Chapter 8

Governance and implementation of innovation policies

This chapter explores a number of issues that are key to the governance and implementation of innovation policies. The first section of the chapter focuses on how to improve multi-level governance, i.e. in aligning policy actions across different ministries, agencies and stakeholders, but also across different levels of governments and across borders. The second section focuses on questions of trust in policies related to innovation, including the role of public engagement and risk management related to innovation. The final section focuses on specific questions related to the implementation and evaluation of innovation policies, including how governments can overcome challenges related to the implementation of reforms.

8.1. Governance and policy coherence

Why governance matters for innovation

Innovation is an area of policy making that is characterised by multiple levels of governance, which implies that the public authorities in charge of innovation belong to various levels of authority and policy competences, and budgetary resources are distributed across these levels of government. Moreover, even within a single level of governance, effective innovation policies need to be joined up across a broad set of policy and delivery areas, including tax, science, education, immigration, enterprise, foreign direct investment (FDI) and even health policy. This increases the number of actors, organisations, agendas and policies to be co-ordinated in order to achieve coherent policies. Two important developments have contributed to an increase in the importance of various levels of government:

- The first is **globalisation**, which is characterised by the emergence of new powerful internationalised actors – multinational enterprises (MNEs) – and by the geographical extension of the scope of innovation partnerships and competitive pressures. Intergovernmental organisations and international instruments also increasingly shape governance regimes, notably in Europe where the European Commission plays a prominent role in supporting research and innovation agendas (OECD, 2010a).
- Secondly, **regionalisation and decentralisation** have made local and regional governments more powerful and increased their capacity to design and operate their own development policies (OECD, 2005a, 2010b, 2014a).

Research and development (R&D) and innovation activities are increasingly global, thanks to the shifting international organisation of functions within MNEs, which are internationalising their R&D at faster pace and on a larger scale than before (OECD, 2010a). The increasing complexity of innovation and pervasiveness of new technologies generate a drive towards much wider partnerships extending over national borders. As a response to this trend, national innovation policy is increasingly framed in global terms, reflecting a growing sense of global identity, the global nature of many problems and issues, and the globalisation of markets and production. National innovation policies aim at fostering domestic innovation potential, strengthening capabilities and developing local skills, and may also have an explicit goal of raising the attractiveness of the country for global innovation performers and mobile talents (OECD, 2014b).

Policies, both at national and at supranational levels (the European Union [EU] R&D framework programmes are an emblematic case), foster the participation of national actors in international R&D and innovation networks. Indivisibilities, notably in very large research infrastructures, create the need for international policy co-operation in funding and exploitation of such resources. Education systems are also increasingly open, through alignment of curricula and permeability of education trajectories across

national borders as well as incentives to foster the international mobility of students, teachers and researchers.

The importance of regions in innovation policy is linked to the following two trends (OECD, 2011). First, the growing role of regions in national innovation policies, which reflects the importance of place and proximity for innovation. Second, a shift in regional development policy paradigms, with an increasing focus on the mobilisation of knowledge assets and the promotion of innovation for endogenous growth, while moving away from a redistribution policy paradigm.

Subnational authorities – mainly regions, but also cities in some countries – have therefore become important actors in shaping and implementing innovation policies with a territorial dimension. Exploiting benefits of spatial and cultural proximity between firms and other organisations, such as universities and public research institutes (PRIs), is at the root of these efforts, as proximity facilitates the flow of tacit knowledge that is important for developing new combinations of ideas, technologies and skills as well as for spurring co-operation and interactive learning processes (see Chapter 6).

As a result of these two major developments, the governance of innovation policy is characterised by a shift from the national level as the unique locus for the design and implementation of innovation policy, to both the international and subnational levels. Those two levels have experienced a rise in relevance and an increase in policy activity in innovation, while often targeting the same innovation actors as national policies. To achieve policy coherence, multi-level governance of innovation calls for a clear division of labour and strong complementarities among these various levels, and it seeks to avoid wasteful forms of policy overlap or policy gaps.

Multi-level governance is complex, however; it requires that authorities at various levels possess not only the right capabilities and resources to effectively run their own competencies, but also the capacity and means to enter into negotiations, align their policies and conclude agreements with authorities from other levels. Failures in capabilities and resources can have important effects on the processes and outcomes of multi-level governance efforts.[1] The recently adopted *OECD Recommendation of the Council on Effective Public Investment across Levels of Government* (OECD, 2014c) offers a framework for addressing public investment in a multi-level governance context, confronting challenges in co-ordination, capacity (particularly at the subnational level) and framework conditions.

Co-ordination across levels of government is just one dimension in the complexity of patterns for innovation governance. Another complementary dimension is that of co-ordination between policy domains at the same level of government, i.e. horizontal governance. Sound innovation policy governance incorporates both multi-level (or vertical) and horizontal considerations to achieve policy coherence.

In addition, the emergence of public-private partnerships in policy making result in more diversified patterns of stakeholders and further increase the complexity of multi-level governance. Public actors responsible for developing and implementing innovation strategies and policy instruments therefore need a skill set that increasingly involves a networking function with stakeholders outside of government.

Multi-level governance in innovation policy faces several challenges. First, articulating goals and means among various levels of government is a time- and resource-consuming process, involving high transaction costs. Moreover, achieving good co-ordination and

alignment of policies is hampered by imperfect information. Also, weak horizontal governance at one level of government makes the negotiations and search for better articulation of policies with another level of government more cumbersome. And lack of resources and public budgets for innovation at one level acts as a barrier to co-ordination efforts with other levels. Finally, the need for flexibility in multi-level arrangements often comes in conflict with a need for stability and long-term perspective in policy.

Improving horizontal governance

Innovation, like growth/competitiveness, climate change mitigation, managing demographic change and crisis management, is an issue requiring policy responses that do not fit neatly with the competencies of any single governmental department or agency. Citizens and businesses increasingly expect public policies and services to be seamless and responsive, not defined by administrative structures. Good governance for innovation is therefore about joint action, where administrations work in a co-ordinated and collaborative manner across boundaries and take a user-based perspective, e.g. in providing a single point of contact for firms or academic institutions. Poor co-ordination can increase the risk of duplication, inefficient spending, a lower quality of service, and contradictory objectives and targets. In a context of budgetary pressure, improved co-ordination has become an imperative.

Yet government structures and policy toolkits struggle to keep pace with this rapidly evolving operating environment. Renewal of the strategic capacity, organisational design and management structures of the public sector can certainly be helped by new technologies, but better governance starts from more basic foundations, notably effective leadership and better mobilisation of resources across government. Some of these foundations are explored in Box 8.1.

Box 8.1. **Improving governance: The role of the Centre of Government**

In the 2013 OECD survey of Centres of Government (OECD, 2014d), a majority of countries (some 59%) confirmed that the number of cross-ministerial policy initiatives has increased over the past few years and almost all reported that leading policy co-ordination has now become one of the priority tasks of the Centre of Government. The Centre plays this leadership role in different ways: 1) integrating cross-disciplinary perspectives into policy advice for the head of government and/or cabinet; 2) leading policy co-ordination via both traditional committee architectures and more innovative and informal channels; 3) facilitating resource sharing through a closer partnership with ministries of finance; and 4) supporting experimentation and testing of new delivery systems, many of which are based on shared service models.

There is no doubt that across large organisations, co-ordination is always difficult to achieve, for many reasons including inertia and strong silo cultures; gaming and other incentive problems; and inflexible financial resource systems. The OECD survey of Centres of Government indicates that 62% of Centre of Government officials consider that they exert a moderate degree of influence over ministries to promote co-ordination. Maintaining this influence depends on avoiding certain risks; in particular, interaction between the Centre and departments must be consistent and structured, not an ad hoc approach determined by time and resource availability.

Co-ordination has been traditionally addressed by means of inter-ministerial bodies, usually chaired by a senior official from the presidency or prime minister's office. More than three-quarters of countries have co-ordination groups at the state secretary level, with

Box 8.1. **Improving governance: The role of the Centre of Government** *(cont.)*

additional co-ordination groups at the director level and at head-of-unit or expert level. The new emphasis on strategic management of cross-sectoral policy initiatives is testing these traditional methods of co-ordination, which were designed to manage more "routine" co-ordination issues. The Centre of Government is now playing more of a leadership role with respect to specific strategic priorities, designing action plans in co-operation with relevant departments and leading on project management. In some cases, these are issue-specific or one-off reform initiatives, though often wide-ranging and sometimes controversial. A prominent example is that of austerity-era public-sector reform, but others include economic recovery strategies and transition to a low-carbon economy.

Exercising influence and guiding reform across several ministries has to be done in a way that does not create resistance or suggest over-centralisation. Several countries' Centres now provide technical and advisory support to line ministries, e.g. project and programme management skills, to help them adjust and meet the extra demands of horizontal projects. This makes it easier to integrate horizontal working or participation in horizontal projects into performance management systems at either the organisational or the individual level. Such systems represent the main incentive to participate in cross-departmental initiatives (accounting for almost 60% of such incentives), with financial incentives less common (accounting for some 30%).

The horizontal co-ordination processes managed by the Centre of Government are increasingly broad in scope and participation. For example, multilateral action on economic, social and environmental issues now touches the core of domestic public policy in individual countries. Effective working at international level is an increasingly important aspect of good governance at the domestic level and comes increasingly into the sphere of the Centre of Government (even though, as the survey indicates, formal responsibilities for international aid and foreign policy usually lie outside the Centre itself). International regulatory co-operation as a way to unblock trade negotiations and co-ordination of complex climate change responses are two examples of global debates that are influencing domestic policy making.

Centres of Governments also understand the need to innovate to promote innovation. For example, having space to experiment is commonly mentioned as an important factor in innovation. The Centre of Government can play a crucial role in several of the enablers of innovation – for example, getting senior government leaders on board, making innovation an accepted "part of the day job", experimenting and promoting the adoption of new ideas across the whole of government. For some countries, this is very clearly part of the remit of the Centre, either by using its own resources or by working closely with other governmental and non-governmental organisations to develop "prototypes". The Centre can also play a role in working with departments individually and collectively to organise the transition from existing systems and infrastructure to new ones. For departments, and for the civil servants working directly with existing systems, it can be difficult to envisage adopting something entirely new.

Source: OECD (2014d), *Centre Stage – Driving Better Policies from the Centre of Government*, *www.oecd.org/gov/Centre-Stage-Report.pdf*.

One specific example of the need for better governance related to innovation concerns systems innovation. For example, there is a growing understanding that system-wide changes are necessary to make economies socially, economically and environmentally sustainable. Although many national governments have put sustainability and green growth objectives at the centre of their economic development strategies, achieving this goal will require wide-ranging changes in their underlying economic, technological and

social systems, from transport, water and energy systems to modes of consumption and waste management. Ensuring that socio-technical systems move towards greater sustainability is a major challenge for governments, but also for civil society.

At the core of such transitions is a shift in governance structures that not only allows change to occur but also directs and orchestrates some of the changes. The "smart city" initiatives that mobilise technological and social innovations to make the production and consumption of a city's goods and services more sustainable illustrate this point (e.g. Santiago Smart City in Chile). At the national level also, improved governance mechanisms and better means of engaging a range of stakeholders are needed to facilitate system innovation. Finland and the Netherlands, for example, have developed public-private partnerships to foster co-ordination and alignment (Strategic Centres for Science, Technology and Innovation [SHOKs] in Finland and the Top Sectors approach in the Netherlands)]. Another example is Denmark's approach to Growth Teams (Box 8.2).

Box 8.2. **Denmark's approach to smart specialisation**

In order to exploit the opportunities of globalisation to the fullest, the Danish government introduced in 2011 a new approach to business and growth policy addressing areas where the Danish private sector had gained a strong position internationally. Eight "Growth Teams" were set up with business leaders and other experts as members tasked with evaluating how changes to regulation, public-private partnerships, etc. could promote further growth.

Based on their recommendations, the Danish government has published specific plans for growth for each of the following eight areas: Blue Denmark (maritime transport, etc.); Creative Industries and Design; Water, Bio and Environmental Solutions; Health and Care Solutions; Energy and Climate; Food Sector; Tourism and Experience Economy; and ICT and Digital Growth.

The rationale for this approach was not to "pick the winners", but rather to acknowledge the revealed comparative advantages of the eight areas and their significance for the Danish economy, their differing interactions with government and regulations, and their potential to contribute to solving grand societal challenges such as climate change, public health and a growing global population – an approach also reflected in the Danish Innovation Strategy. This approach did not mean focusing on subsidies for specific sectors but rather on complementary policy measures such as reduced or smarter regulation, a sufficient supply of labour with relevant competencies, and improving public-private partnerships, e.g. in R&D.

Thus the plans for growth address the sector-specific barriers to investment and focus on areas where new markets can be developed. A specific example is better government regulation of the waste water sector, where efficiency improvements will help to develop cost-effective technology that can also underpin further exports of Danish solutions. It could also be in relation to corporate R&D activities, where the creation of a single, transparent access point to Danish health data will strengthen medical research in Denmark and attract new R&D activities.

Improving the very general framework conditions remains a key pillar of Danish growth policies, but the work of the Growth Teams has shown that there are a range of more detailed policy issues that are addressed well only through a sector-specific approach.

Making the most out of regional and local science, technology and innovation efforts

Cities and regions are increasingly taking explicit policy measures to support innovation in their jurisdictions. Cities are focused more on urban development projects that seek to co-locate firms (often high-tech or creative industries) with universities, research centres, etc. This takes the form of a city district or a more contained science and technology (S&T) park or small business incubator, in some cases around selected "clusters". Regional governments have a wider range of tools at their disposal. In terms of high-level strategic bodies and technology foresight exercises, regions are almost as active as national governments. Regions are also financing R&D in public entities, but to a somewhat lesser extent in private entities. Technology transfer activities and innovation advisory services to existing and start-up firms are promoted by regions in most member countries. Programmes to support clusters and excellence hubs are frequently used, but more so at regional than national level. This is also the case with incubators and science and technology parks (OECD, 2011).

It is common for both national and regional levels in the same country to use similar policy instruments, which may be complementary or duplicative actions. There is not a strict division of labour across levels of government in terms of science, technology and innovation (STI) instruments. Country structure (federal, unitary elected regions, unitary administrative regions) does not appear to determine the number of instruments at regional level or the share in common with the national level (Figure 8.1). One explanation for the large number of instruments reportedly used in common at both levels is the diversity of ways an instrument may be used. The same type of instrument may be complementary by having a different configuration, target group, territorial scope or operating approach. In some cases the same instrument may be used by both levels with active co-financing and thus be aligned. Some redundancies across levels are difficult to avoid and may actually reinforce system stability.

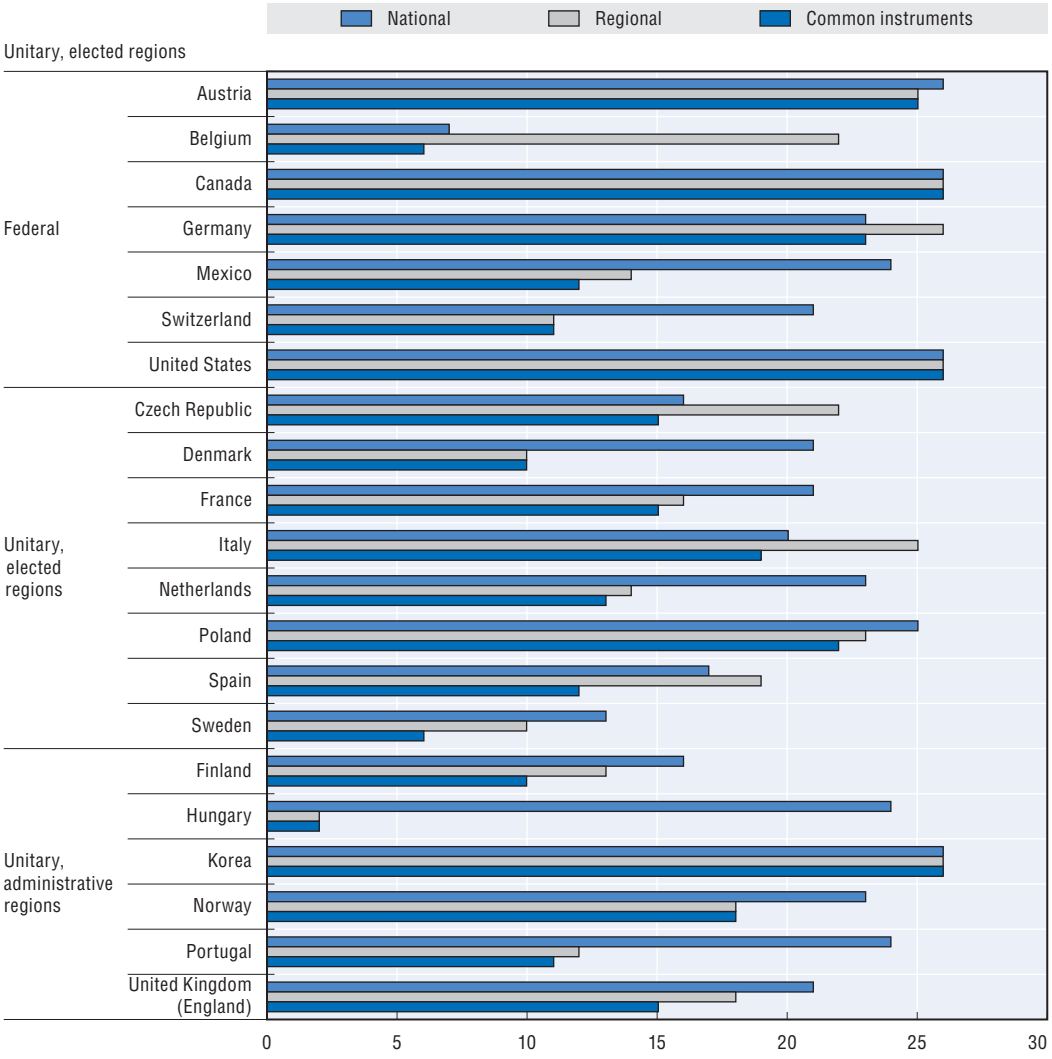
However, excessive redundancy can be attributed to a lack of awareness of the instruments developed at another level of government or a failure to distinguish between target groups or topics in the instruments offered. The result can be wasted resources, insufficient scale of the smaller programmes and excessive complexity for target groups (i.e. firms, research institutions). Streamlining the range of policy instruments is therefore an important task for government, although one that often proves hard to achieve.

Furthermore, regional governments account for a notable and growing share of public spending on innovation-related matters. In countries such as Belgium, Germany and China, subnational government shares of different aspects of STI spending (typically public expenditure on R&D) can be 50% or greater. These counts exclude many business development programmes that also support innovation. In other countries, that share may be less than 10%, such as for Austria, a federal country, or Denmark, a unitary country (Figure 8.1). Countries almost uniformly reported an increase in the regional share over the last five years.[2] Increases in such STI spending by subnational levels result from broader decentralisation trends, including financing and policy responsibilities.

Regions and cities can also be a better scale for the development of certain policy innovations that can be generalised nationwide. Cities, in particular, are critical sources of national growth and play disproportionately large roles in countries' economies, knowledge generation and environmental performance. Compared with higher levels of government, cities offer more easily identifiable policy synergies and complementarities. Urban policy makers are more likely to identify and combine complementary climate policies within and across sectors, given the interconnectedness of urban systems such as transport, land-use

planning and economic development (OECD, 2010c). For example, cities are responsible for a significant share of green infrastructure investments (Figure 8.2).

Figure 8.1. **Many STI instruments are used by both national and regional governments**

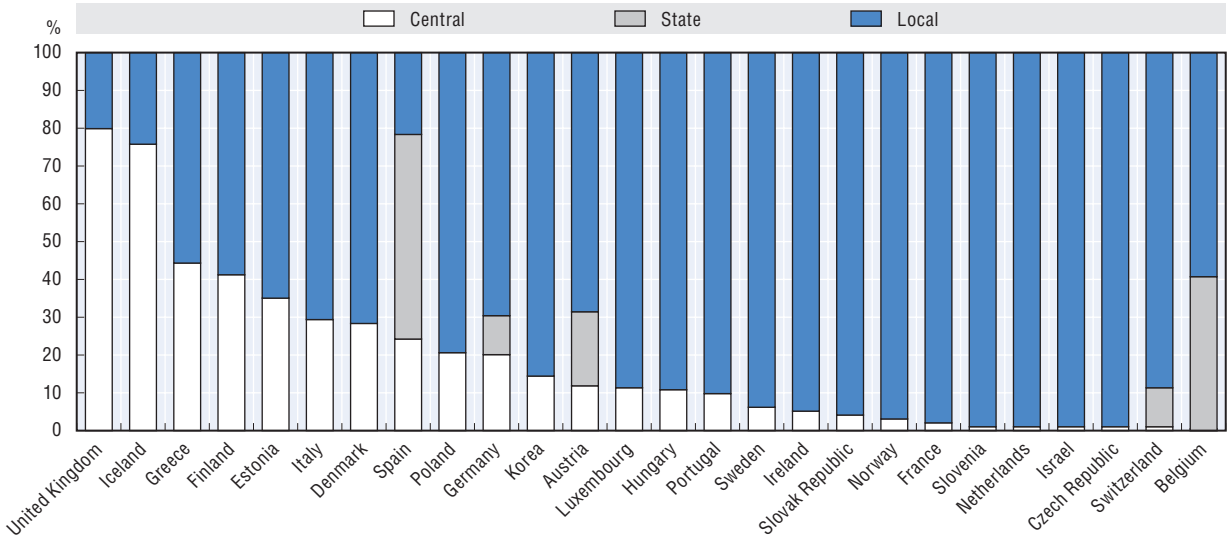


Notes: National refers to the number of instruments used at national level, regardless of whether they are used at other levels. Regional refers to instruments reported at regional level, regardless of whether they are used at other levels. The "common instruments" category refers to the number of instruments reported at both national and regional level, which includes those instruments reported in the tally of national and regional instruments.

Source: OECD (2011), *Regions and Innovation Policy, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264097803-en* using data from OECD (2009a), OECD-GOV Survey on the Multi-level Governance of Science, Technology and Innovation Policy.

Cities are also the places in which smart innovative approaches, driven by information and communications technologies (ICTs), analysis of (big) data and machine-to-machine communication, naturally arise. Smart cities often target different aspects of urban development, such as transport, electricity grids, buildings, or the delivery of public services in fields such as healthcare or education. Beyond governance challenges raised by the many levels of government and of stakeholders involved, smart cities are likely to improve citizens' well-being and increase the efficiency of the urban system as a whole.

Figure 8.2. **Gross capital formation in environmental protection by level of government, 2012**



Note: State government data only for Austria, Belgium, Germany and Spain.

Source: OECD, *National Accounts Database*, April 2014, *http://data.oecd.org/*, based on OECD (2013a), *Regions at a Glance*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/reg_glance-2013-en*.

The number and diversity of situations across regions and cities lends itself to policy experimentation in country contexts where they have the flexibility to so. A national government can then see what works and what doesn't before introducing a suitable adjusted national programme (see also the discussion on experimentation in Section 8.3 of this chapter). Better aligned national and regional strategies and policy actions are therefore essential, and can improve the policy effectiveness of both. Given the reality of increasing subnational policy action, the imperative for greater coherence is stronger than in the past. In addition, that coherence can provide greater impacts from respective policy action. For example, a national government may finance a public research entity, while a regional initiative to link up firms in the area with the research facility could help extract more economic benefits from that national investment. National policy makers may have the data or analyses to inform regional-level policy making while regional public agencies may actually have better information on the needs of local firms that could inform national policy. In both of these examples, sharing information across levels of government becomes critical for better intergovernmental co-ordination of STI policy.

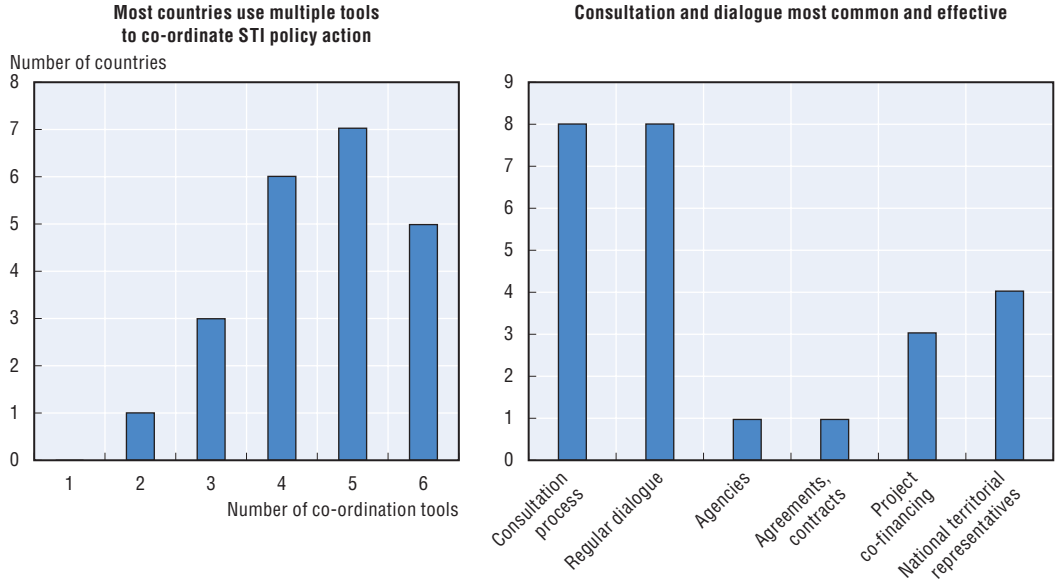
Clarity with respect to the role of regions for STI policy in a given country context sets the stage for better co-ordination. Regions may be active in different parts of the national policy process: 1) setting the overall strategy and framework; 2) developing policy; 3) financing policy; 4) implementing programmes and instruments; and 5) assessment/evaluation (of strategies, programmes and instruments). Some national STI strategies consider regions as relevant given the spatial dimension to the innovation process and the role of certain innovation hubs. In some countries with stark variations in regional capacity, national plans have highlighted that addressing this imbalance is a way to improve national performance. The role of regions for STI policy in federal countries may be set by the constitution, a specific S&T law that gives a role for regions or an administrative act outside of STI policy, such as in the regional development field. Generally, but not always, these formal roles are the same for all regions in a country. Even if regions do have similar

formal powers, there may be de facto asymmetric decentralisation of STI policy due to differences in regional capacity, financial or otherwise (OECD, 2011).

Co-ordinating national and regional efforts takes multiple channels in OECD countries, but consultation and dialogue are ranked most common and effective (Figure 8.3). In addition, some national governments have agencies or national representatives responsible for particular regions that help to co-ordinate actions across levels of government. In other cases, some form of contract may be used to ensure financing for an STI policy objective, or co-financing may be used for specific STI projects. There is no right approach *a priori*, since the use of different co-ordination tools may prove more or less effective in practice. However, ultimately any tool to improve information sharing will underpin greater intergovernmental policy coherence.

Regional strategy development is another important tool for clarifying and communicating regional priorities, but such strategies need to be based on a valid assessment of regional strengths and needs. Generally OECD regions have some form of business development or explicit innovation strategy, of varying degrees of quality. The use of a smart specialisation strategy for European regions, a condition for receiving European Structural and Investment Funds, was implemented to help regions clarify their relative strengths to ensure a better use of funds for more realistic and less duplicative investments (see Chapter 6).

Figure 8.3. **Aligning STI actions between national and regional governments**



Source: OECD (2011), *Regions and Innovation Policy, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264097803-en* using data from OECD (2009a), *OECD-GOV Survey on the Multi-level Governance of Science, Technology and Innovation Policy*.

National strategies and labelling mechanisms can serve as strong alignment tools, but could be more effective if they involve regions in the development and implementation phases. It is very common for regions in a country to align their priority sectors with national priorities. They do so in part to better capture national STI funds in their regions. The quality and relevance of a particular region's role towards this national picture requires some clarifications, as not all regions can be strong in all priorities.[3] The strategy development process in some OECD countries involves a consultation process with regions

of varying degrees (from participating in a workshop to a more formal role). A national government designation of a cluster, research centre or science park as "world class" or of national significance also serves to gather funding from different levels around commonly recognised innovation assets.

In some cases, the interests of national and regional innovation policy efforts may differ for good reasons, so national policies need to allow for some flexibility and promote capacity building. Ultimately a region needs to consider what is most relevant for its industrial structure and assets. In some regions, research centres and universities may simply be less competitive in national calls or specialised in research areas that are not top priorities at a national scale. However, these regions still need to support innovation-driven economic development, which may require some flexibility in certain national programmes. In cases where regions simply do not have assets that are considered of national priority, the national government may wish to support capacity building by actors in the regional innovation system, from firms and universities to the public sector itself.

Cross-border governance

Cross-border governance of STI involves at a minimum co-ordination, if not the partial or total delegation of policy making from the national to the international level. It implies, among other things, international co-ordination of national policy initiatives, removal of obstacles to the movement of resources, setting of international standards and regulations, and transfer of authority to intergovernmental organisations and supranational authorities. It is part of a wider dual delegation process that gives a greater say in STI matters to the international, but also to the subnational, level of governance (see Chapter 5).

In terms of international STI policy goals, most countries seek efficiency and/or effectiveness gains from complementarities in orientation, planning, regulation and resource pooling. However, national governments focus on domestic challenges and can be reluctant to take a global or even a collective view. The economic and financial crisis has increased that reluctance, as has the emergence of STI as a focus of industrial policy. Countries also have concerns about the appropriation of the benefits of public investments in education, research and innovation, given the increasing international competition for scarce talent and investment. As a result, narrower objectives often determine the nature and extent of national involvement in cross-border STI initiatives. These range from foreign policy and economic diplomacy, to access to funding for the development of national STI capabilities and access to international scientific networks. Commitment to cross-border STI policy is therefore often shaped by contingency and tends to vary over time. Ultimately, the reluctance to internationalise aspects of STI governance reflects the limitations of existing arrangements to provide credible assurances about the distribution of the resulting costs and benefits.

Extensive international policy co-operation frameworks for R&D have developed in Europe, but international frameworks in other regions and STI areas are still in their infancy. For instance, much can still be achieved by developing technological standards related to the environment or improving international co-ordination on cybersecurity.

Cross-border governance of STI can be achieved through arm's-length policies, such as bilateral or multilateral agreements of limited duration or co-ordination of national policies, without delegation to a supranational body. This seems to be the preferred approach to cross-border governance of STI outside of Europe. Even within Europe,

international STI governance frameworks – by far the most developed of their kind globally – have historically been designed as complements, rather than substitutes, to national frameworks.

However, a number of STI policy areas can benefit from delegation of decision making and deeper integration. These are areas characterised not only by high fixed costs but also by high international transaction costs owing to the need for access on equal terms to highly specialised, single-purpose assets (e.g. the European Organization for Nuclear Research [CERN] and the International Thermonuclear Experimental Reactor [ITER]) as well as a high frequency of interaction and high uncertainty. A recent example of the latter is the high-risk, high-potential research funded by the European Research Council (ERC), which can maximise success by drawing from the largest possible pool of excellent scientists. Outside of Europe, the Consultative Group of International Agricultural Research (CGIAR) is an example of a long-term strategic arrangement with common R&D programming and performance functions (OECD, 2012b).

OECD analysis of the challenges in establishing international research infrastructures, including shared financing, governance and legal frameworks, suggest there is no one-size-fits-all model for such facilities. However, lessons can be learned, for example from different cost-sharing arrangements. Increasingly, and partly related to the move towards more open science and innovation, international distributed research infrastructures have become more prevalent. These are located across several countries, share a common purpose and are co-ordinated in some way but otherwise can be of very variable geometry.[4]

There have recently been ambitious initiatives to promote cross-border governance of STI in several regions, including Southeast Asia and Latin America, e.g. the Association of Southeast Asian Nations (ASEAN) Committee on Science and Technology. However, unlike Europe, they have a short history and limited continuity to date. The case of Europe is unique, in that its progress in cross-border governance of STI is part of wider economic integration.

Cross-border innovation policies are also relevant at the regional scale. When functional regions for innovation do not conform to national administrative boundaries, a need arises for alignment of policies across the borders involving, in most cases, both subnational and national authorities active in the cross-border area (OECD, 2013b). In Europe, policies dedicated to territorial co-operation across national borders add a supranational level that needs to also be aligned with strategies and policies at national and local levels.

In response to the *OECD STI Outlook 2014* policy questionnaire, many national authorities reaffirmed their commitment to cross-border governance of STI, specifying some of their reasons, but also listing important barriers and policy initiatives to lift them (OECD, 2014b). Mutual policy learning and the transfer of good practices appear to be important motivations for engaging in international STI forums. Global "grand challenges" such as climate change and threats to health and resource sufficiency are also strong motivators for international co-operation. Other countries see unexploited scale economies as the major challenge, though with some countries citing the lack of dedicated funding for large-scale and longer-term co-operation as a key obstacle. Fragmentation of funding agencies – and of the rules and procedures for research funding – is considered an important obstacle. A number of countries also mentioned barriers to cross-border governance of STI, including

the absence of comprehensive national policies or mechanisms for domestic co-ordination of cross-border governance arrangements as an important constraint. Progress on these and other areas can potentially be made and could also help to strengthen international frameworks that affect innovation across the globe.

Below are some key policy learnings from the OECD's work on governance and innovation.

Main policy messages on governance of policies for innovation

- The governance and implementation of national innovation strategies are critical to their success. The process of developing a national strategy requires early and adequate involvement of stakeholders, including business, academia, social partners and key actors.
- Given the wide range of policies that affect innovation, it is important to ensure that the full set of government policies that affect innovation are well aligned, not only at the level of central government, but also between the central government and regional and local authorities, many of which are actively involved in innovation activities.
- The development and implementation of innovation policies requires strong capabilities within the public sector, including in ensuring the support of stakeholders for policy actions.
- The growing importance of governance also reflects a new approach to policies for innovation in many countries, where governments are increasingly acting as a facilitator in the face of complexity and uncertainty, enabling closer co-ordination between individual economic agents as well as fostering greater experimentation in the economy. This includes greater emphasis on building networks, improving co-ordination and regulation, promoting awareness, and less reliance on government funding.
- Cross-border governance is of growing importance for innovation, to help address common challenges, share costs and benefit from mutual learning. But governance mechanisms are underdeveloped and are affected by several barriers, including fragmentation of funding and lack of dedicated funding for long-term co-operation.

8.2. Trust, public engagement and risk governance

As discussed in the previous section, the success of innovation strategies is heavily influenced by the engagement of stakeholders in the development of policies and strategies. It is also influenced by a number of broader factors, notably the degree of trust in government and the degree of public engagement in science and innovation policies. Moreover, how governments manage and govern risks related to innovation is a major factor for innovation. This section discusses these three aspects.

Ensuring trust in government

On average, only 40% of OECD citizens today report that they trust their government, while 57% feel that corruption is widespread in business (Gallup, 2013). Low levels of trust can reduce compliance with laws and regulations, diminish investor confidence, and increase risk aversion, which is likely to have an impact on innovation. Levels of trust were already low, but were particularly hard hit by the crisis, which stemmed from numerous regulatory failures and mismanagement not only by government but also by business. As a result, trust in public institutions and in certain private sector institutions – banks and

financial institutions as well as major corporations – suffered. Strengthening trust will help restore the predictability in the economic environment that is necessary for long-term and risk-laden investment decisions linked to innovation.

Restoring trust involves action across a set of inter-related drivers that encapsulate what citizens expect from government, for example:

- **Reliability:** The ability of governments to minimise uncertainty in the economic, social and political environment of their country and to act in a consistent and predictable manner; this has fairly clear implications for the propensity of firms to invest in innovation in a particular country. Previous sections of this report have pointed to the importance of stable and predictable policies related to innovation, given the long-term nature of investment decisions in this area.
- **Responsiveness:** The provision of accessible, efficient and citizen-oriented public services that effectively address the needs and expectations of taxpayers; this relates to the ability of government to identify the needs of businesses and provide appropriate support, including support for innovation activities.
- **Openness and inclusiveness:** Institutionalising a two-way communication with stakeholders to improve transparency, accountability and engagement; this helps to promote collaborative behaviour between the government and non-government sectors, including with respect to joint innovation-related activities.
- **Integrity:** The alignment of government and public institutions with broader principles and standards of conduct that contribute to safeguarding the public interest while preventing corruption; this dimension has a direct impact on innovation as firms are less likely to conduct innovation activities in a country in which respect for the rule of law and integrity are low.
- **Risk management:** Trust in the innovation area also depends on sound public policies to manage the risks associated with innovation, as discussed further below.

While many of these policies fall outside the focus of this report, they have an important impact on the effectiveness of government efforts to strengthen innovation and therefore need to be kept in mind. The forthcoming OECD Trust Strategy will look at measurement of trust, fairness in decision making and the impact of trust in specific policy domains, including tax policy, corporate governance, education and regulation.

One policy domain area that is particularly important for innovation concerns trust in science. Trust in scientists, the science system and the way science is used to inform policies are major issues that affect the ability of governments to promote change. Increasingly governments are turning to the scientific community to provide advice and evidence that can inform decisions and policies across a range of issues, from short-term public health emergencies to longer-term challenges, such as energy security. Such advice can be a valuable, or even essential, input to policy making, but its usefulness depends on how it is formulated and communicated as well as how it is perceived by its target policy audience and by other interested parties. It is rare that scientific evidence is the only consideration in a policy decision and, particularly for complex issues, many interests have to be balanced in situations where the science itself may be uncertain. The rapid evolution of ICTs and moves towards more participative democratic decision making have put additional pressure on science to help provide answers and solutions, while opening up the academic world to surveillance and criticism. While science advice used

to be most often formulated behind closed doors, the new norms for science advisory systems are openness, transparency and accountability. Ongoing OECD work is exploring the appropriate mechanisms to provide scientific advice to policy makers, including the responsibilities and legal liabilities of institutions and individuals.

Public engagement and public perception

Closely related to the discussion on trust are questions related to public engagement and public perception. The public debate on the impact of science and technology on people's lives has been ongoing for centuries and has evolved in response to crises and new developments. For example, rapid advances in automation and robotics are raising concerns about technical change and its implications on future employment levels and the distribution of wealth within and across countries. Many societal concerns about the applications of science and technology appear to arise in conditions where the scientific evidence appears to be persuasive, but not complete, yet the socio-economic implications and the appropriate policy solutions from a broad societal perspective are much less certain.

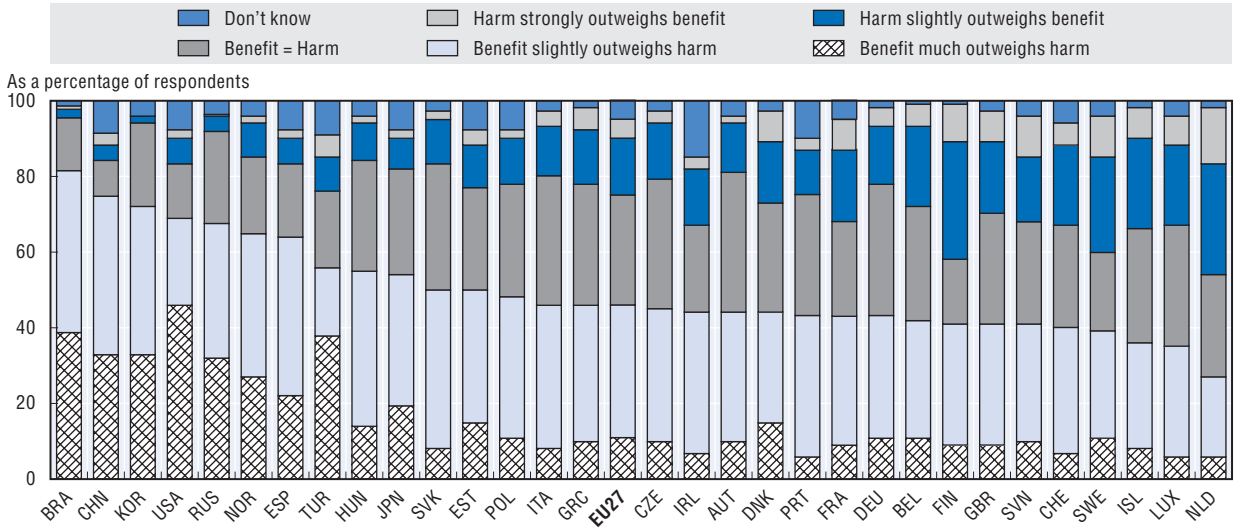
It is a critical issue for governments to find effective ways of consensus building, especially for difficult S&T issues, involving the relevant parties, including citizens and scientists, but also media, as well as fostering public engagement in science. Gauging the public perception regarding these processes and actual degree of participation will inform the design of policies. Another important issue is how scientists view and engage with the public. Policy makers are increasingly interested in encouraging scientists to demonstrate or at least articulate the beneficial impact of their activities on the economy and society (OECD, 2014b).

While the importance of innovation for sustaining economic growth and driving improvements in living standards is generally acknowledged, there is also widespread evidence of significant attitudinal and knowledge "gaps". Public perception surveys in a large number of countries indicate that, although most people have a positive view of the impact of S&T on their personal well-being, a significant proportion have mixed or negative opinions about the effects of scientific research (Figure 8.4; OECD, 2013c). From the perspective of the adoption of new goods and services, a European poll found that nearly half of the EU25 population was significantly hostile to new innovations or very reluctant to try new products or services or pay a premium for them (European Commission, 2005). Public engagement and better risk management (see below) are some of the key responses to this challenge.

Policy makers will need to identify and monitor systematically skills and attitudes of relevance to science and innovation in order to improve them. Individual and collective attitudes are complex and constantly evolving phenomena, although some changes occur only over generations. At the same time, some social and environmental challenges require more immediate action in terms of consumption behaviour and social habits, for instance. Efforts to promote a science and innovation culture can be undermined not only by high-profile incidents and crises of confidence (e.g. Fukushima), but also by a less apparent erosion of trust in the decision-making process and in its use of science and evidence. This has triggered some serious rethinking about the impacts of S&T on the economy and society and a reassessment of the appropriate policy responses, including in the area of scientific advice (OECD, 2015).

Figure 8.4. **Public perception of scientific research benefits, 2010**

Responses to the question: "Have the benefits of scientific research outweighed the harmful results?"



Note: International comparability may be limited. Results are based on surveys conducted by means of face-to-face interviews. For Japan, Mexico and the Russian Federation, data refer to 2011. For Korea, data refer to 2006. See source for further detail.

Source: OECD (2013c), *OECD Science, Technology and Industry Scoreboard 2013*, *http://dx.doi.org/10.1787/888932890542*, based on EU and national sources.

Policy measures directed at civil society, schools, universities and workplaces have sought to develop an innovation culture in view of the fact that innovation is driven by science, business, practitioners and users (Vincent-Lancrin, 2012) and pervades many spheres of human activity (Table 8.1). Such policy measures seek to improve public access to information on the future of STI and to promote society's participation in policy design. For example, the OECD Declaration on Future Policies for Science and Technology underscored the importance of raising awareness of S&T and recommended public participation in the definition of major technological orientations (OECD, 1981).

Other policy measures aim to raise awareness of and interest in S&T, especially among youth. Traditionally this has meant broad dissemination of scientific information, via the mass media, promotion of science events and other initiatives and support for the activities of science museums. The development and use of ICTs, the increasing access to digital infrastructures and the Internet, and greater interactive online communication – e.g. social media – have helped engage the public but also reduced reliance on traditional sources.

Promotion of science and innovation among youth largely takes place in classrooms. However, the evidence suggests that individuals in many countries think that schools do not make a substantial contribution to promoting entrepreneurial competencies and attitudes. Major reforms of education systems seek to add new disciplines and new learning practices to curricula. They have concerned all levels of education, from primary schools to higher education institutions, and have required building capacity in teaching and infrastructure.

Policy initiatives to build a science and innovation culture also target workplaces. They encourage a new research and innovation culture to help universities fulfil their "third" mission of transferring and co-creating relevant knowledge with the rest of

Table 8.1. **Typology of policy measures for enhancing a science and innovation culture**

Spheres	Main target populations	Key policy instruments	Some country examples
Civil society	Youth and adult population	Public dialogue (awareness workshops, conferences, standards)	Slovak Republic's Scientific Patisserie, France's Observatory of Biology
		Participation to STI policy design (public consultation)	Finland's national stakeholder conference, Great New Zealand Science Project, Turkey's technology roadmapping
		Science communication (science centre/ museum, science weeks/fairs/years/ exhibitions, science media (TV, radio, broadcasts, website and social medias), outreach programme by scientists)	Australia Questacon, Canada Science.gc.ca, Chile VA!, Korea Science Festival and Idea Festival, Start-up Expo and Start-up Fair, Germany BIOTechnikum truck, Turkey's Science Fairs Support Program (TÜBİTAK 4006)
		Awards/prizes and competitions in science and innovation	China innovation and entrepreneurship race, New Zealand's Future Scientist prize, Slovak Republic's Innovative Deed of the Year, Russia's Competition for Innovation in Education
Classrooms and education systems	Students at all educational levels	Formal education initiatives (lecture courses, new curricula)	Danish Foundation for Entrepreneurship-Young Enterprise, Norway's Action Plan for Entrepreneurship in Education, Sweden's compulsory teaching of entrepreneurship, Turkey's FATIH Project
		New pedagogical practices and networking activities (hands-on exercises, experiment labs, participatory learning, role models and mentorship)	Austria Young Science, Germany Little Scientists' House, Norway's IPRs educational scheme, Slovak Republic Scientific Patisserie
	Teachers	Capacity building for teaching, including the design of innovative teaching methods and materials	Austria's new teaching methods, Ireland's Project Maths
		Training opportunities, awareness conferences and workshops, financial incentives	Estonia's training of academic teachers on entrepreneurship, New Zealand's fellowships for S&T teachers, Young Enterprise Norway
Workplaces	Academia (researchers, doctorate students and postdocs)	Training opportunities (e.g. IPRs, start ups, etc.), awareness conferences and workshops	Technology Transfer Offices in many countries
		Support for commercialisation of public research results and industry-science linkages (remuneration schemes, performance criteria and promotion, industrial PhD)	Innova Chile CORFO, Colombia's regional alliances, Germany's VIP and EXIST grants, New Zealand's Callaghan Innovation's R&D Student Grants
	Firms	Support to industry-science linkages, and technical assistance to firms (innovation vouchers, experts detachment, industrial PhDs, extension programmes)	Technology Transfer Offices in many countries, Colombia's pilot program for training and advice in innovation management
		Training opportunities, seminars and information workshops and support, visibility	Costa Rica's CATI (IPRs) and National Portal of Innovation, New Zealand's Entrepreneurship Development Programme, South Africa's Science awareness awards, United Kingdom's Business Link

Note: IPRs = intellectual property rights.

Source: OECD (2014b), *OECD Science, Technology and Industry Outlook 2014*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/sti_outlook-2014-en* based on country responses to the STI Outlook policy questionnaire 2014, and input received from national delegations.

society. Training, information workshops, and revised remuneration and promotion frameworks seek to raise awareness of IPRs and interest in the commercialisation of public research results in the research community. Researchers, especially early in their careers, are helped to launch start-ups. Firms receive technical assistance through financial and non-financial channels such as innovation vouchers, extension programmes and seconding of experts.

Managing the risks related to innovation

Climate change, loss of biodiversity, loss of topsoil, disease threats (such as multi-drug-resistant bacteria), adverse effects on health and the environment from the use of chemicals, and the consequences of population ageing are among the many complex

risks facing the globe. As described in various parts of this report, breakthroughs in S&T are needed to address such global challenges in cost-effective ways. For instance, among many recent developments, digital technologies have helped to monitor disease outbreaks that threaten to become pandemics, and nucleic acid identification technologies can help to quickly identify the pathogens involved. Space technologies have unique data- and knowledge-enhancing functions with respect to climate change. Recent research has identified molecules in blood that predict, with at least 90% accuracy, whether an individual will develop mild cognitive impairment or full-blown Alzheimer's disease (Mapstone et al., 2014). Synthetic biology could allow petroleum-based products to be manufactured from sugar-based microbes (OECD, 2014f). And nano-composite materials offer the prospect of lighter vehicles, lowering fuel consumption (OECD, 2014g).

While new technologies can have diverse positive economic and social effects, potentially negative outcomes can also arise. It is unavoidable, for instance, that policy will have to manage a future where ICT allows ever more scientific information to be available to ever larger numbers of people, with some of this information being potentially dangerous. Moreover, as biotechnology advances, understanding of how to deliberately make diseases worse will also spread (for instance, adding a gene to mousepox – a version of smallpox – can make this pathogen more lethal and able to infect vaccinated individuals).[5] Indeed, the appropriateness of publishing details of the genomes of dangerous microbes is currently being debated.

Examples from biotechnology, as above, are among the more evident risks. But there are many others. For instance, some manufactured nanoparticles might have harmful effects on health. And in future, atomically precise manufacturing might be used to make weapons, in a highly proliferated way. Accidental outcomes of scientific experiments are also a potential source of risk, especially perhaps when experiments create conditions that otherwise do not exist in the natural world (Rees, 2003). And vast and critical interlinked ICT systems might behave in unpredictable and emergent ways. (In fact, interacting algorithms caused the "Flash Crash" of May 2010, when more than a trillion dollars in value were lost in minutes from global stock markets.) Indeed, scientific understanding of such complex systems is inadequate. Improved understanding is essential if governments are to protect society from potentially serious disruptions (Nesse, 2014).

More generally, uncertainty in science policy is pervasive. R&D is a probabilistic investment, and the direction of science and innovation and their ramifications involve elements of randomness and often long-term and hard-to-foresee outcomes. Even relatively short-term and prosaic policy questions can be hard to grapple with in informed ways. Accordingly, governments need to deploy a range of tools – from foresight studies and expert advice to quantitative modelling – to help steer policy and reduce unnecessary risks. But all such techniques have strengths and weaknesses.

The recent OECD Council Recommendation on the Governance of Critical Risks (OECD, 2014h) makes a range of recommendations to countries to strengthen risk governance, notably in:

1. Establishing and promoting a comprehensive, all-hazards and trans-boundary approach to country risk governance to serve as the foundation for enhancing national resilience and responsiveness, including the development of a national strategy for the governance of critical risks.

2. Building preparedness through foresight analysis, risk assessments and financing frameworks, to better anticipate complex and wide-ranging impacts.
3. Raising awareness of critical risks to mobilise households, businesses and international stakeholders and foster investment in risk prevention and mitigation.
4. Developing adaptive capacity in crisis management by co-ordinating resources across government, its agencies and broader networks to support timely decision making, communication and emergency responses.
5. Demonstrating transparency and accountability in risk-related decision making by incorporating good governance practices and continuously learning from experience and science.

The United Kingdom's Government Chief Science Adviser (GSCA, 2014) provides a useful overview of how policy can manage innovation-related risk and how science can help to assess risks in non-science domains. Key observations from this work are included in Box 8.3.

Box 8.3. **Science, innovation and the management of risk**

Innovation is essential for managing a diverse array of critical risks. Improved scientific understanding of complex systems is essential if governments are to protect society from possible disruptions to these systems. At the same time, science and innovation themselves create new risks that need to be managed. For instance, manufactured nanomaterials offer a range of possible benefits, but also have risks related to health and safety that need to be managed.

The GCSA (2014) provides useful policy guidance on innovation and risk management, in particular:

- Policy decisions on the risks and applications of a new innovation should consider the costs and benefits of not acting, as well as those of acting.
- Decision making needs to take account of the different ways of achieving the same or similar desired outcome.
- Science is one framework through which innovation and risk can be assessed, but economic, social and political considerations should also be included. Relevant social and ethical values can vary greatly among communities and countries.
- It is important to distinguish between hazard, exposure and risk. Confusing these concepts can impair communication and decision making.
- If risk is quantified, there should be transparency regarding how numbers have been generated. How numbers are presented, or framed, will also affect their interpretation.
- The incentives faced by regulators should enable innovation. Along with consumer welfare, the economic duty of regulators of infrastructure and utilities should include innovation and system resilience. Regulators should be accountable for all major decisions they take.

These issues are also core to the debate about innovation and policies for innovation today. As suggested by the UK report, several challenges put the management of risk at the core of discussions on innovation policy (GSCA, 2014):

- Governments shape the legal frameworks, institutions and policies that shape the risks and incentives faced by various actors in the innovation system.

- Innovations can cause both good and harm, leading to a debate on the risks associated with innovation. As modern societies have become safer and more free of risks, risk aversion has grown in many societies.
- Designing systems that manage the risks associated with innovation is difficult and requires a sound evidence base. However, it is also influenced heavily by social and cultural values that affect whether innovators can receive a social licence to engage in specific innovation activities.

These challenges have also been explored in OECD work on innovation, notably in work on the governance of nanotechnology and biosciences. For example, a recent report on innovative governance of biomedicine and health technologies (OECD, 2013d) notes the importance of balancing risk and benefit given limited knowledge and a context of uncertainty. In another example, OECD (2014g) examines the use of nanomaterials in tyres. This work shows that while it is straightforward to demonstrate benefits for society from this innovation, serious data gaps exist regarding risks to health and the environment.

Given the pace of discovery in the fields of biomedical and health innovation, new products or procedures may reach regulators while the available information on them may still be incomplete and insufficient to enable regulators to make entirely evidence-based decisions. Early consultation is therefore becoming an indispensable means of maximising the amount of information available to regulators. Innovators often hold more and better information than regulators in relation to at least some kinds of technical and scientific developments. The report also notes the need for timely public engagement and communication. Biomedical innovation creates challenges with respect to risk, equity, privacy, confidentiality, human dignity, right to life and freedom of research. This makes for a particularly complex environment for decision makers and the public alike, necessitating special efforts in communication and consultation.

There is another dimension of risk related to innovation that is important in the policy context, namely whether and how to address the economic risks related to innovation. Innovation is inherently risky, and firms and other innovation actors face great uncertainty in making their investments in innovation activities. For instance, the future of synthetic biology depends on achieving reliable, low-error, accurate and inexpensive DNA synthesis (i.e. writing of the genetic code). The technical difficulties involved in reaching cost parity between DNA synthesis and DNA sequencing are considerable and create high financial risks for the often small companies working in synthetic biology. Such firms are natural targets for forms of public support that help to mitigate financials risks faced by small high-technology ventures (e.g. loan guarantees, public procurement or enhanced access to equity finance).

Similarly, green nanotechnology operates in a complex landscape of fiscal and legislative policies. An important policy objective is to reduce uncertainty around the use of environmental nanotechnology. In this regard, innovative approaches to sharing risk and knowledge are being developed based on large consortia made up of companies, public laboratories and institutions (e.g. NanoNextNL, Genesis). Among other benefits, consortia can help to manage the uncertainty of bringing a product to market when no similar technologies have previously been commercialised, or when the demand for the technology is not yet clear.

Creative thinking can be brought to bear on how policy might best address risk. A relevant recent example concerns the work of Andrew Lo, professor of finance at the Massachusetts Institute of Technology (MIT). Lo and his colleagues have employed concepts from financial engineering to tackle the problem of neglected funding of drug research for certain types of disease (such as those that primarily afflict populations in poor economies). Most lines of drug research are expensive and fruitless. High costs and skewed research payoffs, combined with other features of the market for some drugs (for instance, medical authorities wish to minimise the use of new antibiotics to slow the development of resistance), have led to pharmaceutical companies abandoning some critical areas of research. But Lo and his colleagues have demonstrated that a portfolio approach to early-stage research might provide a solution (Fernandez, Stein and Lo, 2012). Above a threshold volume of research expenditure, a financial structure could be created that would pool the results of R&D projects with different risk, return and duration profiles. The portfolio entity could finance its activities by issuing debt, a critical advantage because a much larger pool of capital is available for investment in debt than equity. Based on an analysis of data from 1990 to 2011, for new molecular entities in oncology, the fund could yield rates of return sufficient to attract institutional investors such as pension funds and insurance companies.

Well-designed innovation policies, as discussed in Chapter 6, can help to mitigate some of the economic risks of innovation, in particular in areas where innovation is important to meet core public policy objectives, e.g. health or the environment. Moreover, stable and predictable policy frameworks, as discussed earlier in this report, are important to help firms manage the inherent economic risks of innovation.

8.3 Implementation and evaluation

Implementing innovation strategies

Most OECD countries and most emerging economies have adopted innovation strategies over the past decade. These typically offer a vision of the main challenges that the national research and innovation system is confronted with and the directions that should be taken to address these challenges. Innovation strategies have many possible uses: they can trigger an exchange of views among stakeholders and help achieve alignment on priorities regarding research and innovation; foster the convergence of views among stakeholders and decision makers; help in planning resources; and establish a concrete agenda for policy action.

In practice, innovation strategies often involve a range of objectives; some of these are not achieved and some are not even implemented (OECD, 2014b). Typical challenges arise from poor design, including a lack of realism in the choice of some objectives, possibly due to an inadequate design process, or from the process of implementation itself. Other barriers to implementation arise from a lack of involvement or even resistance of certain actors, whose concerns and agendas have not been sufficiently integrated into the strategy. Obstacles can also reside in institutional settings, if they are not amenable to the possible reorientation of resources required by new strategies. Moreover, as innovation becomes a tool to achieve a wide range of policy objectives, developing a coherent strategy becomes increasingly challenging, as a range of ministries and stakeholders need to be involved, as discussed in Section 8.1.

National innovation strategies are in most cases broad in scope, covering innovation, research, entrepreneurship and part of higher education (OECD, 2014b). They therefore often involve a variety of organisational actors, each with its own culture, structure, constraints and objectives. Actors involved include ministries in charge of research, higher education and the economy, as well as agencies in charge of funding, performing or evaluating research. Beyond the government, research teams, universities, various types of enterprises (multinational, start-ups, SMEs), as well as professional associations may be involved.

In addition, innovation has an important role in areas where security, social or environmental objectives are central, e.g. defence, health and the environment, and where the corresponding ministries are leading the agenda in their respective areas. Hence, although innovation is essential, the ministries directly in charge of innovation policy do not have a leading role in these areas. How to ensure coherence concerning innovation-oriented initiatives across these separate thematic areas, each led by distinct entities, is therefore a challenge. Many countries have found it difficult to mobilise the broad range of actors involved in the implementation of their national strategies (OECD, 2014b). Understanding the reasons for these difficulties, and identifying the obstacles, is often the key to ensuring a properly functioning innovation system. A particular challenge is also to include not only existing (incumbent) firms, but also young innovative firms and challengers involved in more radical innovation.

Overcoming challenges with policy reform[6]

As with other areas of policy, implementing new innovation policies can be difficult. These difficulties can emerge from many areas, including lack of funding, lack of understanding, poor institutional frameworks or poor governance, several of which have already been addressed in previous sections. Implementation of new policies can, however, also meet with resistance from specific interest groups that are affected by the policy reforms. While many new innovation policies may have only modest goals, and therefore do not necessarily give rise to such resistance, some others may, e.g. deep university reforms, or large shifts in the budgets allocated to science and/or innovation.

At the root of many of the obstacles to reform lies the large heterogeneity of citizens, firms, scientific institutions and other actors that are affected by reforms, which implies that reforms will have a differential impact on them, sometimes substantially altering the relative value of different types of human and physical capital. Even socially beneficial reforms may therefore contradict the interests of many, largely because of distributional consequences that may be unrelated to the core aims of the reform. This heterogeneity also influences the political process, not least because it structures the incentives of politicians seeking election.

When it comes to policy reform, there is thus a twofold challenge. The first is to design reforms that will enhance aggregate welfare, even allowing for the costs that reform may impose on some agents. The second is to devise strategies for securing adoption of such reforms that prevent the opponents of change from blocking reform, but that also address their legitimate concerns about its distributional consequences.

Despite these common challenges, there are no one-size-fits-all approaches to overcoming the obstacles to reform or even identifying the most urgent reform priorities. This is because the heterogeneity of institutions and economic structures across countries ensures that the challenges facing would-be reformers vary widely across both time and

space. Reform design and strategies for reform adoption therefore need to reflect the specific institutional and cultural context of the country concerned. Even where common problems can be identified in different countries, the specific institutional features of a country imply that simple, unaltered "transplants" of policies and institutions from one environment to another rarely take root. Some degree of adaptation is usually required. This must be borne in mind when trying to draw lessons from reform experiences across countries.

Nevertheless, the evidence suggests that cross-country comparisons can be fruitful. First, for all their institutional, political and economic differences, countries face a large number of common challenges, also in the innovation area, e.g. in strengthening productivity, promoting the scale-up of innovative firms, addressing social challenges and strengthening inclusiveness, as has been made clear from previous sections of this report. Moreover, in many policy domains related to innovation, the recent *Science, Technology and Industry Outlook* shows that countries have increasingly adopted common approaches, even if the specific institutions and policies still vary considerably from one jurisdiction to another (OECD, 2014b).

Although the OECD's work on innovation policy has not specifically looked at these questions, experience from other areas provides some useful insights (OECD, 2010d). Notably, this work points to a number of regularities in the way reform processes unfold in different areas and across countries, which suggest that, despite the wide variety of challenges and circumstances they face, policy makers contemplating reforms need to address a certain number of basic questions in the early stages of reform design (Box 8.4). Not all of these lessons pertain also to innovation policy, but nevertheless provide important guidance for policy makers.

The discussion on the "how" of structural reform presented in Box 8.4 has not been as strongly present in the debate on innovation policies as in other areas of structural policy, such as education or environmental policy reforms. Nevertheless, it is relevant and has a bearing on the success of implementing policies in this area. For example, recent OECD work on systems innovation raises questions in regard to the political economy aspects of reform in areas such as transport innovation, green growth and cities. Policies to change such systems may negatively influence vested interests, which implies that political conflict and power struggles are likely and will need to be managed. System innovation entails not just winners, but also losers, especially when old systems are replaced by new systems. Organisations with interests linked to old systems may resist and oppose the changes. Many workers have skills that are firm- or even job-specific, and many firms are invested in capital and equipment that may be of value only for pursuing certain activities in particular locations. Such human or technological capital may be difficult to redeploy in response to a changing environment. Moreover, system innovation may require adjustments in policies, institutional frameworks, incentive structures and investment patterns.

A few other aspects of the OECD work on *Making Reform Happen* (OECD, 2010d) are relevant to innovation policy. First, a common "stylised fact" about the difficulty of structural reform is that the costs sometimes tend to be incurred up front and concentrated on a few agents, while the benefits take longer to materialise and are generally more diffuse. This may be the case with innovation policies that contribute to rapid structural change in the economy.

Box 8.4. **An initial checklist for policy reform**

While neither the OECD work nor the political economy literature in general can yield any universal formulas for reform success, the research undertaken to date and summarised in this section suggests that policy makers should bear in mind the following questions when designing both policy reforms and strategies for their adoption and implementation:

- *Do the authorities have a clear mandate for change?* The first finding of the OECD work is that, in particular for all-encompassing reforms, it is important to have an **electoral mandate**. Reform "by stealth", via the quiet adoption of a series of seemingly technical changes, can sometimes yield progress, but it has severe limits.
- *What more can be done to demonstrate the need for change and/or the desirability of the proposed solutions to the public and key stakeholders?* The second finding of the OECD work points to the importance of **effective communication**. Successful reforms have usually been accompanied by consistent co-ordinated efforts to persuade stakeholders of the need for reform and, in particular, to communicate the costs of non-reform.
- *How strong is the evidence and analysis underlying the arguments for reform?* It is important that policy design is **underpinned by solid research and analysis**. An evidence-based and analytically sound case for reform serves both to improve the quality of policy and to enhance prospects for reform adoption.
- *Are institutions in place that can manage the reform effectively, from design to implementation*, or is there a need to create/strengthen such institutions? These challenges are more likely to be met where **appropriate institutions** exist, capable of supporting reform from decision to implementation. Building such institutions can take time, as their effectiveness depends on their reputation, but where they exist, their prior analysis appears to have enhanced the prospects for reform in particular areas.
- *Does the reform have clearly identifiable "owners"*, in terms of both politicians and institutions responsible for taking it forward? Virtually all of the assessments prepared in the context of OECD work point to the **importance of strong leadership** – whether by an individual policy maker or an institution charged with carrying out the reform. However, successful leadership is often about winning consent rather than securing compliance.
- *What is the expected time frame for design, adoption and implementation?* The more successful reforms examined in the OECD analyses generally took **several years to prepare and adopt**, and they often took far longer to implement. This creates challenges for innovation policies that by their nature are focused on the long term, and often go across different governments.
- *What is to be the strategy for engaging those threatened by reform?* Can they be persuaded to support it? To what extent can/should their objections be overridden? Should they be compensated for their anticipated losses – and, if so, how and to what extent? The reform experiences in OECD countries suggest that **it pays in most circumstances to engage those who will be most directly affected by reform**. Secondly, it is important to recognise that concessions to potential losers need not compromise the essentials of the reform: they may indeed be coherent with its overall logic, improving the prospects of particular groups that will be affected by the reform without contradicting its overall aims.

Source: OECD (2010d), *Making Reform Happen: Lessons from OECD Countries*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264086296-en*.

Scientific uncertainty often presents a further challenge, as it implies that the evidence put forward to support the case for reform will often be contested, and those threatened by policy changes will try to generate more "favourable" evidence to introduce into the debate. Consequently, the choice of analytical technique is often highly politicised. In many countries, a widespread attitude of mistrust towards government adds to the difficulty, since official claims about the need for reform are likely to meet a sceptical reception by much of the electorate. The brief discussion on trust in government in Section 8.2 and that on scientific advice in Chapter 5 of this report are relevant in this context, as is the need for evidence and indicators already highlighted in Box 8.4.

Recent policy reforms in OECD countries suggest a number of lessons about how to address these challenges. First, as already noted before, engagement of stakeholders and the public is crucial. Second, while research alone is no "fix" for politics, there is no substitute for a solid, evidence-based case for reform when dealing with stakeholders and voters. Public acceptance of a degree of scientific consensus does matter. Third, path dependence implies that the selection of policy instruments depends to some extent on existing institutions and regulatory regimes. Policy makers need to consider, for example, how easily a given legal system can cope with the introduction of new policy instruments. Efforts to ensure that policy changes are compatible with the broader institutional and regulatory environment are more likely to succeed where governments create institutions or processes that permit a whole-of-government approach to innovation policies. In many cases, these considerations also point to the need to rely on a mix of policy instruments to address multiple market failures.

Strengthening monitoring and evaluation

Another key question is how to incorporate monitoring, evaluation and policy learning in the development of innovation strategies. Effective evaluation is crucial for demonstrating accountability in public spending, establishing the legitimacy and credibility of government intervention in innovation processes, but also to support the processes of learning, prioritisation and improvement of policies over time. However, many OECD countries still put the main emphasis on accountability in their approach to evaluation, which may ignore the dynamic benefits of policy learning over time. Appropriate measurement, monitoring and evaluation are critical for the design and governance of innovation policy, allowing policy makers and analysts to:

- Assess the contribution of innovation to achieving social and economic objectives.
- Understand the determinants of and obstacles to innovation, which is crucial for designing effective innovation policies.
- Establish the impact of – often a portfolio of – policies and programmes, and whether or not policy has contributed to correcting or ameliorating the problem it set out to resolve (e.g. tackling market failures that affect the availability of finance, skills, advice and technologies).
- Evaluate the effectiveness of different policy approaches, thereby enabling government to make informed decisions about the allocation of funds. Evaluation can assist decision makers in assessing the relative effectiveness of policies and programmes and help them to make judgements about where to place their efforts in order to obtain the greatest

benefits for given costs. Thus, it can contribute to improving effectiveness, value for money, and appropriateness of policy and programme interventions *ex post* and justify future interventions.

- Continuously improve the design and administration of programmes. Evaluation is a key tool for learning about how well policies and programmes are delivering, what problems may be emerging, what practices work well and what should be done better in the future.
- Stimulate informed debate. The results of evaluations may encourage public debate that can offer opportunities to a mix of stakeholders – from programme sponsors and managers to beneficiaries – to reflect upon the appropriateness and performance of policies, programmes and institutions.
- Enhance public accountability of relevant policies.

An important consideration in evaluation is to consider the extent to which desirable outcomes would have occurred without public intervention (the "counterfactual"). Two tendencies are common here. The first is the so-called "project fallacy", whereby outcomes that are in reality cumulative and dependent upon the interaction of several factors are wholly (or mostly) attributed to the intervention under evaluation. This is also complicated by the fact that innovation policy instruments sometimes tend to work as a package, and may be difficult to evaluate in isolation. The second is the tendency to underestimate the effects of an intervention because of a narrow evaluation focus or because of the timing of an evaluation. For example, the effects might not yet have occurred or have occurred so long ago that beneficiaries fail to attribute them to the public intervention. Awareness of these tendencies is important, even if the problems they create cannot be fully solved.

Evaluation provides one source of information among many others in shaping policy and programme management processes, and appreciating this is important in informing expectations around its usefulness. In the context of evaluation, it also important to accept and understand that mistakes and errors are inevitable in the process of policy making. Part of the policy challenge is to design governance procedures to detect and correct these errors (Rodrik, 2008). It is for this reason that evaluation has become a central element in innovation policy. Fortunately, there has been a trend in the evaluation community towards greater use of more rigorous techniques that have two related characteristics: the identification of a counterfactual (what would have happened in the absence of the policy) and the inference of causality (rather than simple correlation).

For example, increased use of randomised control trials (RCTs) in countries such as the United Kingdom and the Netherlands, in areas such as R&D support, is motivated by the recognition that rather small differences in policy design can have significant implications for policy effectiveness and efficiency. (See Warwick and Nolan [2014] for a discussion.) And developments in structural econometric techniques, such as the more widespread use of instrumental variable estimation methods, have gone a long way towards increasing the robustness of evaluations of existing policy measures. Some key policy learnings on the evaluation of innovation policies are below.

Box 8.5. **Policy learnings on the evaluation of innovation policies**

The following principles – based on the recent deliberations of an OECD-mediated expert group – reflect good practice in innovation policy evaluation (and are in fact relevant to evaluation in many fields of public policy):

- **Make explicit, at the highest level, the commitment to evaluation of policy.** There should be an explicit commitment to undertake *ex post* evaluation of significant industrial and innovation policies and strategies. Overt recognition of the importance of evaluation for evidence-based policy making, by senior policy makers and agency heads, is vital in securing the necessary human and financial resources for evaluation.
- **Consider mandating evaluations when public funding is provided.** A key reason various programmes in the United States have been thoroughly evaluated – such as the Manufacturing Extension Partnerships programme – is because mandatory evaluation requirements were attached to the use of federal funds.
- **Insist on developing data and evaluation strategies as a prerequisite for the start of programmes.** A clear programme evaluation strategy should be established from the outset, with an *ex ante* evaluation plan that, to the extent possible, articulates the theory of change and shows the main expected channels of impact (from inputs and activities to outputs and outcomes). A strategy should exist to ensure that the data necessary for evaluation are collected from the outset. Governments also have a duty to make more data available so that researchers and other interested parties can also assess policy effectiveness.
- **Choose the evaluation technique in the light of the size and nature of the programme concerned.** Studies of major programmes – especially pilot schemes that could be ramped up later – should use a variety of methods: random assignment, quasi-experimental assessments, interviews with beneficiaries or participatory approaches involving stakeholders. There should be a move to more use of randomised experiments as the basis of *ex post* impact assessment.
- **At the level of innovation and industrial strategies, a mix of evaluation methods is likely to be needed.** State-of-the-art econometric methods have a role in assessing components of a strategy, but are less likely to be useful for the policy portfolio as a whole. Tracking of macro- or meso-level indicators, international benchmarking, subjective assessments via survey methods, narrative reporting, case studies and other techniques all have a role to play.
- **Insist on full disclosure in evaluation reports.** There should be a commitment to public diffusion of evaluation findings of publicly funded programmes. The choice of methods and evaluation parameters used, methodological drawbacks and areas of subjective judgement should be described in full. There should be a commitment to transparency and early publication of evaluation findings and the data on which they are based. Published evaluation findings should be accompanied by metadata that facilitate online searches.
- **Robust governance mechanisms are needed to ensure evaluation is objective.** Programmes should be evaluated by, or in collaboration with, genuinely independent experts, possibly from an audit office. Ideally, the body that implements the evaluation would work with programme managers but would not be dependent on continued contracts from the sponsor of the programme.
- **Good mechanisms for policy learning are needed to ensure that the findings of evaluation feed back into policy making.** This may require measures to increase awareness of the use of evaluation – and evidence-based decision making more generally - for policy making, and could also require measures to make evaluations mandatory for certain policy measures. Having an explicit commitment to evaluation at the highest level is particularly important.

Source: Warwick and Nolan (2014), "Evaluation of industrial policy", *http://dx.doi.org/10.1787/5jz181jh0j5k-en*.

The use of policy experimentation

The use of randomised control trials is also enabling a greater experimentation with policies (OECD/The World Bank, 2014), where governments can experiment at a small scale with specific policy initiatives, and roll them out at a larger scale when evaluations show the programme is effective in meeting its objectives. Experimental approaches partly respond to the growing understanding that innovation policies characterised by top-down government interventions are not the right approach. The reasons for the failures of such policies are well known, and include the risks of capture by vested interests, lack of information on the economy and strong information asymmetry with private actors, often combined with a lack of capability in the public sector for effective policy making and implementation.

Another, more appropriate approach to innovation (and industrial) policy involves search, experimentation, monitoring, learning and adaptation, all of which need to occur in a context of international openness to knowledge, trade, investment and competition. This new approach also rests on close co-operation with private and non-governmental actors, who are often better placed than governments to help identify barriers to innovation, and point to areas for productive investment or policy action.

This new approach also rests on a much stronger focus on (diagnostic) monitoring and evaluation, which need to be embodied in programmes and policies from the outset. This is particularly important for new and emerging areas of policy, where there is significant experimentation under way and where the scope for learning and identification of good practices is the largest. Such learning should benefit from early and periodic sharing of lessons from policy experimentation at the global level, which will require strengthened mechanisms to identify and diffuse good practices, including through specific knowledge platforms and networks.

The work on experimentation also raises questions on how policy makers – and private actors – learn from experience and mistakes that are made, how to encourage more entrepreneurial experimentation and appropriate risk-taking not only by enterprises but in policy making, how not only success but failure can be openly discussed and built upon, and how such learning can be organised, embedded and institutionalised in the policy-making process. It also points to a need to better understand systems and their behaviour, and how policy can influence the behaviour of (increasingly) complex systems to achieve more sustainable growth and shared prosperity. Some other relevant recommendations from the OECD-World Bank work on experimentation are the following (OECD/The World Bank, 2014):

- Policy makers should incorporate monitoring and evaluation plans at the policy design stage to improve the quality and efficiency of public expenditures supporting innovation policy.
- Governments can sometimes also achieve better results in the innovation area by involving agencies and actors on the periphery of policy making, which can limit capture by vested interests and may enable more creative and co-operative policies than those emerging from more central agencies. Such agencies may also be able to achieve more with less.

Improving measurement

Improving measures of innovation is essential for policy making and evaluation and for promoting innovation in businesses, the public sector and society at large. However, while progress is being made, current innovation indicators remain too focused on the inputs of the innovation process rather than on its outcomes, and aggregate numbers or indices do not adequately reflect the diversity of innovation actors and processes and the links among them. Continued efforts are needed to take this work forward and to adapt

the measurement agenda to experience at the national and international level. A number of policy issues – in particular, the role of broader (beyond R&D) innovation, the growing importance of the public sector in innovation and better assessment of the economic impact of innovation to name but a few – require improved measurement. However, there is no point of having a first-class data infrastructure if it is not available to the users in a standardised and accessible fashion. And to improve policy evaluation, greater attention should be paid to the quantification of policy variables and the characteristics of their design and implementation. Priorities include:

1. **Improving the measurement of broader innovation and its link to macroeconomic performance.** This includes further work to:
   - advance the measurement of knowledge-based capital and ICT investment and its inclusion in productivity statistics
   - redesign STI surveys to take a broader view of innovation
   - invest in a high-quality and comprehensive data infrastructure to measure the determinants and impacts of innovation by linking different data sets and exploiting the potential of administrative records.
2. **Recognising the role of innovation in the public sector and promoting its measurement.** As already discussed in Section 4.5, there is need to account for the use of public funds, measure the efficiency of producing and delivering public policies and services, and improve learning outcomes and the quality of the provision of public services via innovation.
3. **Promoting the design of new statistical methods and interdisciplinary approaches to data collection.** Design of policies for innovation needs to take into account the characteristics of technologies, people and locations, as well as linkages and flows among them. New methods of analysis that are interdisciplinary in nature are necessary to understand innovative behaviour, its determinants and its impacts at the level of the individual, firm and organisation. Better use of new data sources, notably the Internet, would also help.
4. **Promoting the measurement of innovation for social goals and of social impacts of innovation.** The current measurement framework fails to measure the social impacts of innovation. The development of measures that provide an assessment of the impact of innovations on well-being, or their contributions to achieving social goals, needs to be promoted. This includes better measurement of the people dimension of innovation, including skills needs in the digital economy. It also involves measurement of important policy dimensions, e.g. security, privacy and consumer protection in relation to the digital economy.
5. **Integrating and standardising data on STI.** Significant efforts to increase the availability and accessibility of STI data are taking place across the OECD and beyond, also encouraged by the latest advances in Internet technology, big data and the drive for transparency. However, these are often disparate and unconnected developments, and access to these data is limited by a patchwork of laws, regulations and practices that are unevenly applied and interpreted. Initiatives to develop these critical infrastructures, and improve access to them while ensuring data confidentiality, should be supported and co-ordinated in order to avoid wasteful duplication of efforts, and attention should be paid to the design and regulation of emerging networking platforms, interoperability and related standards.
6. **Incorporating policy monitoring and evaluation at the design stage of policy making.** In order to strengthen policy design and enable policy learning over time, metrics also need to be designed *ex ante* and generated by policy implementation and experimentation on a smaller scale. Data also need to be generated on the design and characteristics of the

policies themselves. The breadth and complexity of the science and innovation policy framework has not been conducive so far to a systematic categorisation of its different attributes across countries, resulting in a high degree of reliance on qualitative views or on established public R&D funding indicators. Financial support, public demand, tax, regulatory and many other government measures can in principle be documented and codified in a systematic fashion.

The 2016 Blue Sky conference, to be held in Belgium, will help advance the agenda in these and other areas, with the aim to strengthen the evidence base for policy making.

Notes

1. At the same time, policy makers can learn from having a variety of approaches to innovation; alignment should therefore not be confused with harmonisation.
2. Per OECD, 14 countries out of 15 reporting countries in 2010 to the OECD (2009a), *OECD-GOV Survey on the Multi-level Governance of Science, Technology and Innovation Policy*.
3. This challenge is described in, among others, OECD (2012a), *OECD Reviews of Regional Innovation: Central and Southern Denmark*, and OECD (2009b), *OECD Reviews of Regional Innovation: 15 Mexican States*.
4. OECD has facilitated the establishment of several such distributed infrastructures, most recently in relation to Scientific Collections (SciColl, 2013), and the lessons learned, including different governance options, have been analysed (OECD, 2014e).
5. *www.theguardian.com/commentisfree/2014/jul/21/five-biggest-threats-human-existence*
6. This section draws on OECD (2010d) and briefly summarises some main lessons learned, applying them to the context of innovation policy reforms.

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