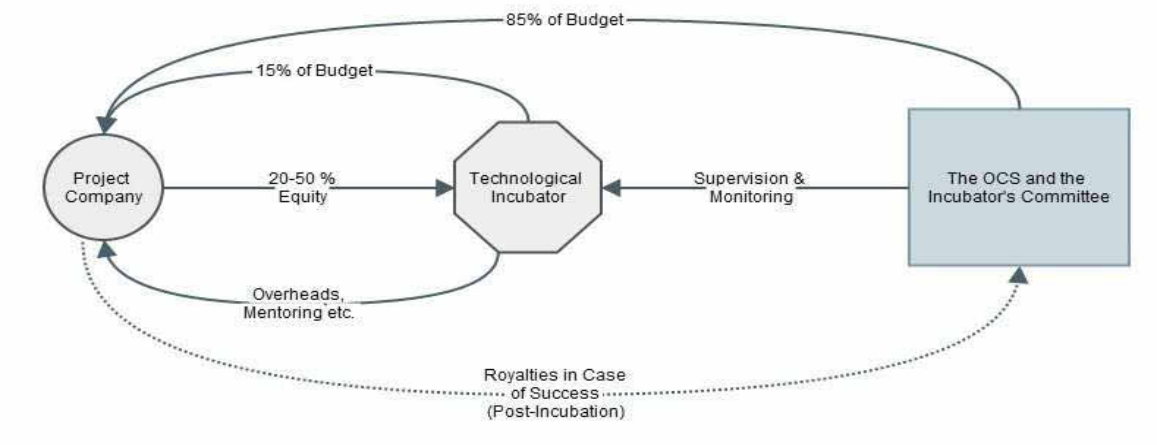
- Even well designed programmes fail to be delivered effectively or do not meet the original objectives, especially if projects are of cross-cutting, multi-disciplinary and long-term nature. For example, the evaluation of the Finish SHOK scheme indicated that due to the formulation of strategic research agendas by large firms, it lead to fairly short-term and unambitious research projects that did not meet the original objectives. Furthermore, the rule that IPR is to be shared among partners has caused problems for the commercialisation of knowledge. This shows that programme design may create conditions that thwart the goals to be achieved. (Lahteenmaki-Smith et al. 2013).

4.3 Financing challenges

110. Some challenges in P/PP' finance can be identified as: first, the difficulty of measuring the potential value generated from STI-related projects, largely due to the nature of intangible knowledge assets. The economic valuation such as cost-benefit analysis can be a clear indicator to the external investors who consider investing, because they can estimate their future value as a result of investment. The exactness of evaluation is very conducive to the design of incentive structures for the PPP partners as a whole. Second, at issue is off-budget spending in governments' account. The majority of PPP finance is not usually accounted for in the national debt, which leads to a lack of transparency and even a temptation of political influence over the decision of a PPP project.

111. Third, financial sustainability is a fundamental challenge to the stability of P/PPs. A number of factors and actors can affect financing for P/PPs i.e. political leadership, economic condition, legal and institutional framework, incentive structure, organisational capacity, cohesiveness of partnerships, financial commitment. In order to ensure financial sustainability, it is important for policymakers to design a strategic PPP in a way that incentivises participants to collaborate closely, thereby creating synergy toward the achievement of originally-intended objective. It is also important to recognise that side-effects such as moral hazard needs to be constrained, while incentive structures let PPP participants work efficiently to attain their goal. In this regard, a conditional grant which requires recipients to pay it back if they are successful, could be a helpful instrument to mitigate moral hazard as indicated in the PPP case in Israel (Figure 9). The reasoning is that PPP partners will be inclined to spend the grant more carefully if they expect to repay it, thus increasing the probability of success.

Figure 9. Financing Mechanism in the Incubators Programme in Israel



Source: TIP case study for Israel (OECD, 2013).

112. On balance, the impact of PPP finance matters most during the entire life cycle. A variety of financing modes through strategic P/PPs focus more on increasing adaptive efficiency, which targets the enhancement of technological superiority and the sustainable economic growth, rather than emphasizing allocative efficiency, which tends to address the economic allocation of the existing resources. Therefore, the impact of P/PPs can be created in a varying way that accelerates system-wide innovations, structural changes, capacity-building, core technology leadership in the global markets, and integrated forces of collaboration, thus leading to the underpinning of sustained economic growth.

Box 11. Staggering of industrial annual fees to support research: The Bay Area Photovoltaic Consortium (BAPVC)

The Bay Area Photovoltaic Consortium is a partnership joining universities, industry, and the US Government with the mission of developing advanced technologies to deliver high-performance photovoltaic modules at low-cost.

BAPVC is a consortium led by Stanford University and University of California Berkeley (UCB). BAPVC is funded by the U.S. Department of Energy with additional support from industry and universities. DOE is providing USD 25 million over five years (2011–2016) as part of the SunShot Photovoltaic Manufacturing Initiative (PVMI) to provide a source of research funding for all universities in the United States.

Membership Level	Criteria (annual fee)	Benefits
Executive Membership: ***GE Global Research*** ***Dupont***	USD 200,000	Participation on the Executive Board Participation on the Industry Board Right to Executive Member intellectual property rights as described in the Industry Membership Agreement
Regular Member: ***AGC America, Inc.*** ***HelioVolt Corporation*** ***Stion*** ***Total*** ***BASF***	USD 50,000	Participation on the Industry Board Right to Regular Member intellectual property rights as described in the Industry Membership Agreement

Participating Member: ***Alta Devices*** ***EpiSolar***	USD 10,000 Must be a start-up By invitation only	Right to Participating Member intellectual property rights as described in the Industry Membership Agreement

*Source:*www.bapvc.stanford.edu.

Box 12. UK funding bodies: Principles for funding multi-institutional collaboration in innovation and research (shortened version)

This Framework of Principles relates to funding for collaborative, multi-institutional research and related research activities and may include public or private sector research organisations, as well as business and other partner organisations where these bring distinctive contributions to the collaborative research activity.

- The UK funding bodies will ensure that scope for multi-institutional collaboration is made clear in funding calls, and that policies are developed taking into account their impact on university groups and consortia. Any costs relating directly to the management of the collaboration may be included in relevant funding bids.
- A multi-partner collaboration may or may not be based on an existing consortia - any collaboration must demonstrate that it brings together the capabilities, expertise and resources necessary to address the proposed project.
- Where research requires contributions from more than one funding body, the funders have clear arrangements to manage joint funding arrangements and to ensure such proposals are appropriately assessed, avoiding any 'double jeopardy'.
- Where proposals can demonstrate that a spatial concentration or clustering of the partners will help with exploring the potential social or economic impact for the research (e.g. as detailed in the Pathways to Impact for the proposal) this will be taken into account. Regional or geographical co-location of partners as such is not a funding criterion.
- Research Councils only fund eligible research organisations which have the appropriate mechanisms in place to assure the Councils over the costing of research and the management of grant funds. Research Councils recognise that it will often be appropriate for a single research organisation to act as the accountable organisation for the purposes of a multi-institutional partnership.
- For the purposes of research funding metrics, institutions are able to report on their share of research income and expenditure from a grant being managed centrally by another partner in accordance with HESA Finance Statistics Return procedures.

Source : www.hefce.ac.uk/whatwedo/rsrch/howfundr/multi/.

4.4 Evaluation challenges

113. There are conceptual and measurement problems that plague ex-ante performance and productivity assessments of collaborative schemes, whether using objective outcome indicators or subjective/qualitative indicators. In general, the evaluations of P/PPs share several challenges not only with other collaborative schemes but also with generic innovation support schemes (partly drawn from Cunningham and Gök (2012):

- **Causality problems:** The main challenge in evaluation is to clarify the linkage between a policy intervention and its effects. Even though overall impacts of an intervention can be measured, it is a much harder task to discern net effects from gross effects excluding deadweight since counterfactual examples are rarely exist in practice. P/PPs are more difficult to find the control groups for counterfactual analysis rather than other instruments due to the large scale and the long-term duration. In addition, it is also difficult to distinguish the effects of a P/PP from the

effects of other policies in the context that most actors are probably engaged with multiple policy interventions.

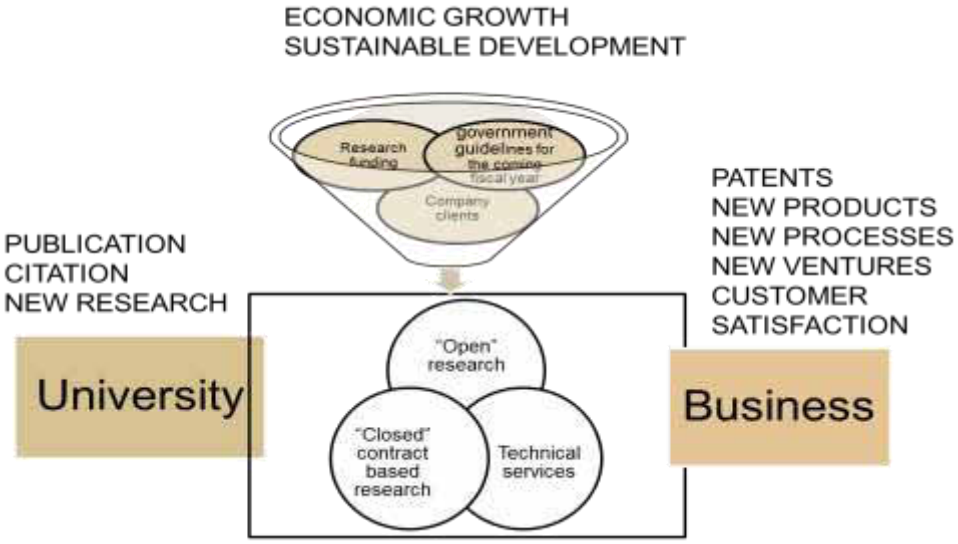
- **Timing:** Timing is a typical problem in evaluation of policies; since evaluation results are often needed before the effects of policy intervention has been realized. It is more problematic for strategic P/PPs which has long-term perspective in its effect, but whose outputs need to be evaluated and reported timely to secure funding in the course of their duration. In addition, the comparative evaluation of various P/PPs can produce biased results since the time at which different P/PPs materialize their major impacts is varied.

- **Scope of evaluation:** Although certain qualitative techniques can produce in-depth information about outputs and changes brought by individual interventions, they may not capture overall impacts of P/PPs operation. Conversely, an econometric model measuring overall impacts of P/PPs may not provide useful information about individual interventions. Furthermore, in the context in which P/PPs are used as a policy instrument to cope with grand challengessuch as climate change, biodiversity and food security, traditional impact assessments which focus on economic impacts is not sufficient to meet policy needs.

- **Human capitals and informal relationships**: Although human capital development is considered as one of key instruments to strengthen overall innovation capacity of firms, universities, and nations, the contribution of R&D to human capital building and the impacts of newly-developed human capital are hardly considered in evaluation due to their tacit nature. The observation that informal knowledge communities, so called "knowledge value collectives", play a crucial role to develop and exploit new knowledge (Bozeman and Rogers, 2002) implies there may be a distortion of impacts when the value of human capital development is ignored.

114. The choice of evaluation techniques should be aligned with policy needs. One way to increase the reliability of evaluation is to use multiple methods and then to compare or to triangulate among results. An experimental policy implementation which would be small scale and have pre-setting control group could be a solid brick to build more reliable and realistic evaluation. For example, Swedish Agency for Growth Policy Analysis considers a multi-method approach such as the utilization of the open R&D results (e.g. citations, patents and IP rights), follow-up survey of the RTOs' customers (e.g. customer satisfaction survey), quasi-control group approaches (if possible), and benefit-cost analyses for evaluating RISE (Research Institutes of Sweden).

Figure 10. Goals and indicators in evaluating RISE (Research Institutes of Sweden)



Source: Dan Hjalmarsson, presentation at the OECD expert group meeting on the evaluation of industrial policy in January 2014.

5. Conclusions

115. The rise of strategic P/PPs epitomises a shift in STI policy aimed at accelerating the transition from a purely collaborative approach to knowledge creation and innovation towards mobilising collaboration to address specific economic and global challenges. They do so not by addressing general weakness in the NIS systems such insufficient industry-science relationships, but by targeting specific areas of collaboration where there are important challenges for which STI could be mobilised.

116. The space in which P/PPs operate is one where neither government nor the private sector can achieve their objectives without the active participation of the other. In today's innovation policy landscape, characterised by globalisation, the extension of innovation policies beyond R&D and technology, there is a need for co-development of knowledge in a partnership which stretches into areas which traditionally have been the sole territory of either the public or the private sector. In fact, the public sector is also innovating and mutual learning could help both firms and governments address internal deficiencies. Finally, however, the success of P/PPs depends on mutual trust, shared visions and joint value creation between public and private actors. The examples contained in the annex to this report provide a wealth of information on innovative governance, financing and contractual arrangements that can help other countries in designing strategic P/PPs.

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