THEMATIC NOTE 2

Governance of Innovation Systems

Christopher Palmberg, ADVANSIS Ltd.
Tarmo Lemola, ADVANSIS Ltd.

SYNOPSIS

Investments in developing an NIS should give governance particular attention, especially the systems and practices for setting priorities and agendas, designing and implementing policies, and obtaining knowledge about their impacts. This note provides examples of the roles that innovation policy and its governance have played in the development of innovation systems in Finland, Republic of Korea, and South Africa. Based on these cases, the note identifies governance activities relevant to innovation systems for agriculture in developing countries and discusses the related policy issues, lessons, and recommendations emerging from the case studies. A key issue arising from the cases is that well-functioning innovation systems critically depend on how well governments can bring together and coordinate the activities of the various actors and stakeholders fundamental for advancing science, technology, and innovation in various sectors of the economy.

BACKGROUND AND CONTEXT

Governance concerns the mechanisms by which decisions are made in an organization, whether public, private, or nonprofit. Governance has several dimensions, including power, culture, incentives, leadership, and coordination. In governance of an NIS, the systems and practices for setting priorities and agendas, designing and implementing policies, and obtaining knowledge about their impacts receive special attention (see OECD 2005). A number of factors impinge on the efficiency of the governance of an NIS—in other words, the extent to which policy processes have the greatest effect with a given use of resources (OECD 2010). Evidence indicates that efficient governance depends on certain qualities, including:

- ***Legitimacy.*** The policy actors and approaches adopted in policy processes have to be widely appropriate and accepted for the tasks at hand.
- ***Coherence.*** The different strands of innovation policy and associated policy instruments must fit together.
- ***Stability.*** Innovation requires sufficiently stable framework conditions, institutions, and policy.
- ***Ability to adapt.*** As the environment for innovation evolves, and innovation evolves along with it, governance actors need to be able to adapt.
- ***Ability to steer and give direction.*** A related capability is the governance system's ability to provide direction to actors and steer the innovation system as a whole. The ability to provide direction requires commitment and leadership from policy makers at the highest level.

Governance of innovative activity is not provided by government alone. The research and business sectors as well as other stakeholders such as NGOs play important roles in many aspects of the governance of an NIS. For example, a society's accumulated social capital can make an important contribution to innovation by increasing trust among the actors, which makes joint innovation efforts as well as communication and sharing of knowledge between the actors easy and successful.

Innovation system governance at the sectoral level is an important part of overall innovation system governance. In the agricultural sector, the earliest attempts at coordinating AIS were centered on strengthening agricultural research coordination. A number of developing countries have established research governance bodies, but they tend to represent only a narrow range of AIS stakeholders, consisting primarily of ministerial representatives or researchers. They have often lacked a consistent, rigorous process for setting priorities. The current movement to improve the representativeness of these governance bodies and their mode of operation is encouraging, however (for example, seeking to represent a wider range of stakeholders and regions, improving transparency, and using diverse prioritization tools). The overall trend is toward strengthened research

governance and multidisciplinary NIS governance (as discussed in this note), wherein agriculture is one sector among many. Some countries have made specific efforts in AIS governance, however. Typically these efforts center on subsectoral governance and coordination—for instance, through commodity boards and subsector networks—rather than on national agriculture/rural innovation governance structures (like Chile's FIA and Australia's Rural Research and Development Council). Module 1 discusses innovation coordination in agriculture in greater detail and provides examples of AIS coordination and governance at the macro, meso, and micro levels.

Although this TN discusses NIS governance, benefits, policy issues, and lessons primarily from developed countries, it can help identify relevant issues and lessons for developing countries and their AISs. Finland, Korea, and South Africa have been chosen as examples because, in different ways, they represent NISs in which government actors and agencies play an important role. They also represent NISs at different phases of development to illustrate governance challenges from different viewpoints. A separate note in this module discusses overall innovation policy issues.

Finland

Finland began to apply the NIS concept before many other countries, and its NIS has a relatively streamlined governance structure, developed in the mid-1980s and early 1990s. The Finnish Funding Agency for Technology and Innovation (Tekes, teknologian ja innovaatioiden kehittämiskeskus), was established in 1983, and R&D programs soon followed. A key characteristic of the Finnish system is that high-level government officials (prime minister, finance minister) as well as representatives from universities, public research organizations, and industry participate in the Research and Innovation Council, which develops national guidelines for innovation. Operational responsibility for policies is delegated to the Ministry of Education and Culture (for basic research), the Ministry of Employment and the Economy (for applied research and the enabling environment for innovation), and other ministries.

A second important characteristic of the Finnish NIS is that the main funding agencies (Academy of Finland for basic research and Tekes for applied research) enjoy considerable autonomy in implementing programs, introducing new policy instruments, and managing these programs and instruments on a day-to-day basis. A third characteristic is the strong tradition of collaboration and coordination throughout the NIS, both across the main ministries and agencies involved as well as down through the various decision-making levels. There is a strong element of consensus building among the main stakeholders in the design and implementation of policies. Companies and the research community are often involved in policy discussions as experts or through their branch organizations. Innovation policy also explicitly aims to support collaboration and networking between industry, universities, and public research agencies. For example, the R&D programs commissioned by Tekes require collaboration by industry, universities, or public research agencies.

Republic of Korea

Korea's government has taken an active approach to NIS governance, especially since the mid-2000s. As in Finland, in Korea the NIS involves high-level government officials (ministers and other key stakeholders) in designing STI policy through the Presidential Advisory Council for Education, Science, and Technology (with representatives from industry, academia, and research) and the National Science and Technology Council (formed by government ministers). The role of ministries in implementing policy down to the level of individual R&D programs and projects is noteworthy, especially within the Ministry of Education, Science, and Technology (MEST).[1]

Unlike Finland, in Korea the NIS has a complex governance structure. Government science and technology policies have long roots, and the government's overall role has been pronounced. A key challenge for Korea is to govern its rapidly growing portfolio of policy measures (OECD 2009b), and Korea is responding with efforts to improve the coherence of its policies through horizontal coordination (between advisory councils and ministries) and vertical coordination (between ministries and the government research institutes).

A third characteristic of the Korean system is the duality in corporate structures. Large conglomerates or multinationals (*chaebols*, literally "business families") dominate research, development, and industrial transformation, whereas SMEs remain relatively underdeveloped. In this sense, Korea is still a mixture of an advanced and developing country. This duality has crowded out entrepreneurship and may have hampered technology diffusion and knowledge spillovers throughout the system. Especially compared to Finland, collaboration and networking in Korea between companies, universities, and research institutes is less pronounced, though collaboration within chaebols is extensive. A central challenge for the Korean NIS is to encourage more collaboration and

networking, both nationally and internationally (OECD and World Bank Institute 2000; OECD 2009b).

South Africa

In the mid-2000s, South Africa became one of the first developing countries to adopt an NIS approach. South Africa is emerging as a global player in STI in certain fields but faces a range of challenges in developing its NIS amid difficult socioeconomic conditions and weak government coordination. Responsibilities for science and technology have been fragmented among numerous ministries, departments, and agencies. Private R&D has been concentrated in a few large, diversified companies with established links to government departments, research organizations, and universities. The innovation system has been virtually disconnected from black communities (Hausman and Klinger 2006; Lingela 2004).

Since 2000, science and technology have been under the purview of the Department of Science and Technology (DST). The Parliamentary Portfolio Committee for Science and Technology oversees DST; the National Advisory Council on Innovation and a large group of stakeholders at the National Science and Technology Forum provides advisory support. Other key STI ministries include the Department of Education, Department of Trade and Industry, and sectoral departments such as minerals and energy, agriculture, water, and forestry. These departments steer their activities through sectoral agencies, foundations, and other funding organizations (OECD 2007b).

South Africa has made remarkable progress in a short period, as evidenced by STI indicators such as a more diversified industrial structure and increasing GDP per capita. Nonetheless, huge social inequalities remain. The limited involvement of the "second economy" of black communities in entrepreneurship and innovation remains a primary characteristic and challenge for the NIS. One source of this problem may be the continued, poor horizontal coordination across the main ministries, agencies, and funders of R&D (OECD 2007b). This lack of overall government coordination is a second characteristic of the South African innovation system.

Limited technology transfer and networking between academia and industry is a third characteristic of the NIS, caused in part by the lack of mental models for how an innovation system functions beyond the public sector. The enabling environment for entrepreneurship is also underdeveloped, as reflected by the limited collaboration between large and small companies, the poor availability of venture capital funding, and an outdated IPR regime.

In 2009, the government established the Technology Innovation Agency (TIA) to improve coordination of innovation funding (Nordling 2009). The new agency is responsible for administering a handful of existing innovation schemes: the Biotechnology Regional Innovation Centers, the Innovation Fund, the National Advanced Manufacturing Technology Strategy, and the Tshumisano Trust.

ACTIVITIES AND CAPABILITIES NEEDED

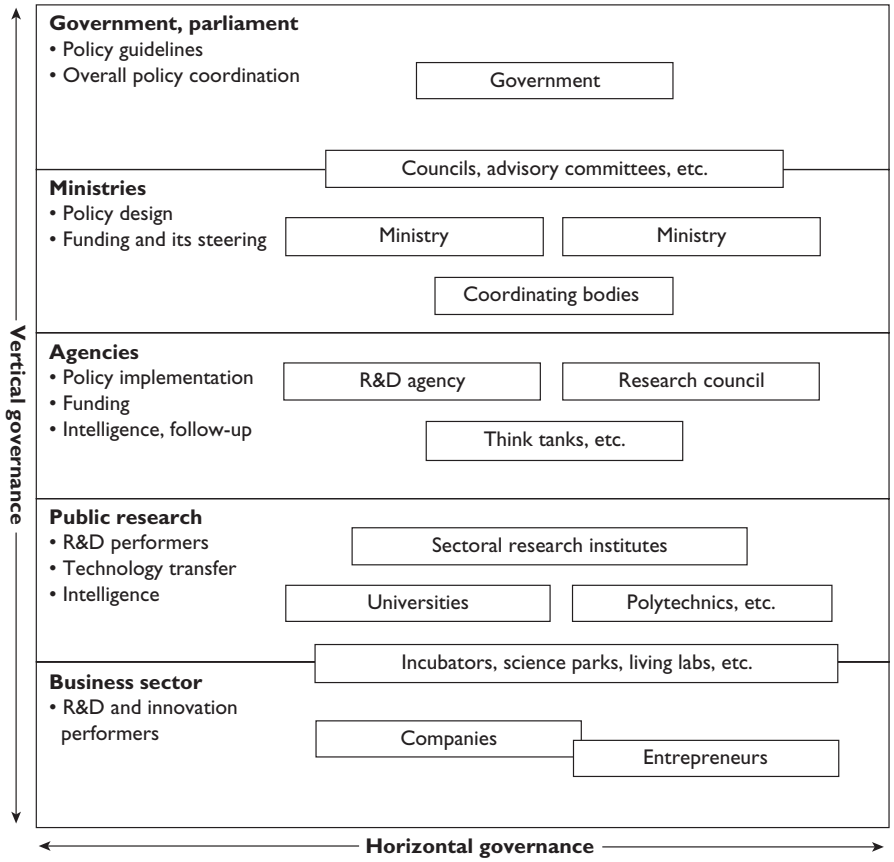
Good governance is manifested in the degree to which capabilities in the following areas can be developed and supported: perception of and responses to challenges, setting policy priorities and coordinating agendas, implementing and managing policies on a day-to-day basis, and obtaining and processing intelligence.[2] These capabilities are associated with different levels of governance in an innovation system and depend on how interactions and coordination are governed (vertically and horizontally) throughout the system (Nelson 2003; OECD 2007b, 2008, 2009a, 2009b, 2009c). Figure 6.2 depicts typical decision-making levels, key public (or semipublic) organizations, and avenues through which an innovation system can be governed to develop and sustain these capabilities. The figure highlights the key governance capabilities within the institutional and organizational framework of an NIS.

Strengthening policy makers' capacity to perceive and respond to challenges

The ability to perceive and respond to challenges is important for an NIS to be agile and proactive. In other words, these capabilities are vital for developing innovation policy guidelines. These capabilities are *embedded in the NIS as a whole, at all levels of governance,* although councils, advisory committees (consisting of diverse stakeholders), and similar groups subordinate to the government or parliament often play an important role in responding to these challenges by creating a common vision, or consensus, of how to address them.

Finland, Korea, and South Africa illustrate different ways in which the ability to perceive, and respond to challenges plays out in practice. While the Finnish capabilities to perceive challenges are embedded in the NIS in a decentralized way (box 6.9), the Korean innovation system has tended to respond to challenges through a more top-down approach (box 6.10). South Africa's response to the challenge of developing policies to reconfigure the NIS in the years immediately following apartheid can be described as a decentralized as well as top-down NIS (box 6.11). In this case, there was considerable concern about the poor socioeconomic context

Figure 6.2 Typical Governance Structure of a National Innovation System



Source: Adapted from OECD 2005.

Box 6.9 Finland Responds to the Challenges of Globalization

The ability of Finland's innovation system to perceive and respond to challenges is best seen in the way that innovation policy reacted to globalization. The impact of globalization was felt most acutely in the business sector, as R&D increasingly moved to foreign locations and price competition became tight, especially in traditional industries. The emergence of countries such as China and India as increasingly competitive locations for manufacturing, research, and development raised concern among labor unions and other national innovation system stakeholders. Public research organizations felt building pressure to compete globally for the best students and become more engaged internationally. In 2004, the government launched a project to assess how globalization would affect various sectors and their employment prospects in Finland and to develop corresponding policies to respond to those challenges by altering the business environment. The final report was based on numerous background studies commissioned from national think tanks and experts, over 20 sectoral dialogues between employers and employee unions, and the work of the high-level steering group appointed by the project. The project was intended to feed into the ongoing, decentralized process to formulate a globalization strategy for Finland which subsequently influenced various areas of policies, such as taxation, R&D programs, and internationalization schemes to support companies.

Source: Prime Minister's Office, http://www.vnk.fi/julkaisukansio/2004/j19-26-osaava-avautuva-uudistuva-suomi/pdf/en.pdf.

Box 6.10 Korea Responds to the Asian Crisis of the Late 1990s

The Korean experience following the Asian financial crisis highlights the importance of capabilities to perceive and act on challenges to innovation at the national level. The crisis caused significant downsizing among large companies, mass layoffs of highly skilled personnel, and large reductions in spending on R&D. Aside from increasing its expenditures on education, the Korean government responded by increasing its R&D budget, to offset the decline in corporate spending. It also used the crisis as an opportunity to develop technology-based small and medium enterprises (SMEs), using the Special Law to Promote Venture Firms enacted in 1998. A coordinated mix of policy measures was put in place: regulations to improve the environment for venture startups and their growth; government-backed venture funds and tax incentives for investors; and measures to support research. Among other things, these measures fuelled rapid expansion in the number of corporate R&D labs, with SMEs accounting for much of this increase. This success cannot be explained by policy intervention alone, as it was aided by rapid innovations in digital and other technologies, but government action shaped an environment that enabled new businesses to seize emerging opportunities.

Source: OECD 2009b.

Box 6.11 A White Paper and Foresight Exercises Facilitate Changes in South Africa's Innovation Policy

In 1996, a White Paper on Science and Technology laid down the new, post-apartheid government's priorities in science, technology, and innovation. Foresight exercises followed at the end of the 1990s and acknowledged South Africa's many socioeconomic challenges. These combined efforts clarified the challenges to government officials, highlighted weaknesses of the emerging national innovation system, and suggested actions to address these challenges and weaknesses. Human resource issues related to poverty, education, and absorptive capability were singled out as a key constraint on technological developments and innovation. The preparatory work on the White Paper resulted in a national R&D strategy, endorsed by the government in 2002. It propelled an innovation system approach to the forefront in policy design and highlighted the importance of moving toward an innovation policy with a broad mandate to meet socioeconomic needs through science and technology as well as innovation.

Source: OECD 2007b.

(poverty, segregation, one-sided industrial and company structure) and the narrow science and technology focus of the apartheid regime. These challenges prompted the South African government to adopt a broader and more holistic innovation system approach to policy that could better direct activities toward common socioeconomic goals.

Establishing and/or strengthening capacity in coordination bodies to set policy priorities and coordinate agendas

Capabilities to set policy priorities and coordinate agendas are important to economize on scarce resources (especially in developing countries) and to align policies with existing structures and framework conditions. These capabilities are usually *embedded in ministries (or department equivalents*), which typically also design policies and steer funding to sectoral agencies or directly to public research organizations. This level of governance is often vertically linked to the government through various councils and advisory committees.

Ministries also frequently establish *dedicated coordination bodies* to ensure better coordination between ministerial and other agendas, especially in broad technology areas such as nano-, bio-, or environmental technologies. These areas require the involvement of many stakeholders and consultation processes to elicit their views. These coordinating

bodies facilitate more horizontal, "'whole-of-government" approaches and policy mixes to respond to an innovation policy agenda that is widening because of globalization, new technologies, and new forms of innovation (open innovation, nontechnical innovation, user-driven innovation, and others) (see discussions in OECD 2005 and EC 2009).

The fact that a high-level policy council plays a central role in research, development, and innovation policy does not mean that the resulting policy favors centralization. For example, the Finnish Research and Innovation Council, chaired by the Prime Minister, does not allocate resources for research, development, and innovation. The Council is very much an advisory body responsible for the strategic development and coordination of Finnish science and technology policy as well as the NIS as a whole. The implementation of policy (including the allocation of resources) is delegated to various ministries, public funding agencies, and ultimately companies, universities, and public research institutes.

In all three countries, certain organizations play a critical role in addressing challenges proactively by setting priorities and coordinating agendas for action. They are described in box 6.12.

Strengthening the capacity to implement and manage policies on a day-to-day basis

Policy design, prioritization, and agenda setting alone will not respond to socioeconomic needs and deliver innovation and growth; policies must be implemented. Implementa-

Box 6.12 Organizations Involved in Prioritizing and Coordinating Policy in Finland, Korea, and South Africa

Research and Innovation Council, Finland. The strategic development and coordination of science, technology, and innovation (STI) policies in Finland are the responsibility of the Science and Technology Policy Council, an advisory body to the government. The composition of this council is distinctive in some respects and underlines its capacity to perceive challenges, draw overall policy guidelines, and facilitate coherence, consensus-building, and coordination throughout the system. It involves a wider range of sectors than similar councils. The chairmanship is held by the Prime Minister, emphasizing its top-level status, and involves key ministers (for employment and the economy, education, and finance, for example). The council also includes representatives from academia, industry, and labor organizations. It dates to 1963, and its mandate for technology was added in 1986.

Ministry of Science and Technology and National Science and Technology Council, Korea. The Ministry of Science and Technology (MoST), which became the Ministry of Education, Science, and Technology (MEST) in 2008, was established in 1967. Its importance grew along with Korea's increasing emphasis on research, development, and innovation in the 1980s and 1990s and the broadening of the innovation policy agenda in the 2000s. It commanded a large budget and had a broad mandate for policy design, coordination, and evaluation of science and technology in Korea, as well as the formulation of programs and projects. It also promoted public awareness of science and technology.

In the 1980s and 1990s, a range of ministries launched R&D programs, sparking demand for better coordination. The National Science and Technology Council (NSTC), established in 1999 and chaired by the president, has since been Korea's highest decision-making body on STI. As a cross-ministerial body, NSTC has a central role in working across ministries to coordinate the expanding policy priorities and agendas. Its strong links to MEST are underlined by the fact that MEST provides the NSTC with a secretariat. The NSTC's horizontal scope at the sectoral level is strengthened through five subordinate expert committees on key industrial technologies, large-scale technologies, state-led technologies, cutting-edge converging and interdisciplinary technologies, and infrastructure technologies.

Department of Science and Technology, South Africa. The case of South Africa's Department of Science and Technology (DST) is interesting because this department gained responsibility over STI just as South Africa's policy makers endorsed an innovation system approach. The shift toward innovation occurred in response to the enormous socioeconomic challenges of post-apartheid South Africa. Subsequently DST has played an important role in setting priorities and agendas based on white papers and forecast exercises.

Source: Lemola 2002; Dahlman et al. 2006; OECD 2007b, 2009b.

tion is an essential element of good NIS governance, but it has often failed owing to competing rationales between ministries, lack of political will and funding, changing external developments (an economic crisis) or other complications (for example, see OECD 2005).

Policy implementation and the management of R&D funding and other schemes are *often delegated to the level of agencies*, for example to R&D agencies (such as Tekes in Finland or TIA in South Africa) and research councils (the Academy of Finland or the Research Council for Fundamental Science and Technology in Korea). Delegation of these responsibilities implies a need either to strengthen the capacities of these agencies or to establish a new agency. It also highlights the need for ministries to strengthen their steering capacity. Delegation of managerial authority is usually accompanied by stronger requirements to report outputs and outcomes and thus increase accountability at lower levels.

The day-to-day management capabilities of NISs are reflected in the routines and procedures that (for example) ministries and agencies use to interact with companies, researchers, and other target groups of R&D programs and policy schemes. These agencies also collect intelligence on technological and market trends to support decision making, as discussed later. Key issues are to avoid unnecessary bureaucracy and red tape, strike a good balance between transparency and secrecy in R&D projects, and ensure policy continuity amid political change and external events.

Aside from vertical coordination of innovation policy, more attention should be paid to horizontal coordination. Horizontal coordination occurs across the boundaries of distinct policy domains and sectors. The development of a horizontal innovation policy involves placing a broader strategic approach above departmental goals by integrating priorities and objectives across various policy sectors. Horizontal governance of innovation policy requires the integration of innovation-oriented thinking into other policy domains and greater attention to interfaces with policy sectors that use and apply science and technology.

The Finnish innovation system offers a good example of the role that agencies such as Tekes can play in implementing policy (box 6.13). In this case, the relatively clear separation between responsibilities for designing innovation policy (occurring at the governmental and ministerial level) and implementing it (occurring at the agency level) has been important for a flexible and proactive innovation policy and for avoiding political deadlocks that block implementation. Overall, this division of labor and the strong vertical and horizontal connections existing throughout the Finnish innovation system have been important preconditions for the relatively short time that elapses between policy design and implementation, which in turn strengthens Finland's capacity to respond quickly to emerging challenges. These preconditions may have been easier to meet in

Box 6.13 Tekes as an Implementer of Innovation Policies in Finland

Tekes, founded in 1983, is based in the Ministry of Employment and the Economy. It has relative autonomy to set priorities and agendas in specific technology areas, following guidelines developed at higher levels (the Science and Technology Policy Council and ministries). Tekes' role eventually expanded to include channeling the bulk of public funds for R&D to industry and public research agencies, with the exception of basic research agencies. Its major funding instruments include R&D grants and loans for companies and applied research grants for public agencies. Research grants are typically allocated via technology programs planned and implemented with companies and research institutes. Although the themes of programs are planned with companies, public research organizations, and other agencies, the funding is competitive, and companies must contribute complementary funds (usually around 50 percent). The idea is to stimulate collaboration between program partners and maximize benefits from knowledge spillovers. Each program has a coordinator, a steering group, and a manager from Tekes. Funding for programs ranges from €20–150 million, generally over three to five years. Hundreds of programs have been initiated since 1983; 29 operated in 2009. These programs have played an important role in promoting entrepreneurship, introducing new areas of technology, and renewing industries.

Source: Ylä-Anttila and Palmberg 2007; Tekes (www.tekes.fi).
Note: Tekes = Finnish Funding Agency for Technology and Innovation.

Finland than elsewhere because of its small size and the high level of trust between the main actors in the system.

Establish/strengthen capacities to obtain and analyze intelligence

A well-functioning NIS must have the capabilities and related governance structures to obtain and analyze intelligence on the impacts of innovation policy as well as future technological and market trends. These capabilities relate to technology and innovation studies, development of STI indicators, evaluations of R&D programs, and other types of policy instruments and interventions, as well as technology foresight and assessment. These capabilities are often spread out in the NIS; for example, ministries and agencies typically have their own *research and analysis units* (box 6.14). For the sake of objectivity in impact assessment, however, the most viable arrangement is for independent expert organizations (think tanks, consultancies, public research organizations, universities, and so forth) to gather and analyze intelligence. In the case of public research organizations, the problem may be that many research groups receive R&D funding and may have vested interests. Transparency and objectivity should be the key criteria in impact assessment.

Capabilities to obtain and analyze intelligence are also often built in collaboration with transnational think tanks such as the World Bank and OECD. Both organizations develop STI indicators and impact assessment methodologies and standards; they also undertake assessments and evaluations of innovation systems.

Evaluations of the inputs, activities, outputs, and impacts of research, development, and innovation are essential to enhance the effectiveness, efficiency, appropriateness, and accountability of policies to foster innovation and improve social welfare (see module 7). For this reason, they are integral to improved innovation intelligence. Aside from improving accountability, the main strength of evaluation may reside in its capacity to provide insight, learning, and understanding.

Evaluation usually includes priority setting, an ex ante impact appraisal, monitoring of progress (interim evaluation), and an ex post evaluation of results and impacts. These cumulative assessments aim to measure performance, support target or performance-based management and

Box 6.14 Strategic Intelligence Capabilities and Activities in Finland, Korea, and South Africa

Finland. *Tekes* monitors results and assesses the impacts of projects it funds. For monitoring, Tekes collects project effectiveness information at the beginning and end of each project and three years after its conclusion. An impact assessment is done to gain feedback on how the project attained its objectives, how effective the project was, and what could be learned from the project to improve Tekes' future operations and strategies. Tekes also follows international comparisons and reports, such as comparisons commissioned by the Organisation for Economic Co-operation and Development, European Union, and others, and conducts peer reviews of innovation activities in various countries.

Korea. The *Korean Institute of Science and Technology Evaluation and Planning (KISTEP)* is the nation's main STI planning agency and supports the Ministry of Education, Science, and Technology's policy planning and coordination. Its specific functions are to formulate, coordinate, and support major science and technology policies by, for example, forecasting science and technology development trends; analyzing and evaluating science and technology programs by all ministries; conducting research into domestic and overseas research planning, evaluation, and management systems; and disseminating R&D policy information and data.

South Africa. South Africa has also been developing its capacity to undertake policy assessments and analysis. These capabilities have been developed within the main ministries, agencies, and advisory bodies. Of particular importance is the *Centre for Science and Technology and Innovation Indicators (CeSTII),* which is responsible for national R&D and innovation surveys based on a memorandum of understanding between the Department of Science and Technology and Statistics South Africa in 2004. Several universities also host research groups with a focus on technology and innovation studies.

Source: OECD 2007b, 2009b; Tekes, www.tekes.fi.
Note: Tekes = Finnish Funding Agency for Technology and Innovation.

budgeting, enhance accountability and transparency, and improve communication of outcomes to policy and decision makers and sponsors.

In Finland, the evaluation of research, development, and innovation comprises meta-evaluation and system reviews (Ministry of Employment and the Economy 2010), evaluations of scientific and technological fields and programs, and evaluation of universities, research institutes, and other R&D institutions. Using information from evaluations to inform policy has remained a challenge in Finland, however, despite the numerous evaluations undertaken in the past ten to fifteen years.

POTENTIAL BENEFITS

The benefits of an innovation system approach and good governance of an NIS should ultimately be visible at the macroeconomic level through increasing innovation and economic growth. As noted, OECD and others have developed a range of innovation input and output indicators, although the relative role of some factors, such as governance, is virtually impossible to assess through indicators.

The most relevant indicators for measuring the benefits of an innovation system approach capture knowledge flows and collaboration or knowledge distribution throughout the system (under the assumption that they generate innovation and growth). Some of these indicators are available—for example, information on the mobility of researchers and personnel, innovation surveys on R&D collaboration, data on interfirm collaboration, rates of technology diffusion—but it is beyond the scope of this note to apply them to the case study countries.[3] Instead, the experiences of Finland, Korea, and South Africa will be used to highlight some of the more subtle and intangible benefits of an innovation system approach in general.

As emphasized throughout this note, an innovation system approach can *focus the policy debate*—create consensus and a common vision—on issues of key importance for sustaining innovation and growth, especially in response to emerging challenges and in times of crisis. Examples described here include globalization (Finland), economic crises (Finland, Korea), and poverty and segregation (South Africa).

An innovation system approach to policy thinking and analysis can *highlight latent potential for knowledge flows and collaboration* across the various fields of science, technology, and industry and achieve "new combinations" as a source of innovation. To do so, countries will require good capabilities in obtaining and processing intelligence on the structure and development of different sectors of the economy (as in Finland and Korea).

Similarly, well-governed innovation systems can *bring previously disconnected actors together* and create new nodes and platforms for innovation. Finland and Korea have implemented explicit coordination schemes and policy programs to achieve this goal, such as the Tekes programs. Policy in South Africa has focused on integrating the "second economy" with activities at the traditional core of the innovation system.

The success of an innovation system depends considerably on the extent to which it engages private companies in research, development, and innovation. The *innovation system concept can extend the policy mix from supply-sided schemes* (such as R&D funding) *toward a large array of more demand-oriented schemes* (such as standardization, public procurement, and regulations). (For examples from the three countries discussed here, see Dahlman, Routti, Ylä-Anttila 2006 and OECD 2007b, 2009b). Nonetheless, an important consideration for governance of the innovation system is that a delicate balance must be struck between relying on market forces and more interventionist policies, such as regulations.

Finally, although an NIS generally focuses on developing national innovation capacity, it does not lose sight of the value that the innovation system approach places on knowledge flows and collaboration, including internationally generated knowledge flows and collaboration. *Knowledge flows and collaboration extend beyond national borders, and an innovation system approach can help to identify opportunities and bottlenecks of critical importance* (see Edquist 1997 for a review of innovation system approaches that emphasize the international dimension).

LESSONS LEARNED

The following lessons related to innovation system governance are relevant to developing and sustaining governance in an AIS.

A step-by-step process, building on existing structures and contexts

The development of an innovation system approach to innovation policy may *take significant time* (decades rather than years) *and should be pursued systematically and iteratively* so that emerging challenges and feedback from the research community and private sector can be addressed in a flexible way. Core governance structures for innovation

systems often are based on existing policy structures such as ministries, but they also typically involve the establishment of dedicated ministerial departments, councils, agencies, think tanks, and other entities.

Most developing countries have little room to maneuver in research, development, and innovation. Consequently their only strategic choice is to stick to incremental innovations—for example, to improve existing products, services, and processes. All countries will need monitoring and governance arrangements that allow sufficient adaptability to reverse unwise decisions quickly. Countries with relatively small research systems, such as small countries or economies in the initial phases of development or recovery, have a particular need to concentrate their efforts. Many countries have established various prioritization practices in recent years. Korea, for example, uses a mix of instruments for priority setting, including technology foresight and technology road-mapping. These processes are distributed across ministries and agencies and create a diversity of competing priorities and visions (which ideally are reconciled in the national innovation policy). For an example from Thailand of a national innovation council, see the overview in module 1.

An innovation system approach *should acknowledge existing industrial structures* (ICT and Nokia in Finland), company distributions (Korea's chaebols), *and the overall socioeconomic framework* (the lack of involvement of South Africa's "second economy"). Properly applied, the innovation system approach will facilitate collaboration and knowledge flows across actors and stakeholders whose efforts to innovate were previously separate or who were excluded from innovation altogether.

Strong, visible commitment at the highest level

A common feature of countries that have successful research, development, and innovation policies is *strong and visible commitment at the highest political level* to long-term development of financial and human resources for research, development, and innovation. Other key factors are the integration of key ministries (finance, education) in planning and implementation processes, broad-based consensus on the basic elements of research, development, and innovation policy, and wide agreement that investments in research, development, and innovation are needed over the long term. In Finland and Korea, a high-level policy council with representatives from ministries, government, R&D agencies, and the private sector turned out to be an efficient mechanism for overall coordination of research, development, and innovation policies.

Mobilizing actors and resources

For policy to be more relevant and effective, it must embody clear visions, strategies, and priorities. Leadership in the governance of research, development, and innovation are also vital to mobilize actors and resources. Leadership is best undertaken by distinguished individuals (a president, prime minister, minister of finance), ministries, or innovative agencies and enterprises. These leaders have a broader perspective on policy agendas for research, development, and innovation and can help to maintain their coherence.

Coordinating bodies

The *role of coordinating bodies in setting priorities and coordinating agendas is increasingly important* owing to challenges arising from globalization, emerging technologies, new forms of innovation, and a range of global issues such as energy and climate change, poverty, health care, and access to clean water. Coordinating bodies benefit from links to the highest levels of government (vertical coordination) but must also include decision makers and other stakeholders from diverse areas of the economy (horizontal coordination). The councils in Finland and Korea are two examples of such coordinating bodies. Governance of innovative activity is not provided by government or the public sector alone. It is important that *representatives of the private and third sectors* actively participate in formulating and implementing policy through various forms of public-private partnership.

A clear role for high-level councils

High-level councils can and often do play important roles in setting priorities and agendas and as overall policy coordination platforms, but it is evident that simply establishing a council is not enough (OECD 2009a,b,c). Their needs and tasks must be well-defined in the specific context, with attention to the strategic needs of the country's innovation system. The council's composition, too, needs to be considered in view of the strategic tasks. It must be open to newly emerging actors in innovation in the country.

Horizontal coordination

A broader understanding of innovation and innovation policy means that more attention should be paid to *horizontal coordination,* which refers to the crossing of administrative and cultural boundaries between policy domains and sectors.

Autonomy to implement

An innovation system approach can aid both policy design and implementation; policies also need to be implemented to deliver innovation and growth. In particular, *policy implementation may best be facilitated at the level of relatively autonomous agencies rather than ministries and departments where political and other issues may be inhibiting factors* (Tekes is one example; TIA in South Africa may be another).

Transparency

Innovation policies benefit from *transparent schemes and the avoidance of bureaucracy and red tape*. Programs for R&D can be efficient for focusing activities on predefined areas (for example, the specific technology areas represented by Tekes' R&D programs). Care should be taken to include elements of competitive tendering. Policy continuity is also important to stabilize the innovation horizon (of private companies in particular).

Learning and evaluation

The *ability to obtain and analyze intelligence on market and technological developments and trends* is of key importance for a well-functioning, proactive innovation system. Finland, Korea, and (to an increasing extent) South Africa conduct foresight exercises and impact assessments. These capabilities are preferably spread out throughout the innovation system and strengthened through international collaboration and related forums. They should be actively promoted and maintained.

Improved means of evaluating the inputs, activities, outputs, and impacts of research, development, and innovation are needed to manage R&D organizations and instruments and provide important feedback for policy making. The development and implementation of monitoring and evaluation require intervention from the upper levels of innovation policy. Many countries are finding that evaluations of research organizations, research and technology programs, and other policy instruments are an effective and indirect way to control and manage research organizations. Although evaluations are increasingly used to improve the design and implementation of the instruments of research, development, and innovation policy, they are not always readily available or communicated to policy makers at the strategic decision-making level.

RECOMMENDATIONS FOR PRACTITIONERS

Innovation systems emerge gradually and organically if the enabling environment is favorable. Knowledge flows and collaboration cannot be created by policy, but policy can create suitable conditions for them to happen. Good governance is central to the performance of an innovation system, and policies can strongly influence good governance. Practical recommendations for establishing governance structures include the following general and tentative "steps":

1. ***Develop awareness*** of innovation systems concepts and identify good practices in similar sectoral, regional, and national contexts. Engage in international dialogue.
2. ***Communicate the viability and challenges*** of implementing an innovation system approach. Probe the possibilities for seeking, and achieving, consensus and a common vision on key issues.
3. ***Analyze structural and institutional preconditions*** for governance structures related to innovation systems. Involve companies, public research agencies, and other relevant stakeholders (main ministries, regulators, NGOs) in policy design, consultations, and strategizing.
4. ***Consider the suitability of existing institutions*** to handle STI matters. Consider the need for new, STI-dedicated agencies and other institutions.
5. ***Assess the economic, legal, and political viability*** of introducing STI issues and the innovation system concept at various levels of governance. Ensure that mechanisms for priority setting and coordination can be put in place.
6. ***Develop existing institutions*** to support STI or establish new STI institutions if required. Ensure that they have a clear mandate and specific roles to avoid overlap. Be ready to divest obsolete schemes and institutions if necessary to foster the growth of new ones.
7. ***Ensure relative institutional autonomy*** in policy implementation. Ensure that sufficient capabilities and resources are in place for day-to-day management of policy schemes and initiatives, now and in the long run (to ensure policy stability and predictability).
8. ***Implement policy schemes*** (at the agency level or below) and initiatives as considered relevant, based on an assessment of societal needs. Consider which policy mix is most suitable to the context. Ensure that schemes and initiatives are transparent, nonexclusive, and predictable, and support both networking and competition.
9. ***Ensure that institutions and capabilities remain in place*** (compare with the third step) to analyze and assess technological and market trends, as well as to assess the impacts of policy schemes, initiatives, and the innovation system as a whole. Continue to engage in international dialogue.