UN Commission on Science and Technology
for Development

2008-2009 Inter-sessional panel
Santiago, Chile
12-14 November 2008

Issues Paper on

Science, Technology and Engineering for Innovation and Capacity-Building in
Education and Research

A summary of key issues identified by the Commission

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Prepared by the UNCTAD Secretariat
Introduction

In April 2008, the 12th session of the United Nations Conference on Trade and Development (UNCTAD) reaffirmed the central role of science, technology and innovation in both achieving the Millennium Development Goals, and creating the capabilities to use existing technologies and create new knowledge. The Conference requested that UNCTAD strengthen its work in this area, and also its support of the United Nations Commission on Science and Technology for Development (CSTD)\(^1\).

The following month, these outcomes of UNCTAD XII were reiterated by the CSTD at its 11th session. In the substantive discussions of the Commission on the priority theme “Science, technology and engineering for innovation and capacity-building in education and research” the following points were highlighted\(^2\):

- Science and technology are essential tools in meeting development goals, especially those contained in the United Nations Millennium Declaration;
- 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;
- It is important for developing countries to integrate science, technology and innovation policies into national development strategies; and
- North-South and South-South cooperation is important in harnessing knowledge and technology for development.

This note is intended to use these interrelated issues as a framework for discussion at the panel meeting of the Commission in Santiago, Chile, in November 2008. Its aim is to assist the Commission to identify a way forward, based on a concerted international effort, in its work to support developing country governments to build effective national innovation systems (NSI). The innovation systems approach, which is summarized in Box 1, highlights the main actors involved in supporting technological change and innovation in developing countries.

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\(^1\) United Nations 2008a  
\(^2\) ECOSOC 2008
Box 1: The "National System of Innovation" approach

Metcalfe (1995) defines NSI as a, "...set of distinct institutions which jointly or individually contribute to the development and diffusion of new technologies and which provide the framework which governments form and implement policies to influence the innovation process". This definition makes explicit reference to institutions, governments and innovation policies and implies the existence of linkages among the actors in the system. The systems approach assumes the overall performance of a set of elements, which interact and mutually constrain and influence each other. The diagram below depicts a national system of innovation as one that is comprised of a set of actors such as firms, public research organizations, universities and supporting institutions, such as financial institutions and government regulatory agencies. The diagram also depicts the interactivity and interdependence of the different components of the system.

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Source: Metcalfe 1995

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3 Metcalfe, S. 1995
I Science, technology and the Millennium Development Goals

Despite the understanding that scientific and technological innovations provide powerful tools through which MDGs can be met\textsuperscript{4}, the most recent UN Millennium Development Goals Report (2008) indicates that indigenous technological capabilities have not yet played a very significant role\textsuperscript{5}. The report shows that progress has been registered in a number of MDG areas such as the attainment of 90\% primary school enrollment level, the drop in mortality rates caused by diseases such as malaria, HIV/AIDS and measles and an increase in the number of people with access to safe drinking water. It can be noted that, for some targets, progress has depended upon large-scale internationally-funded projects to distribute product-embedded technology directly to users. These include, for example, the distribution of anti-retrovirals, insecticide-treated bed nets, and measles vaccination programmes. 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, or indeed, creating long-term income-generating opportunities. Consequently, they may be unsustainable beyond the end of their anticipated funding periods.

Perhaps the most important factor here is the time period required by many countries, especially in sub-Saharan Africa, for capacity-building in science, technology and innovation. In this respect, there is a need to plan beyond the 2015 Millennium Development Goals targets. In doing so, other barriers to the deployment of science and technology, including systemic failures, must be identified and addressed. Examples from food and agriculture, health, energy and education, which illustrate some of these barriers, are presented below.

Food and Agriculture

The world market has recently experienced a tremendous increase in food prices, which have been triggered by the compound impact of higher fuel prices along the value chain, low agricultural production, weather shocks and shifts from farming food crops to biofuel crops. It is now estimated that poor families spend up to 80\% of their budget on food\textsuperscript{6}. Biotechnology has so far failed to fulfill initial high expectations in respect of increasing agricultural production in poorer countries. There exists a multiplicity of factors that undermine the effective use and application of

\textsuperscript{4} Juma & Lee 2005  
\textsuperscript{5} United Nations 2008b  
\textsuperscript{6} World Bank 2008
STI to increase production of food crops and livestock. These include access to agricultural inputs, a reduction of investment in agricultural R&D, lack of extension services, and poor agricultural infrastructure such as roads, irrigation systems and food storage facilities. Other factors to be considered include land management practices and alternative uses of arable land for cash crops and biofuels and land ownership patterns. Studies have also shown that the use of public subsidies to protect agricultural producers in developed countries adversely impacts on agricultural opportunities and productivity in developing countries.

Health

Scientific and technological developments taking place in the biomedical field 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\(^7\). Many of these technologies are proprietary and are often owned by large pharmaceutical companies or international consortia, and this makes it difficult for many developing countries to access these technologies. On the other hand, there is a very large body of advanced knowledge that is in the public domain, can (and is) used already in R&D in developing countries. However, the development and diffusion of health technologies from the R&D system to the healthcare delivery system must take into account the systemic challenges that prevail in many countries. These factors include the availability of skilled medical professionals who can not only attend to patients but can also effectively use the equipment and techniques and the existence of clinical trial and monitoring capabilities. The lack of scale-up and manufacturing capacity and the inability to effectively initiate and manage clinical trials in most developing countries is likely to adversely affect the diffusion of far less costly technologies such as diagnostic kits and simple therapies.

Energy

There is no specific MDG in respect of energy, but it has been explicitly accepted that access to energy services is essential in achieving the targets of most or all of the Goals, particularly those concerning health and environmental sustainability\(^8\). Cleaner energy sources that have potential

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\(^8\) Harnessing the potential of renewable energy sources such as solar energy, wind, and geothermal energy can prevent the dependency of developing countries on fossil fuels and reduce environmental degradation that results from the extraction and consumption of fossil fuels. Improved access to clean energy could play a role in improving health
to be deployed in developing countries include renewable energy generated from natural resources such as hydropower, solar power, wind power, hydroelectricity, micro hydro, biomass and biofuels. However, with the exception of hydropower, most renewable energy technologies are not yet cost-competitive when compared to fossil fuels, at least in respect of large-scale applications (essentially, grid electricity). R&D is needed, and is on-going in many countries, to reduce the costs of renewable energy technologies, but, for now, their deployment usually depends on sustained government support. This limits their potential in most developing countries. At the local, small-scale level, such as households and community mini-grids, the potential of renewable energy technologies is often limited by other factors. These include a general lack of institutional capacity at the local level, high initial costs of energy systems for consumers, and in rural areas in particular, the lack of local capabilities for maintenance and repair, as well as an inadequate or unreliable supply of parts.

Education

For some countries, meeting the MDG in respect of universal enrollment in primary school education remains the key priority. The MDG Report 2008 emphasizes the importance of the quality of education provided. 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 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. A key constraint on increasing school enrollment is the lack of trained teachers, and distance learning programmes in teacher training have already been implemented in some countries. 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, as science, engineering and mathematics appear to be increasingly difficult areas – across both OECD and non-OECD 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.

particularly maternal health and reducing child mortality as women and children suffer the most due to the use of fossil fuels.
Gender Perspectives to STI Application in Developing Countries

Women’s involvement is a crucial element in the development process. Women are actors in – as well as targets of – development. Women need S&T to serve their development needs and should actively participate in the setting of priorities for how S&T is designed and used to address these needs (UNESCO 2007).

A number of arguments for women’s participation in science, technology and engineering for innovation centre on social welfare aspects – the increase of the general good to society. An increase in women’s education has social impacts, which in turn positively affects economic growth. Studies show that promoting female education reduces fertility and child mortality levels and promotes the education of the next generation, each of which in itself has a positive impact on economic growth (World Bank 2001). Increased access to and use of ICT by women has also been shown to have numerous positive effects not only on women themselves but on society as a whole. Observed effects include increased income and economic empowerment, reduction in discrimination, better social standing and more positive media images, higher status and a greater role in decision-making in the household and society, improved self-esteem, expanded mobility and easier access to education (Huyer and Carr 2002, Huyer and Mitter 2003, Hafkin and Huyer 2006).

Short term and long term issues

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 capabilities. UNCTAD's Least Developed Countries Report 2008 reports that progress on the Millennium Development Goals targets has been due primarily to significant increases in public service provision. The LDCs report notes that progress is much slower where meeting targets is more strongly dependent on raising household incomes, which itself involves more complex and long-term development efforts.

The Millennium Project Task Force on Science, Technology and Innovation recognized, in their 2005 publication, that time to develop indigenous capabilities in science and technology, together

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9 UNCTAD 2008
with efforts to overcome systemic barriers would be prerequisites for the achievement and sustainability of progress on the MDGs. The authors argued that:

“…if long term goals are to be achieved and growth and problem-solving are to become indigenous and sustainable, developing countries need to develop their own capabilities for science, technology and innovation…[meeting this goal] requires an approach that views science, technology and innovation as a system of interconnecting capabilities…”

These capabilities, collectively, are those, which were identified and articulated by the Commission at its 11th session: “the ability to acquire, adapt, diffuse and adopt existing knowledge… [and] … the capacity to produce and use new knowledge”.

II Building indigenous capabilities for science, technology and innovation

First, it is useful here to clarify the use of two key terms which those in the policy and policy research communities use all the time, but which are sometimes interpreted differently, causing misunderstandings to arise in policy debate. These terms are: “innovation” and “absorptive capacity”.

There are many different perspectives on how “innovation” can be defined and characterized. For example, it can be seen variously as:

- a description of the whole process of developing and diffusing the technical innovation
- accomplished only with the very first commercial transaction [of a new product/process]
- occurring when a new product/process is adopted for the first time in: 1. an enterprise (or social welfare provider organization); 2. a country; or 3. the world.

An important point to note is that, in all these definitions, the term is applied only to new knowledge that has been adopted by the productive or social welfare sectors – and not to those technologies that are still at the R&D stage. That said, “first commercial transaction [anywhere in the world]” implies a definition of novelty (or, “new-ness”) that is too narrow for most development policy contexts. The OECD and UNCTAD are amongst those who commonly use the term “innovation” in the last of the three senses listed above.

10 Juma & Lee 2005
11 Freeman, C. & Soete, L. 1997
Absorptive capacity – at the level of organizations, or countries – generally refers to the ability to make effective use of existing knowledge that is acquired from outside the organization or country. In nearly all contexts – including basic scientific research – it is a prerequisite for developing the ability to generate new knowledge. However, the use of the term has so often been associated with the importation of technological “hardware” – or, “turnkey products” – that, at the country level, building absorptive capacity is sometimes perceived as an alternative (and perhaps undesirable) development strategy to building indigenous “innovative” capacity. In reality, the first is an essential element of the second. For example, new technologies might be developed in a country’s own public sector R&D system, but until they can be effectively absorbed into a firm (or hospital, or other technology user organization) no innovation has taken place.

However, whilst building capabilities to acquire, adopt, adapt and diffuse new knowledge (collectively, these capabilities approximate to “absorptive capacity”) is essential for building productive capacity, policy research studies have found that building productive capabilities does not necessarily lead to an accumulation of innovative capacity.\textsuperscript{12} Altenburg \textit{et al}’s recent study, on the “massive dispersal of production capacity” away from OECD countries to China and India, similarly found that “there was no corresponding accumulation of innovation capabilities in these countries”\textsuperscript{13}. Therefore, building absorptive capacity is necessary, but insufficient in itself, to achieve technological catch-up in developing countries.

In respect of China, this conclusion is supported by the OECD’s Innovation Policy Review of China, which found that around 90\% of high-tech exports from the country are from foreign-owned firms, despite massive investments in R&D over the past decade.\textsuperscript{14} Whilst these investments might still bear fruit in the future, it appears that these efforts are leading more rapidly towards scientific – rather than innovation – catch-up.\textsuperscript{15} One possible reason for this is a mismatch between the scientific/technological intensity of the R&D on the one hand, and the needs and/or absorptive capacity of local enterprises on the other.

It has long been argued that firms in some developing countries have failed to invest sufficiently in building technological capabilities. It has also been argued that governments – in both OECD and

\textsuperscript{13} Altenburg, Schmitz & Stamm 2007.
\textsuperscript{14} OECD 2008
\textsuperscript{15} Altenburg, Schmitz & Stamm 2007. China’s share of global scientific publications rose from 2.05\% to 6.52\% between 1995 and 2004.
non-OECD countries - tend to channel relatively few resources and effort into supporting the development of these capabilities within enterprises, and that SMEs are particularly neglected in this respect. At the same time, SMEs are coming to play increasingly important roles across the world. The OECD has noted the emergence of small firms as key players in science-intensive technological development across OECD countries\(^\text{16}\). Large firms that formerly developed new technologies in-house are, increasingly, outsourcing R&D to such firms. In many developing countries, SMEs are, collectively, the key drivers of growth. Fostering the development of SMEs, including their innovative potential, is therefore a key policy issue.

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

- enterprise development;
- human capital;
- STI policy capacity.

Bearing in mind the evolving global context of knowledge production, and the new uncertainties this creates for forecasting technological trajectories, opportunities and threats, the remainder of this section will summarize the key issues for building capabilities for each area.

**Enterprise development**

Technological capabilities at the level of enterprises comprise:

- knowledge, both formal – or, codified – and tacit;
- skills: for example, in design, engineering, operations, management;
- institutional structures and linkages: 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)\(^\text{17}\).

In innovating enterprises, these 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, 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

\(^{16}\) OECD 2005

\(^{17}\) Bell & Pavitt 1993
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.

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

- R&D incentives, such as direct funding for R&D activities and R&D tax credits;
- market stimulation, including government procurement (e-government is a good example) and subsidies for pre-competitive deployment of nationally-prioritized technologies (for example, some renewable energy technologies);
- regulations and performance standards to increase quality, efficiency and enhance environmental performance (sometimes in conjunction with market mechanisms, such as cap-and-trade schemes for emissions of greenhouse gases);
- information supply, including demonstration projects and technical assistance to firms.

In addition, indirect STI policies are 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.

**Human capital**

The relationship between education and capacity-building in science, technology and innovation is perhaps most often discussed in terms of higher education provision and research. It is certainly the case that developing countries need to recruit a critical mass of well-trained scientists and engineers for technological catch-up (and, possibly, “leap-frogging”) to take place. But, in order for science, technology and innovation 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 to 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.
A fresh approach to higher education and research may be needed when taking a long-term approach to building capabilities. 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, imply a need for building greater flexibility in education and research. This need could be addressed by:

- At primary and secondary levels, implementing skills-based (rather than discipline-based) curricula, noting that, in a global information society, ICT "literacy" and foreign language skills are becoming increasingly important;
- In Higher Education courses, at least at the first degree level, broadening the curricula (where single-subject specialization is the norm) and/or offering combined subject degrees.

Postgraduate education and research presents its own special difficulties for capacity-building, in that it requires a high level of specialization over (often) several years but where, in a national context, future demand for a particular specialization is uncertain. Developing country governments cannot afford, within national budgets, to institute across-the-board capacity-building initiatives and therefore have to be selective in resource allocation for postgraduate study and research. However, trying to “pick [future] winners” for resource allocation is a risky strategy. One way to spread risk and make efficient use of resources is to cooperate at a regional level to share knowledge and resources (based on an agreed division of labour in key areas of research).

It must be noted, however, that 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\(^{18}\). Such changes are likely to be met with some resistance from vested interests\(^{19}\).

**Policy capacity**

The potential at the policy level to build national capacity in science, technology and innovation is limited, first of all, to what is economically feasible, politically possible, and (in most cases) socially acceptable. In addition, fragmented institutional structures and mandates, disparate priorities, and weak linkages, at this level very often constrain the potential for STI policies to be integrated into sector policies and overall national development strategies. Furthermore, policy

\(^{18}\) For example, mobility between the public and private sectors, and perhaps between countries within a region.

\(^{19}\) However, it should be noted that the Republic of Korea was successful in instituting a radical transformation of its education and training systems as part of that country’s technological development strategy.
research and analysis, as a key input into policy decision-making, is not very well developed (in terms of meaningful indicators and sound methodologies) in respect of STI. STI policy is, in most cases, very experimental and – given the risks of failure – tends towards conservative incrementalism rather than radical reform. There are, therefore, two areas in which policy capacity-building could usefully be undertaken in developing countries:

- sharing experiences and lessons between countries (especially South-South sharing) on the impact of tried policy measures and instruments in given contexts; and
- efforts to adapt, develop and utilize existing and emerging policy research and analysis tools to fit country-specific needs\(^{20}\).

In respect of learning from successful latecomer technological catch-up, one case study stands out: that of the Republic of Korea, and especially, of the development of that country’s electronics industry. James (2008) provides a useful summary of the role of the government in this process, which is shown in Box 2.

\(^{20}\) One example of such a tool is the UNCTAD STIP Review process.
The specific policies and instruments that were introduced in the Korean or other “East Asian Miracle” countries may offer few useful lessons for other latecomer countries that are now in the early stages of, or have yet to start, concerted efforts at the policy level to support capability-building in science, technology and innovation: their successes took place in specific national and global contexts. However, some fundamental principles can be established:

- the need for a clear strategy;
sustained commitment and effort over a long period (“decades rather than years”);  
the critical importance of building human capital through education and training;  
the establishment of effective government support for building capabilities in the private sector; and  
policy interventions in a range of policy areas.

All of these principles are reflected in the Millennium Task Force on Science, Technology and Innovation recommendation that national governments take:

“…a strategic approach that starts with improving the policy environment, redesigning infrastructure investment, fostering enterprise development, reforming higher education, supporting inventive activity, and managing technological innovation.”

From analytical studies of countries, industries, clusters and firms undertaken over the past twenty years or so, it must be accepted that technological learning, or the accumulation of technological capabilities, at all levels is a long-term process. Efforts to build an effective innovation system over a long period require a clear strategy and sustained commitment, as the example of the Republic of Korea illustrates, and the Millennium Task Force on Science, Technology and Innovation suggests. The Task Force stress the need to place science, technology and innovation at the centre of national development strategy, and this presents a major new challenge to existing policy institutions in most countries, and especially the Least Developed Countries.

III Integrating STI policies into national development strategies

In many countries, explicit science and technologies policies very often focus on management of public funding for R&D. Sometimes, science and technology policies 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 much stronger emphasis on science policies than on technology and innovation policies. Policy dynamics supportive of an innovation process are not the outcome of a single policy, or policy area, but rather they are created by a set of policies across different sectors.

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21 A quote from Mike Hobday’s study of the development of the Korean electronics industry (1995), cited in, amongst others, Bell (2006). The topic of time will be covered further in the following section.
22 Juma & Lee 2005
23 Bell (2006) notes that, prior to the studies on East Asia, the pioneering research on this area was undertaken in Latin America by Prof. Jorge Katz and his colleagues.
24 Juma & Lee 2005
25 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).
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 "innovation systems" approach to understanding the process of technical change at the national level has become the "the most influential approach worldwide". From a national innovation system perspective, STI-related policies cross various sectoral/ministerial mandates, including (but not limited to) education, trade, industry, health, agriculture, energy, and environment. Therefore, the articulation and implementation of a cohesive development strategy centred on STI would require close cooperation between a multitude of policy actors that may now be institutionally separated, have autonomy to set their own objectives and priorities, and compete with each other for national resources.

Recent literature has highlighted serious barriers to the development of effective STI policies as part of national development strategies. The key obstacles are:

- the inertia that is an inherent feature of existing policy systems, and the need for strong and committed political leadership to institute change in the national development planning process;
- despite over twenty years of "innovation systems" research, there is still only a weak understanding of how innovation systems work at all levels, and how the contributions that various elements (including policies and policy instruments) make – individually and collectively – to economic growth and improved human welfare can be evaluated.

This second obstacle serves to compound the first, in that the returns on public investment in particular systemic capacity-building initiatives may be inestimable, and this is likely to strengthen resistance to change at the policy level.

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:

- sets realistic timescales to meet national aims,

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26 Altenburg, Schmitz & Stamm 2007
28 See, for example, Altenburg, Schmitz & Stamm 2007, OECD 2007b
• 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;
• 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.

The complexity of this challenge cannot be overstated. If a national systems of innovation approach is to be used in policy-making, the present state of understanding of innovations systems - and the effectiveness of different policy options and instruments within them – will need to be improved to allow for sound policy guidance. In addition, building a successful innovation system will depend on both the prevailing national and global contexts, and these are constantly changing. In fact, 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 re-orient those systems to cope with fundamental changes in global knowledge markets. According to a recent analysis of the role of science and technology indicators, these changes may render current S&T indicators barely useful as policy guidance tools for future STI development. Finally, 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 Commission, UNCTAD, UNESCO and the World Bank, and, at the government level, through North-South and South-South cooperation.

IV International cooperation in the development of STI policy capacity

It is generally accepted that building systemic innovative capabilities is an imperative for achieving prosperity and enhanced human welfare at the national level. This raises the immediate question of how to move forward on integrating STI policies into national development strategies, given the scale and complexity of the task, especially in countries where STI policy capacity is

29 A key example here 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)

30 Freeman & Soete 2007
now relatively weak. This final section identifies the potential roles of some external actors in the future development of STI policy capacity-building at the national level.

It is hoped that the following brief outlines will serve as a starting point for the Commission's deliberations on this theme at the inter-sessional panel - and in the light of - the other presentations and discussions scheduled as part of this session.

The role of the STI policy research / innovation systems research community

Recent innovation systems literature has highlighted significant gaps in the present understanding of innovation systems, and the nature and timescales of successful development of STI capabilities. Some of these gaps have already been noted in earlier sections of this note. Empirical studies over a long time period are needed to progress the state of knowledge about successful innovation systems in order to provide more useful policy inputs than is now possible.

It would be useful for the policy / innovation systems research community, perhaps in conjunction with other relevant national representatives and international experts, to identify and summarize the nature of the most pressing gaps in knowledge, and propose a broad programme of internationally-networked studies to address them.

North-South and South-South cooperation at the national government level

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 benefits 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 specialist areas of science and technology, which would avoid duplication of effort and make the most effective use of scarce national resources.

STI policy learning might be very effectively gained through the sharing of experiences and knowledge as part of South-South cooperative agreements. In Chile, for example, an OECD Innovation Policy Review has already been carried out, and initiatives are already on-going to
develop/reform STI policies and institutions: early lessons might be shared with other countries that are going through similar capabilities-building processes, and with others 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.

**International support and coordination**

An increasing number of latecomer countries have partnered with international organizations to carry out analytical studies of their existing, or emerging, national innovation system. These studies include the OECD's Innovation Surveys and Innovation Policy Reviews, UNESCO's Science and Technology Policy Reviews, and of course, the UNCTAD Science, Technology & Innovation Policy (STIP) Reviews. However, bearing in mind the very imperfect understanding of innovation systems that has already been noted, and the associated weak capacity to measure the impact of policy intervention on the performance of an innovation system, there is a case for some sharing of experiences and lessons between these organizations, and involving the national counterparts from participating countries. This would enable the agencies to review and improve their own processes, and perhaps to develop a range of cooperative processes to develop policy support for innovation systems.

What is also needed is a focal point for all groups - the policy research community, national governments, other national stakeholder groups, and bilateral and multilateral agencies - to act as a forum for debate and knowledge-sharing. The Commission, which is already playing this role in relation to the WSIS follow-up, might consider whether it could act as a “torch-bearer” for innovation, or as coordinator for a concerted and accelerated international effort to build STI policy capacity.

**V. Summary and issues for discussion**

The main themes running through the key issues identified by the CSTD at its 11th session, and summarized in this paper, are time and systemic capacity-building.

In respect of deploying science and technology to address the Millennium Development Goals, there are short-term and long-term actions needed. In the period up to 2015, efforts will be focused
mainly on the deployment of existing technologies (irrespective of their countries of origin), and STI policy should aim to (as far as is possible):
- remove systemic barriers to their deployment;
- maximize the potential learning benefits from short-term activities to meet the MDG targets.

Beyond 2015, the achievement of sustainable poverty reduction require STI policies that build a dynamic enabling environment for science, technology and innovation, and in particular:
- education and training of an innovative, skilled and adaptable workforce;
- support for enterprise development and the improvement of incomes.

Building absorptive capabilities within enterprises and social welfare provider organizations 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). In addition, a range of policies that crosses sectoral boundaries and ministerial mandates is indicated by the "national innovation systems" approach. Each policy area is likely to have its own set of time lags (before implementation and/or impacts are felt), and therefore there is a need to coordinate policy development and implementation around a common vision, and a clear long-term strategy for its achievement.

The integration of science, technology and policy into national development strategy can be seen as the defining issue on the CSTD theme of "Science, technology and engineering for innovation and capacity-building for 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 extraordinarily complex. The difficulties in balancing short term priorities and long term goals are compounded at the policy level by:
- a lack of empirically-based analysis of the time needed for the process of "learning" (in organizations, and at the national level);
- a lack of appropriate policy research and analysis methods to evaluate the systemic impacts of different policy options.

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.

Different sets of actors should contribute to these efforts: policy decision-makers at the national level, private sector representatives, representatives of civil society, scientific communities
(national and transnational), STI policy/innovation systems researchers, and bilateral and international organizations. A key question is how the activities can be coordinated, and new knowledge disseminated, within a "virtual network" of these disparate actors.

It is therefore on these two issues - the integration of STI policy into national development strategy, and the cooperation between different actors (North-South, South-South and international) to achieve successful policy integration - that discussion will focus most usefully at the November 2008 panel meeting of the CSTD.
References


Freeman, C. & Soete, L. 1997 The Economics of Industrial Innovation. 3rd edition. London. Continuum.


