United Nations E/CN.16/2009/3

Economic and Social Council

Distr.: General
11 March 2009

Original: English

Commission on Science and Technology for Development
Twelfth session
Geneva, 25–29 May 2009
Item 3 (b) of the provisional agenda

Science, technology and engineering for innovation and capacity-building in education and research

Report of the Secretary-General

Executive summary

Although there is consensus that technological change is a driver of economic growth, many developing countries have yet to benefit from the promises of science, technology and innovation (STI). The potential contribution of STI to the achievement of development goals is, and will continue to be, constrained by structural barriers and systemic weaknesses at the local, national and global levels, and by the long lead time required to build indigenous technical and non-technical indigenous STI capabilities.

Indigenous capabilities in STI are essential for the achievement of both short- and long-term development goals. Therefore, building science, technology and engineering for innovation capacity should be elevated from a missing or marginal component of the development agenda of many developing countries to an essential policy of every country's strategy for alleviating poverty, achieving the Millennium development Goals (MDGs), and enhancing economic and social development.

Efforts should be stepped up to share policy-related experiences, through North–South and South–South cooperation, and through existing and new regional and international agreements.

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Introduction

1. The Commission on Science and Technology for Development (CSTD), in response to the request of the Economic and Social Council in its decision 2007/240, decided to explore the substantive theme: "Science, technology and engineering for innovation and capacity-building in education and research" as a priority area during the intersessional periods of 2007–08 and 2008–09.

2. The Report of the Secretary General on the theme "Science, technology and engineering for innovation and capacity-building in education and research" was presented at the eleventh session of the CSTD in May 2008. That report noted that, though there was consensus that technological change was a driver of economic growth, many developing countries had yet to benefit from the promises of science, technology and innovation. The Commission, at its eleventh session, highlighted the following:[1]

(a) Science and technology are essential tools in meeting development goals, especially those contained in the United Nations Millennium Declaration;

(b) The ability to acquire, adapt, diffuse and adopt existing knowledge is crucial for every country, as is the capacity to produce and use new knowledge;

(c) It is important for developing countries to integrate STI policies into national development strategies; and

(d) North–South and South–South cooperation is important in harnessing knowledge and technology for development.

3. To contribute to a further understanding of the issues, and to assist the CSTD in its deliberations at its twelfth session, the UNCTAD secretariat convened an inter-sessional panel meeting in Santiago, Chile, from 12 to 14 November 2008. The present report is based on the findings of the panel, on national reports contributed by members of the CSTD, and other relevant literature.

I. Science, technology and innovation to address the Millennium Development Goals

4. According to the most recent *United Nations Millennium Development Goals Report* (United Nations, 2008), progress has been registered in a number of MDG areas, such as (a) the attainment of 90 per cent primary school enrolment level; (b) the drop in mortality rates caused by diseases such as malaria, HIV/AIDS and measles; and (c) an increase in the number of people with access to safe drinking water. However, progress has been slow in other areas.

5. In agriculture, the world market has recently experienced a tremendous increase in food prices, triggered by the compound impact of higher fuel prices along the value chain, low levels of agricultural production, weather shocks and shifts from farming food crops to biofuel crops. Key factors that undermine the effective use and application of STI to increase production of food crops and livestock include (a) lack of access to agricultural inputs; (b) a reduction of investment in agricultural research and development (R&D); (c) lack of extension services; and (d) poor agricultural infrastructure such as roads, irrigation systems and food storage facilities. Other factors to be considered include land management

[1] Economic and Social Council (2008).

practices and alternative uses of arable land for cash crops and biofuels and land ownership patterns.

6. In the area of health, scientific and technological developments promise to revolutionize the way diseases are prevented, diagnosed and managed and at the same time offer options for addressing public health problems facing developing countries.[2] Many of these technologies are proprietary and are often owned by large pharmaceutical companies or international consortia, making it difficult for many developing countries to access them. While a large body of advanced knowledge is in the public domain, the development and diffusion of health technologies from the R&D system to the healthcare delivery system are in many countries constrained by the availability of skilled medical professionals to effectively use the equipment and techniques. Furthermore, the lack of scale-up and manufacturing capacity and the inability to effectively initiate and manage clinical trials in many developing countries often adversely affect the diffusion of even inexpensive technologies such as diagnostic kits and simple therapies.

7. In education, meeting the MDG in respect of universal enrolment in primary school education remains the key priority in many countries. However, the *MDG Report 2008* also emphasizes the importance of the *quality* of education. Going beyond the MDG targets, many analysts have highlighted the importance of establishing provision of secondary education to enable progression from the primary level. Modern technology, including information and communication technologies (ICTs), has the potential to serve as a tool for the enhancement of learning and for making learning more inclusive by providing opportunities through long-distance courses and e-learning.

8. Over time, ICTs offer enormous potential for making educational provision more inclusive. Science education in schools, especially at the secondary level, is one area that deserves special attention. Science, engineering and mathematics appear to be increasingly difficult areas – across all countries – for the recruitment of students at the tertiary level. The application of ICTs, combined with revised curricula and changes in teaching methods, has the potential to compensate for the general paucity of school laboratories in many countries, for example, through Web-based "virtual laboratories". In education, therefore, it can be said that constraints on the diffusion of ICTs in a country are also potential constraints on improving science education and the education system as a whole.

9. Women's involvement is a crucial element in the development process. Women are actors in – as well as beneficiaries of – development. Women need science and technology to serve their development needs and should actively participate in the setting of priorities for how science and technology is designed and used to address these needs.[3] Increasing access to education for women and girls can allow them to play a leading role in STI: this is apparent in many countries that provide equal opportunities for women in education and in science and technology. Cultural barriers to women's involvement in engineering and science exist in some developing countries, even where opportunities are available, making proactive measures to dismantle these barriers important. Increased access to and use of ICTs by women have also been shown to have positive effects – not only on the women themselves, but also on society as a whole. Observed effects include (a) increased income and economic empowerment; (b) reduced discrimination; (c) better social standing and more positive media images; (d) higher status and a greater role in decision-making in households and society; (e) improved self-esteem (f) expanded mobility; and (g) easier access to education.[4]

[2] World Health Organization, 2002; Weatherall *et al.*, 2006.
[3] UNESCO, 2007.
[4] Huyer and Carr, 2002; Huyer and Mitter, 2003; Hafkin and Huyer 2006.

10. Despite the understanding that, when used appropriately, scientific and technological innovations could provide powerful tools to achieving the MDGs,[5] the most recent *Millennium Development Goals Report* (United Nations, 2008) indicates that indigenous technological capabilities have not yet played a very significant role.[6] UNCTAD's *Least Developed Countries Report 2008* (UNCTAD, 2008) concludes that progress on the MDG targets has been due primarily to significant increases in public service provision.[7] Whilst being crucial to efforts to alleviate human suffering and support development goals, these initiatives often have few spillover effects in terms of building indigenous technological capacity and creating long-term income-generating opportunities. The *Least Developed Countries Report 2008* further notes that progress is much slower where meeting MDG targets is strongly dependent on raising household incomes, which itself involves complex and long-term development efforts.

II. Building capacity in science, technology and innovation

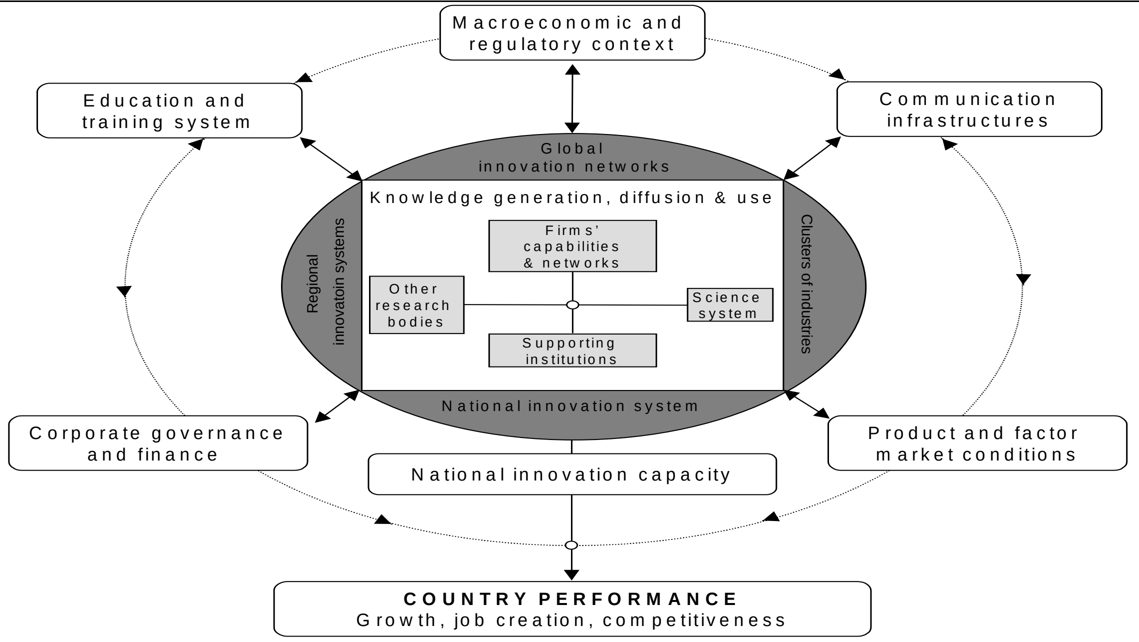
11. The Millennium Project Task Force on Science, Technology and Innovation pointed out that, to sustain progress towards achieving the MDGs, significant time is required to develop indigenous capabilities in science and technology, along with efforts to overcome systemic barriers. These capabilities, collectively, include those identified and articulated by the Commission at its eleventh session: "the ability to acquire, adapt, diffuse and adopt existing knowledge… [and] … the capacity to produce and use new knowledge".[8]

12. The task force recognized that national capacity in STI must be seen in terms of a system of interconnecting capabilities, i.e. a national system of innovation that highlights the main actors involved in supporting technological change and innovation in developing countries. These include firms, public research organizations, universities and supporting institutions such as financial institutions and government regulatory agencies. The diagram below depicts the interaction and interdependence of the different components of the system.

13. It is argued that most of the knowledge that low-income countries need to address their most urgent social and economic problems already exists. On this basis, countries with a generally low level of STI capacity should focus their efforts on building and strengthening indigenous scientific, technical, vocational and engineering capacity to select and use existing global knowledge resources, in order to meet their needs for sustainable development. Capacity-building is therefore needed at all levels – government policymaking, labour force skills, education and R&D, and enterprise development and innovation.

[5] Juma and Lee, 2005.
[6] United Nations, 2008.
[7] UNCTAD, 2008.
[8] Juma and Lee, 2005.

Figure 1. Country performance



Source: Metcalfe, 1995.

14. Innovation plays a critical role in maintaining national competitiveness in the global economy. Small-scale businesses and universities are especially important in the innovation process. The provision of stronger incentives for innovative behaviour at the enterprise level might include tax relief for start-up enterprises, and policies to support partnerships between Government, industry and academia, public investment in education and research, and support for cooperation and entrepreneurial activity. .

15. Building innovative capabilities at the national level in latecomer countries depends among others on efforts in three crucial, interrelated areas:

(a) Enterprise development;

(b) Human capital; and

(c) STI policy capacity.

A. Building innovative capabilities at the enterprise level

16. In many developing countries, firms have failed to invest sufficiently in building technological and innovative capabilities. Furthermore, national Governments tend to channel relatively few resources and little effort into supporting the development of these capabilities within enterprises, notably small and medium-sized enterprises (SMEs). At the same time, SMEs are coming to play increasingly important roles across national economies.

17. The Organization for Economic Cooperation and Development (OECD) has noted the emergence of small firms as key players in science-intensive technological development

across OECD countries.[9] Large firms that formerly developed new technologies in-house are increasingly relying on open innovation systems, outsourcing more R&D to small and specialized firms. In many developing countries, SMEs are, collectively, the key drivers of growth. Fostering the development of SMEs, including their innovative capabilities, is therefore a key policy issue.

18. Technological capabilities at the level of enterprises comprise knowledge, skills, and institutional structures and linkages. Linkages refer to those between different functions within the enterprise, between firms (for example, with suppliers and customers), and with other elements of the national innovation system (such as markets and university research).[10]

19. In innovating enterprises, capabilities are accumulated over time through a constant process of learning. The enterprises themselves may invest in efforts to learn, for example through training, actively searching for new knowledge and information, hiring new staff, and forming strategic links with other organizations, such as other firms or public sector R&D institutes. However, the level of investment in learning will be determined by the potential returns, in terms of new or improved products or processes, or reductions in production costs. Where those returns cannot be fully captured by enterprises, where market conditions – such as lack of competition – provide insufficient incentives to invest in learning, or where firms do not yet have the capacity to make the initial investments, intervention at the policy level is warranted.

20. Direct policy mechanisms and instruments to stimulate learning and innovation in enterprises include:

(a) R&D incentives, such as direct funding for R&D activities and tax credits;

(b) Market stimulation, including government procurement and subsidies for pre-competitive deployment of nationally-prioritized technologies (for example, some renewable energy technologies);

(c) Regulations and performance standards to increase quality and efficiency, and enhance environmental performance (sometimes in conjunction with market mechanisms, such as cap-and-trade schemes for emissions of greenhouse gases and other pollutants);

(d) Information supply, including demonstration projects and technical assistance to firms.

21. Indirect STI policies are also needed to establish an enabling environment for the development of innovative enterprises. These relate to, amongst others, trade, investment and competition policies, industrial (or other sectoral) policy, labour policy, and – crucially – education, training and research policies that ensure an appropriately skilled and knowledgeable supply of labour.

22. UNCTAD's first Multi-year Expert Meeting on Enterprise Development and Capacity-building in Science, Technology and Innovation (Geneva, 20–22 January 2009), focused on the use of technology, innovation and entrepreneurship for poverty reduction. The development of a country's technological, innovation and entrepreneurship capabilities and their ability to access needed technologies are key elements to support high and sustainable economic growth rates in the long term. An STI strategy, integrated into the broader national development strategy, comprising policies aimed at strengthening these

[9] OECD, 2005.

[10] Bell and Pavitt, 1993.

capabilities, and at building effective systems of knowledge and innovation, can play an important role in creating new opportunities for entrepreneurs, improving national economic performance and reducing poverty. A well-designed STI strategy and appropriate STI policies are needed, but it is important to note that some key policy issues are still relatively poorly understood, and some traditional approaches to promoting innovation need to change.

23 In this regard, UNCTAD’s expert meeting identified agricultural innovation as a particularly important area for developing countries, given that the bulk of poverty in the developing world is rural. Farmers need to improve their access to technologies and farmer-owned enterprises should get integrated in wider knowledge and innovation systems that support them in innovating continuously over time. The traditional research- and technology-led approach to innovation in agriculture must evolve. A new innovation paradigm should recognize that there is diversity in the innovation arrangements that can be used in developing countries to build innovation capabilities. Agricultural research needs to be better connected to the needs of entrepreneurs and enterprises. One suggestion is that agricultural technology brokers would be more useful than the traditional agricultural extension services used in many developing countries. However, several policy questions remain open, including how to best foster entrepreneurship for agricultural innovation in a largely informal sector of micro-entrepreneurs. Using cooperatives has witnessed a mixed record with more failures than successes. Another key open policy question is what models of farmer operated enterprises work well, especially for poverty reduction. An important consideration made at the expert meeting was that policymakers should strengthen their intelligence-gathering capacity to better understand promising developments in the informal sector, and in agriculture and rural development more generally.

B. Human capital for science, technology and innovation

24. Developing countries need to build a critical mass of well-trained scientists and engineers for technological catch-up and “leapfrogging” to take place. However, in order for STI to contribute significantly to poverty alleviation (through the creation of new jobs, in particular), the larger mass of the workforce must be equipped with the skills to learn and deploy new knowledge. Furthermore, in both rich and poorer countries, education and training provision needs to be responsive to changing global and national trends in technological development, and the consequent shifts in labour markets.

25. Postgraduate education and research present their own special difficulties for capacity-building, in that they require a high level of specialization over several years as well as sufficient flexibility to accommodate future changes in the demand for a particular specialization. Developing country Governments cannot afford, within national budgets, to institute across-the-board capacity-building initiatives and therefore must be selective in resource allocation for postgraduate study and research. However, trying to “pick future winners” for resource allocation is risky. One way to spread risk and make efficient use of resources is to cooperate at a regional level to share knowledge and resources.

26. Timeliness in matching national goals to related education, training, and research requirements, together with uncertainties concerning future needs, global technological development trajectories, and future STI-related opportunities, implies a need for building greater flexibility in education and research. Effective reforms of the education and

research systems in a country may require institutional restructuring, the introduction of new teaching methods, and changes in staff incentives, rewards and mobility.[11]

C. STI policy capacity

27. Indigenous capabilities in STI are essential to the achievement of both short- and long-term development goals. Building these capabilities is the role of STI policy, which should therefore be at the heart of national development strategies.

28. STI-related policies cut across various sectoral/ministerial mandates, including (but not limited to) education, trade, industry, health, agriculture, energy and environment. STI capacity-building is therefore a cross-cutting issue that requires effective public–private sector linkages and a coherent STI strategy at the national level.

29. Policy capacity-building warrants efforts to adapt, develop and utilize existing and emerging policy research and analysis tools to fit country-specific needs.[12] In addition, there is a need to share experiences and lessons between countries (especially within the South), in respect of tried policy measures and instruments in specific contexts.

30. Key areas and activities for policy capacity-building include:

(a) Initiatives and mechanisms for financing STI;

(b) STI networks that have been established at the local, national, regional and international levels, and/or local clusters;

(c) Mechanisms and incentives to turn “brain drain” into “brain gain”, and/or the retention of skilled personnel;

(d) Innovation strategies that are under implementation;

(e) Studies and other activities that contribute to greater understanding of innovative capacity, how it is developed, and how long it takes, with particular attention to building technological capabilities within SMEs; and

(f) Methods and indicators for monitoring and evaluating innovative capacity.

31. The potential at the policy level to build national STI capacity through adequate policies is generally limited to what is economically feasible, politically possible and socially acceptable. In addition, fragmented institutional structures and mandates, disparate priorities, and weak linkages often constrain the potential for STI policies to be integrated into sector policies and overall national development strategies.

D. Capacity-building through training and research

32. It is important for developing countries to nurture indigenous scientific capability which confers upon them the ability to experiment and come up with new innovative ideas that can be taken up for industrial application. The need for strong scientific capabilities in these countries points us to the role and contribution of universities in the innovation process. In a world where the traditional role of the university – that of graduating students and conducting basic research – is changing towards the conduct of applied research

[11] For example, mobility between the public and private sectors, and perhaps between countries within a region.

[12] One example of such a tool is the UNCTAD Science, Technology and Innovation Policy (STIP) Review process.

leading to innovation and economic development, education and research priorities must be aligned to address local developmental needs. This also means that researchers should be able and willing to participate in entrepreneurial processes, which can be supported through policy-driven incentives.

33. Modern technology has the potential to serve as a tool for the enhancement of learning and for making learning more inclusive by providing opportunities through long-distance courses and e-learning. Learning with ICT offers a variety of advantages, such as (a) global communication with peers, communities and experts; (b) access to timely and relevant information sources; and (c) engagement in rich, relevant tasks based on real situations and data. One way this has been attained is through the creation and utilization of virtual universities' facilities.

34. ICTs influence science and engineering in a variety of ways. They have permeated almost all industrial operations (and are now a crosscutting technology) and have provided a means for building knowledge creating networks and interactions. It is now possible for researchers to access research materials and even conduct research online in areas such as gene sequencing. ICT can be used as a tool for promoting interactive learning and research. One way in which developing countries can benefit from ICT in education and capacity-building is by using online library catalogues, archives of materials (such as the Timbuktu project) and through creating online laboratories for sharing teaching materials and lecture videos.

III. Towards the integration of STI policy into national development strategies

35. In many developing countries, explicit science and technology policies very often focus on the management of public funding for R&D. Sometimes they exist only implicitly within sector strategies and action plans, where they are expressed in terms of sectoral R&D objectives. In general, there tends to be a stronger emphasis on science policies alone, often neglecting technology and innovation policies.

36. Building STI capacity in many developing countries remains marginal to the wider policy environment, with few and/or weak linkages to other key policy areas. The Millennium Task Force on Science, Technology and Innovation[13] stresses the need to place STI at the centre of national development strategy, and this presents a major new challenge to existing policy institutions in many countries.[14]

37. The articulation and implementation of a cohesive development strategy centred on STI requires close cooperation between multitudes of policy actors that may currently be institutionally separated, enjoy the autonomy to set their own objectives and priorities, and compete with each other for scarce public resources.

38. Policy dynamics supportive of an innovation process are not the outcome of a single policy or policy area, but rather are created by a set of policies across different sectors and ministerial mandates that, collectively, shape the behaviour of actors. In other words, a systemic approach is needed at the national strategic and policy planning levels. The Millennium Task Force on Science, Technology and Innovation recommends that national Governments take: "…a strategic approach that starts with improving the policy environment, redesigning infrastructure investment, fostering enterprise development,

[13] Juma and Lee, 2005.

[14] It was reported in UNCTAD's *Least Developed Countries Report 2007* that STI policy tends to be marginalized in the poverty reduction strategies of LDCs (UNCTAD, 2007).

reforming higher education, supporting inventive activity, and managing technological innovation."[15]

39. The many analytical studies of countries, industries, clusters and firms undertaken over the past 20 years or so clearly show that technological learning or the accumulation of technological capabilities, at all levels is a long-term process[16]. Government efforts to build an effective innovation system over a long period thus require a clear strategy and sustained commitment.

40. From studies of the Republic of Korea and other "East Asian Tigers", some key strategies for "catching up" can be identified, as shown in figure 2. These include:

(a) A clear strategy;

(b) Sustained commitment and effort over a long time period, which would span decades rather than years;[17]

(c) Building human capital through education and training;

(d) The establishment of effective government support for building capabilities in the private sector; and

(e) Interventions in a range of policy areas.

41. In contrast to the long-term policy needs identified in this paper, policy resources are often concentrated on, or are diverted to, addressing short-term objectives. Of course, many of the latter are imperatives for meeting human development needs or tackling urgent environmental problems. A critical task for developing-country Governments, therefore, is to design a clear strategy that:

(a) Sets realistic timescales to meet national aims;

(b) Balances the allocation of resources between short- and long-term goals, and between public sector R&D and supporting the development of capabilities within the productive sectors; and

(c) Aims, as far as possible, to ensure cohesion between policies and capacity-building initiatives across sectors, and over different time periods.

Other national stakeholder groups, including private sector firms and/or business associations, NGOs, civil society representative groups, as well as the STI research community should participate in this task.

42. Recent studies have highlighted serious barriers to the development of effective STI policies as part of national development strategies.[18] First, despite over 20 years of research on "innovation systems", there is still little understanding of how innovation systems work at all levels. It is also difficult to evaluate the contributions that various elements (including policies and policy instruments) make – individually and collectively – to economic growth and improved human welfare.[19]

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[15] Juma and Lee, 2005.

[16] Bell (2006) notes that pioneering research on this area was undertaken in Latin America by Jorge Katz and his colleagues. This work preceded the perhaps more well-known studies of East Asian economies undertaken in the late 1980s and 1990s.

[17] From Mike Hobday's study of the development of the Korean electronics industry (1995), cited in, amongst others, Bell (2006).

[18] OECD, 2005, 2007a, 2007b and 2008; Bell, 2006; Jensen et al. 2007; Hekkert et al., 2007.

[19] See, for example, Altenburg, et al., 2007; and OECD, 2007b.

43. Building a successful innovation system will also depend on both the prevailing national and global contexts, and these are constantly changing. The global context of technological development has been changing rapidly and radically, to the point where some OECD countries that had established effective innovation systems are now struggling to reorient those systems to cope with fundamental changes in global knowledge markets.[20] According to a recent analysis of the role of science and technology indicators, these changes may render current science and technology indicators barely useful as policy guidance tools for future STI development.[21]

44. STI policy capacity-building remains a neglected area in many countries, and this is an issue that warrants a stepping-up of support and cooperation at the international level, through the work of relevant international bodies such as the CSTD, UNCTAD, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations regional commissions and the World Bank, and, at the governmental level, through North–South and South–South cooperation.

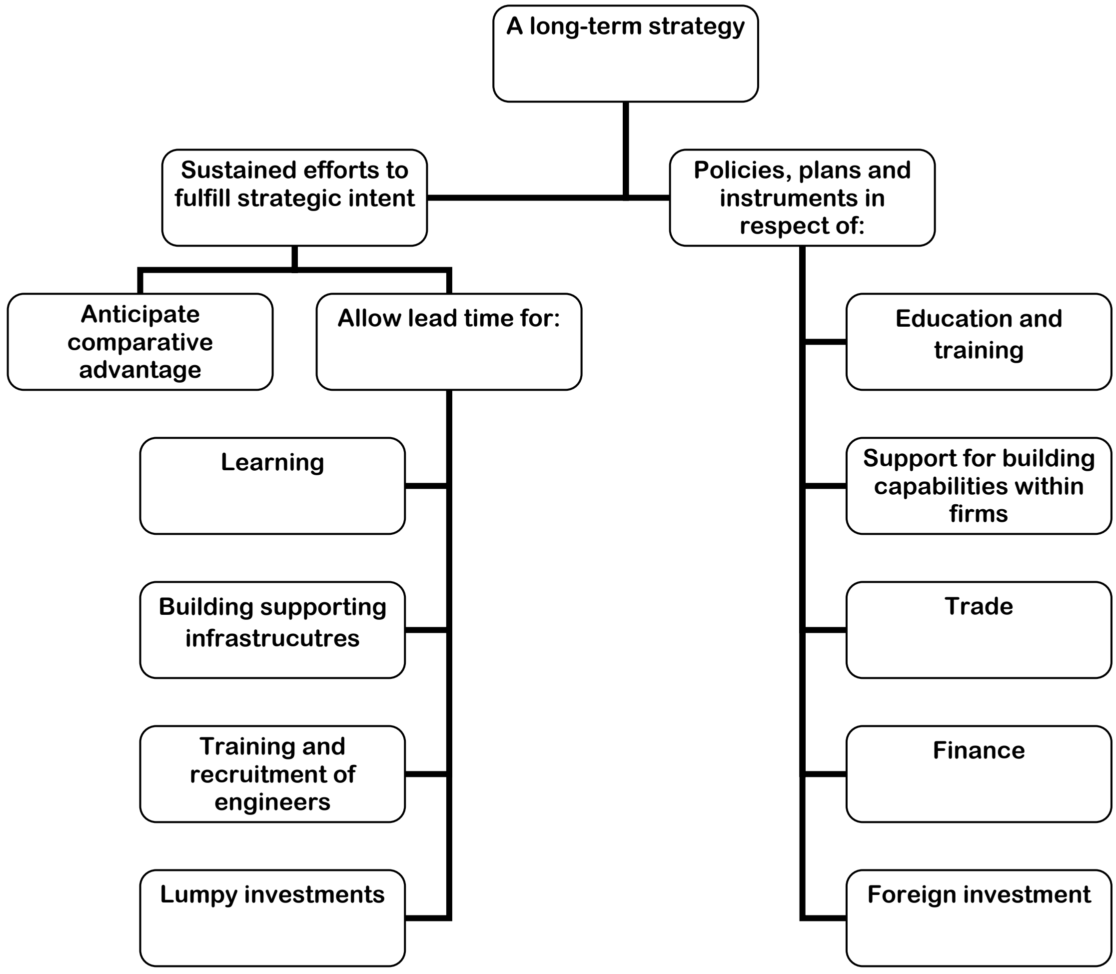
IV. Regional and international cooperation

45. Bilateral and multilateral collaborations that aim to build scientific and technical capabilities are already underway in many countries. In some cases, including the large-scale initiatives to tackle malaria and HIV/AIDS, there are opportunities to gain or enhance the learning benefits from policy development and other institution-building activities that are undertaken through such partnerships. However, such activities will be ad hoc, and will not necessarily fit well with long-term strategic objectives. On the other hand, there may be unexplored potential for regional cooperation and knowledge-sharing in specific areas of science and technology, which would avoid duplication of effort and make the most effective use of scarce national resources.

[20] A key example is Japan, whose innovation system was built to support in-house innovation in large innovating firms and who is now having to adapt to a very different technological paradigm in which product innovation is sourced outside the large firms to a range of smaller firms (OECD, 2005).

[21] Freeman and Soete, 2007.

Figure 2. Key elements for "catching up" in STI



Source: Adapted from James, 2008.

46. For example, STI policy learning might be effectively gained through the sharing of experiences and knowledge as part of South–South cooperative agreements. In Chile, an OECD Innovation Policy Review has already been completed, and various initiatives are already ongoing to develop/reform STI policies and institutions. Early lessons from the Chilean experience could be shared with other countries that are going through similar processes of building capabilities, and with countries that have yet to launch such initiatives. A key question to be addressed here concerns the mechanisms through which such knowledge-sharing could and should take place.

47. Some formal mechanisms for cooperation in STI at the regional and subregional levels do exist. Examples include the Committee of Science and Technology of the Association of South-East Asian Nations (ASEAN), the Division of Science, Technology and ICT within the African Union Commission, and the regional commissions of the United Nations.

48. An increasing number of developing countries are partnering with international organizations to carry out analytical studies of their existing, or emerging, national innovation systems. These studies include the UNCTAD Science, Technology and

Innovation Policy (STIP) Reviews, the OECD's Innovation Surveys and Innovation Policy Reviews, and UNESCO's Science and Technology Policy Reviews. There is a case for making the sharing of experiences and lessons between these organizations more effective, and involving national counterparts from participating countries. This would enable the agencies to review and improve their own processes and methodologies, and perhaps to develop a range of cooperative processes to develop policy support for innovation systems.

V. Summary and recommendations

49. The potential contribution of scientific and technological innovations to the achievement of development goals is, and will continue to be, constrained by structural barriers and systemic weaknesses at the local, national and global levels, and by the long lead time in respect of building technical and non-technical indigenous STI capabilities.

50. In respect of deploying science and technology to address the MDGs, short-term and long-term actions are needed. In the period leading up to 2015, efforts need to focus primarily on the deployment of existing technologies that are appropriate for meeting the needs of sustainable development. STI policy should aim at removing systemic barriers to their deployment and maximizing the potential learning benefits from short-term activities to meet the MDG targets.

51. In the long term, the achievement of sustainable poverty reduction requires STI policies that build a dynamic enabling environment for STI, in particular:

(a) Education and training of an innovative, skilled and adaptable workforce; and

(b) Support for enterprise development and gainful employment.

Building absorptive capabilities within enterprises will be a major goal for STI policy, as these capabilities are necessary for innovation to take place in a country, irrespective of where new knowledge is produced.

52. Indigenous STI capabilities are essential for countries to achieve both short- and long-term development goals. Building these capabilities is the role of STI policy and STI should therefore be at the heart of national development strategies.

53. The integration of STI policy into national development strategies can be seen as the defining issue on the CSTD theme of "Science, technology and engineering for innovation and capacity-building in education and research". Whether the aim is "simply" to integrate STI into national development strategy, or to rebuild national development strategy around STI, the task is complex.

54. There is a clear case for devising a concerted approach at the regional and international levels to build and share policy-relevant knowledge, as well as cooperate on science and technology issues.

55. Different sets of actors should contribute to these efforts: policy decision-makers at the national level, private sector and civil society representatives, scientific communities (national and transnational), STI policy/innovation systems researchers, and bilateral and international organizations.

56. Increasing the levels of North–South and South–South cooperation is essential for improving the efficiency and effectiveness of national efforts to build innovative capacity and meet development goals. Sharing knowledge and experiences related to the design and implementation of specific policy measures can maximize policy learning and minimize wasted resources, as well as build up an inventory of best practices. Regional cooperation agreements and networks can here valuable roles.

Recommendations

57. National Governments would be well advised to take a strategic approach to building capacity for STI at distinct levels, including government policymaking, labour force skills upgrading, enterprise innovation, and education and training. The strategic approach to building capacity for STI should ensure that:

(a) The institutional structures, mandates and resources to enhance education, training and research and to manage national innovation systems are reviewed, involving all relevant stakeholders, to ensure they are aligned with sustainable development needs;

(b) Efforts to create an enabling environment, including effective linkages between different elements and entities with a national system, are recognized as essential for building innovative capacity;

(c) Realistic timescales to meet national goals are established;

(d) Resource allocation for STI activities is balanced between short- and long-term goals and between public sector R&D and supporting the development of technological capabilities within the productive sectors;

(e) Development of technological capabilities in SMEs is given due attention;

(f) Cohesion is achieved, as far as possible, between policies and capacity-building initiatives across sectors and over different time periods; and

(g) An overall long-term strategy objective is the development of a culture of innovation and entrepreneurship.

58. Efforts should be stepped up to share policy-related experiences, through North–South and South–South cooperation, through existing and new regional agreements, and at the international level. In particular, empirical studies and examples on best practice would be welcomed on the following issues:

(a) Initiatives and mechanisms for financing STI;

(b) STI networks that have been established at the local, national, regional and international levels, and/or clusters;

(c) Mechanisms and incentives to encourage "brain circulation" and/or the retention of skilled personnel;

(d) Innovation strategies that address challenges associated with sustainable development;

(e) The accumulation and development of innovative capability, with particular attention to building technological capabilities within SMEs; and

(f) Methods and indicators for monitoring and evaluating innovative capacity.

59. In its role as a "torch-bearer" for innovation, and/or as coordinator for a concerted and accelerated international effort to build STI policy capacity, the CSTD might provide:

(a) A forum for developing countries, the international community, the STI policy research community and other interested parties to:

(i) Share and analyze available empirical evidence on technological learning and STI policy impacts; and

(ii) Identify critical gaps in "innovation system" understanding that the policy research community might usefully address.

(b) A clearing house for sharing information and new knowledge on scientific, technological and STI-related policy issues, including financing and regulation.

60. Efforts should be stepped up within the United Nations system to mainstream science and technology, including ICTs, in national development and poverty reduction strategies, in accordance with the priorities of countries.

61. Efforts should also be made by the United Nations system to respond to General Assembly resolution 62/208 with regards to strengthening its role in facilitating access of developing countries to new and emerging technologies.[22]

[22] General Assembly resolution 62/208, paras 45–47.

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