Distr.
RESTRICTED
E/CN.16/2006/CRP.1
3 May 2006

ENGLISH ONLY

Commission on Science and Technology for Development
Ninth session
Geneva, 15-19 May 2006

Panel on Bridging the Technology Gap between and within Nations

10-12 November 2005
Rabat, Morocco

Summary report prepared by the UNCTAD secretariat[1]

[1] This report summarizes the Panel's discussion; it does not necessarily reflect the views of the UNCTAD secretariat.

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INTRODUCTION

The substantive theme for the ninth session of the Commission on Science and Technology for Development (CSTD) will be "Bridging the technology gap between and within nations".

Countries and communities within a country may diverge greatly in their ability to create and diffuse technologies, giving rise to what is often termed as "technology gap". The gap exits not only in creation and diffusion but also in domestic capabilities to put available technologies into effective use through local adaptation and incremental improvement. Thus, the technology gap constitutes a major challenge for developing countries in their efforts to meet the targets set in the Millennium Development Goals (MDGs).

In order to contribute to further understanding of the issues, and to assist the Commission in its deliberations, the UNCTAD secretariat convened a panel meeting. The present report provides summaries of the main discussion and outcome of the meeting.

I. ORGANIZATION OF WORK

A. Attendance

The CSTD Panel Meeting for the intersessional period 2005-2006 was held in Rabat, Morocco, from 10 to 12 November 2005. It was organized by the Division on Investment, Technology and Enterprise Development (DITE) of UNCTAD. The Government of Morocco hosted the meeting, which was attended by 33 participants, including Commission members, other national representatives and the representatives of other UN agencies and non-governmental organizations (NGOs). Also present were three resource persons: Mr. Carlo Pietrobelli, Professor of Economics, University of Rome III, Italy; Mr. Declan Kirrane, Managing Director, Information Society Communications (ISC), Belgium; and Mr. Alaoui Mdaghri, Consultant on Management, Strategic and Technology Intelligence, Morocco. (See Annex I for the full list of participants.)

B. Documentation

The documentation for the meeting includes an issues paper prepared by the UNCTAD secretariat and presentations given by the participants. All meeting documents are available online at the Science and Technology for Development Network website: http://stdev.unctad.org.

II. SUMMARY OF THE DISCUSSION

A. Technology gap

The technology gap can be defined as the divergence between those who have access to technology and use it effectively, and those who do not. Countries' technological capabilities to acquire, adapt and improve upon scientific and technological knowledge are a major determinant in their capacity to narrow both income and technological gaps and to achieve sustainable economic growth. Science and Technology (S&T) policies are essential to foster the creation and strengthening of technological capabilities, and are therefore central in developing countries' efforts to achieve the Millennium Development Goals (MDGs).

The technology gap has been studied from the following perspectives: technology creation, diffusion, effective applications and domestic capabilities such as human skills and infrastructures, which would facilitate the creation, diffusion and the effective application. Most developing countries do not innovate at the technological frontier. The challenge for these countries, therefore, is to build domestic capabilities and facilitate the diffusion and effective use of the existing and emerging technologies.

Against this background, the CSTD has addressed the role of S&T in meeting the MDGs during the past two years. It has concluded that innovative strategies are needed to enable the effective harnessing of new and emerging technologies, such as information and communication technologies (ICTs) and biotechnology. These strategies would reduce the costs of, and increase the likelihood of achieving the MDGs. At the same time, existing technologies provide lower-risk, lower-cost opportunities for new businesses to gain footholds by applying such technologies to address specific local needs. For example, agricultural activities can be greatly enhanced through more mature technologies such as small-scale irrigation, quality fertilizers, farm mechanization and enhanced crop seed. Significant strides in health care can be made through existing drinking water systems and generic drug manufacturing.

1. The extent of the gap

In spite of technological achievements made by some developing countries in recent years, the "technology gap" between nations remains wide. For instance, one billion people do not have access to telephones and around 8 million villages or 30 per cent of all villages worldwide are still without any kind of connection. The gap exists not just in the creation and diffusion of technologies, but also in domestic abilities to put available technologies into effective use.

Today high income countries spend around 1.5 to 3.8 per cent of their GDP on R&D and fund more than 80 per cent of the world R&D activities. In contrast, most developing countries spend less than 0.5 per cent of their GDP on R&D activities and some developing countries spend as little as 0.01 per cent of their GDP.

The gap is also evident in education. Mean year schooling in 2003 was 12.1 years in the USA, 4.2 in Kenya and 0.8 in Guinea Bissau. Similarly, tertiary science enrolment ratio in 2003 was 27.3 per cent in Finland, 5.5 per cent in Colombia, 2.4 per cent in Albania and only 0.1 per cent in Chad.

One speaker presented a recent study carried out on sub-Saharan Africa (SSA), which has fallen behind in technological achievements as measured by manufacturing value added production (MVA) and manufactured exports. These data show that the performance for most sub-Saharan Africa countries, including South Africa, has either stagnated or worsened between the years 1980 and 2002, while East Asian countries have made substantial gains in MVAs and manufactured exports.

More specifically, MVA per capita statistics indicate that among the countries studied (Zimbabwe, Kenya, Tanzania, Uganda and Ghana), Zimbabwe had the largest base with a MVA production of more than $US 140 per capita in 1980, however, that number declined to $83 in 2002. The other countries had much smaller base, but their MVA performances, similar to Zimbabwe, had worsened between the years 1980 and 2002. South African MVA also declined from almost $600 to $450. Over the same time period, Malaysia's increased from slightly more than $300 to more than $1,200. China's MVA also increased to pass the level of $300 by 2002. Thus, regional comparisons show a big gain for East Asia over the years 1980 to 2002, and a small decline for SSA which had the smallest share of the global MVA to begin with.

Similarly, statistics related to manufactured exports show a substantial gain for China, East Asia (excluding China) and Mexico, while SSA had the smallest share of the world markets (less than 1 per cent) with no trend of increase. Export and MVA statistics in high and medium tech manufacturing is also not reflecting of technological upgrading.

Technology achievement indices such as UNCTAD's Innovation Capability Index (ICI) measure the quantitative components of National Innovation Systems (NIS). Within this framework, SSA has not made any significant gains in its innovative capacity between 1995 and 2001 and continued to have the lowest index values among the regions.

More detailed data also reveal substantially large national differences on domestic capacity-building efforts. For example, tertiary enrolments as a percentage of relevant age group stands at almost 25 per cent for East Asia, 10 per cent for South Asia and Latin America, 7 per cent for Middle East and North Africa and 2 per cent for SSA. The tertiary enrolment ratio in 1999 was more than 50 per cent for Korea and Taiwan Province of China, 30 per cent for Malaysia and Thailand, 13 per cent for China and 15 per cent for South Africa (a decline from 18 per cent in 1995). Of the five SSA countries studied, the enrolment rate was less than 4 per cent.

Moreover, tertiary enrolments in technical subjects stand at less than 0.1 per cent of the population in SSA, at slightly more than 0.1 per cent for Malaysia, India and South Africa, more than 0.4 per cent for Argentina and Chile, more than 1 per cent for Taiwan Province of China and more than 1.5 per cent for Korea. Thus the dispersion for technical subject enrolments seems to be wider than the general tertiary enrolment.

SSA countries also do poorly in the number of scientists and engineers in R&D activities per million population and R&D spending as percentage of GNP. The number of scientists and engineers average at 83 in SSA countries, while the average for all developing world is 514 and for Newly Industrializing Countries (NICs), 2,121. SSA countries spend 0.28 per cent of their GNP for R&D activities while the world average is 0.39 per cent and NICs' average is 1.5 per cent.

In short, the technology gap between nations is wide. Panelists pointed out that the technology gap also exists between countries in their negotiation abilities, between the formal and informal sectors; in scientific understanding between political and private sector leadership and the S&T community; in sharing of S&T information locally and internationally; in energy efficiencies and use; and in the retaining and use of S&T talents.

2. The gap within nations

Technology is not just slow in diffusing across the national borders but also within the borders. This gap within nations is a phenomenon that exists in both developing and developed countries.

In Germany, for example, 15 years after reunification, a technology gap still exists between the East and West. This gap is manifested in terms of productivities, patents, and private sector R&D personnel employment densities. In most of the former East Germany, the gross domestic product per employee is still less than Euros 42,300 while in most of the West, it is more than Euros 48,600.

In the early years of the reunification, capital investment from West Germany helped to upgrade East German technology and productivity; however, that investment has declined due to two reasons: 1. the rapid increase in East German wages; and 2. the increasing attractiveness of eastern European countries for West German investment. Moreover, West German investment has been mostly targeted at manufacturing, and has not included the transfer of R&D activities. Patents per 100,000 employees are less than 50 for most of the East German enterprises, and more than 100 for most of West German firms. As a result, the East German firms achieve only 40 per cent of the innovation productivity achieved by West German firms.

3. Digital divide

Within the technology gap, special attention should be devoted to the digital divide. The digital divide is defined as a growing asymmetry in the capacity of firms, institutions and individuals in different countries to use ICTs effectively in accessing and applying knowledge, and thus, spurring competitiveness and innovation. The digital divide between the information-rich and the information-poor remains significant – at twice the average levels of income inequality – and is therefore a source of increasing concern.

UNCTAD's Digital Divide Report shows that there is a correlation between the technology gap and the income gap. In other words, the technology gap is caused by and/or follows the income gap. Lorenz curve studies and gini coefficients over the years indicate that the inequality in measurements, such as the number of PCs, internet users, mobile phone subscribers and fixed phone lines have been declining (smaller gini coefficients representing more equal distribution), albeit very slowly, while the gini for the number of internet hosts has increased slightly.

More specifically, gini coefficients have declined from around 0.86 in 1997 to 0.65 in 2003 in Internet users. Over the same period, the coefficients also declined from 0.77 to 0.72 in number of PCs, from 0.77 to 0.57 in mobile phone subscription and from 0.65 to 0.53 in fixed phone lines. On the other hand, the gini coefficient for the number of Internet hosts has slightly increased to a level of 0.92. Despite the declining trend, most of these gini coefficients still remain high, indicating the severe extent of the inequality and the technology gap.

Comparative gini coefficients reveal that older technologies such as fixed phone lines are more equally distributed. Yet, also revealed by the gini coefficients is that relative to other sectors, mobile phones sector has demonstrated a leapfrogging by achieving a much wider and faster technology diffusion, effective usage and an establishment of a dynamic sector.

Presentations and the discussions in the panel meeting highlighted the role of governments, private sector, civil society and educational institutions in bridging the digital divide. Participants underscored that governments should set themselves as examples and facilitate faster and subsidized diffusion of technologies, especially of software. The private sector should contribute with its technical and managerial know-how, and its experience on commercialization. Civil society should stimulate public interest in technologies while educational institutions are fundamental in raising skill levels, fostering research cultures and contributing to applied research, mainly through its industry partnership. They also emphasized the importance of forming networks and partnerships among all stakeholders.

B. Capacity-building and technological upgrading

It is apparent that the markets alone often do not facilitate the desired rate and level of technological diffusion and upgrading. Policies and capacity building efforts are needed to stimulate the diffusion and the effective usage to the desired levels. These efforts include both domestic (autonomous) efforts, such as human capital development, improving physical and services infrastructures; and global efforts, such as international technology transfers and internationally coordinated projects.

1. Globalization of technology, technology transfers and learning

Globalization of technology has provided both opportunities and challenges for technological learning and upgrading. With the exception of a handful of developing countries, most notably the Asian NICs, most developing countries have yet to seize the opportunities provided by the globalization of technology. The opportunities posed by such globalization can be investigated under three categories:

i) International technology transfers through trade of innovative goods and capital equipment, trade of knowledge (license and patents) and establishment of FDIs;

ii) Globally generated knowledge through intra-firm networks of R&D centres;

iii) Global inter-firm collaborations and joint scientific projects.

a) International technology transfers

Most developing countries do not innovate at the technological frontier. Instead, they acquire, adapt, diffuse and use technologies that are developed in industrialized countries. Main channels of technology transfer are capital equipment imports, followed by foreign direct investment (FDI) inflows. Licensing seems to play a much lesser role.

The opportunities offered by globalization of technology and international technology transfers are not fully and equally grasped by most developing nations. For example, while East Asian countries such as Thailand, Malaysia and China spend more than 40 per cent of their import expenditures on capital equipments, for sub-Saharan Africa and India, equipment imports constitute only 15 to 23 per cent of their total imports.

Similar variations within developing countries also exist in FDI flow statistics. Transnational corporations (TNCs) that dominate global FDI flows have been the main source of innovation. As major innovators, they play a crucial role in international technology transfer, especially in high-tech industries where extensive use of knowledge-based assets is required. Sub-Saharan countries have not done well in attracting TNC-based FDIs, and their share in world FDI inflows is the smallest and is less than 2 per cent of the world total. Moreover, FDI inflows to SSA are concentrated in resource-intensive sectors rather than technology-based ones, hence FDI-related technological upgrading in SSA is minimal.

On the other hand, the experience of East Asian countries tells a different story. Many of these countries have adopted policies that promote technology transfer, especially via FDI inflows and equipment imports, and effectively inserted themselves into global production networks, and thus, have been among the world's fastest growing manufactured product-exporters. Evidence also suggests that these countries did not just benefit from the technology transfers from parent companies to subsidiaries but also from subsidiaries to local domestic firms.

The policy challenge is thus how governments should build local capabilities to target and facilitate acquisition of technology through FDI. Specific policies need to be formulated to attract FDI with high technology content and increase its potential contribution to the transfer and diffusion of technology, and to the building of local capacity. Therefore, policies on technology transfer through FDI should focus not only on the “physical” aspect of investment, such as imports of machinery and equipment, but also on the acquisition of information and knowledge.

b) Global generation of innovation

Many TNCs may be slow to relocate their R&D activities from their home country to a host country, especially so if the host country is a developing country. However, recent findings do indicate that TNCs eventually transfer some of their R&D activities to the developing countries, mainly to Asia. More than half of world's top R&D spenders are already conducting R&D in China, India and Singapore. In China, the number of foreign R&D units has increased from 0 to more than 700 over a decade; India has been carrying out increasing numbers of clinical research activities for global pharmaceutical companies.

c) Global scientific and technological collaboration

Global collaborations, either through inter-firm partnerships or scientific exchange, provide great opportunities for learning. It has been argued that such cross-border partnerships provide learning opportunities as they bring about a process within institutions and firms in which the flow of knowledge and technology tends to be “two-way”. Evidence, however, shows that although developing country firms have increased their participation significantly, partnerships are still overwhelmingly concentrated in developed countries. A rather small group of developing countries, e.g., NICs and economies in transition with significant capabilities and domestic markets have benefited disproportionately more than others.

A number of policy options exist for governments to increase partnering and hence the competitiveness of firms. However, all the options depend on the creation of an enabling business environment for partnering, which includes macroeconomic stability, legal and regulatory framework, and the infrastructures in the areas of communication, transportation, education and training. Once the government has provided for such an enabling environment, it can pursue various options via public–private sector partnerships. The options include specialized skill development; provision of business development services to firms to make them partnership-ready; FDI strategies which target TNCs interested in partnering; and identification of firms with high potential for such arrangements.

The CSTD has over the years emphasized the crucial importance of South-South research networks to serve as hubs for training and exchange of experiences. International organizations have a role to play in facilitating South-South cooperation to generate research relevant to industrial and technological development, exchange of knowledge and best practice. In this regard, UNCTAD's recently set up network of centres of excellence project is a welcome step in this direction.

2. Domestic efforts and national innovation systems

Technology transfer, adaptation, diffusion and use, does not take place automatically. Domestic efforts at capacity-building are crucial. In the case of FDI, foreign investment may not even take place if the domestic capability-building efforts, human skills and physical infrastructure are not there to begin with. Moreover, the benefits of FDI-based technological upgrading can be fully captured only if the new technologies also diffuse to the domestic firms, and this depends, to a great extent, on domestic capabilities such as skills and infrastructure.

Broadly, most countries focus their capacity-building efforts in the following areas: a) infrastructure; (b) education and human capital-building, (c) public and private research activities.

Infrastructure
Infrastructure includes services such as business incubators, S&T parks, access to finance, business development agencies, investment promotion agencies, etc. Not only does infrastructure serve as the foundation for technology creation and diffusion, but its development also provides opportunities for technological learning and upgrading due to the wide range of technologies employed and the associated institutional arrangements.

Infrastructure services such as business incubators, science and technology parks are all considered central players in well-functioning national innovation systems. Access to venture capital and the collaboration between venture capital investors and incubators are also crucial elements in this respect.

Education and human capital-building

Primary and secondary education systems as well as on-the-job-training contribute to the research and technological upgrading activities via their effect on the labour productivity and business competitiveness. On the other hand, tertiary education, especially in the areas of science, technology and management contribute to the innovation, research and technical human capabilities of the countries.

Four Asian tigers – the Republic of Korea, Taiwan Province of China, Singapore and Hong Kong (China) – have heavily invested in all levels of formal education, and even outpaced the OECD countries in human capital formation as measured by the S&T enrolments in the tertiary education as percentage of population. Studies also show that science education should be strengthened at the earliest level in educational systems. Special emphasis should be placed on S&T-related studies at the tertiary level.

Public and private research activities

A critical driver of technological development and innovation is R&D. Research activities can be carried through universities, public and private research institutes, as well as private company research centres. R&D activities are necessary for innovation, technology creation, as well as for local adaptation and incremental improvement of imported technologies.

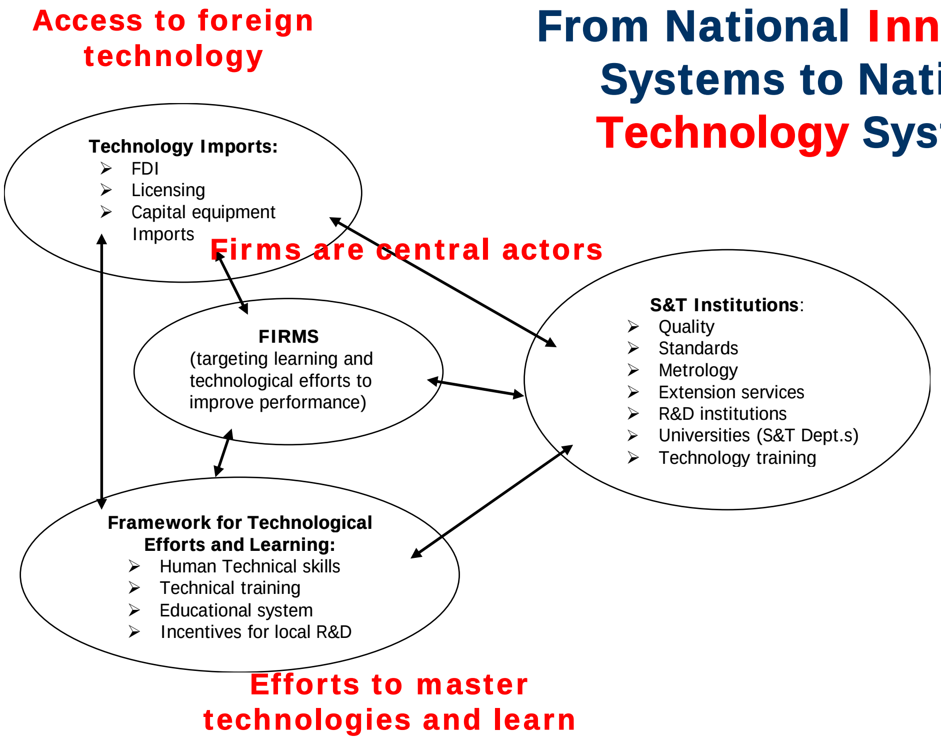
In most developing countries, R&D spending is low, mostly carried out by universities, and is of little relevance to industry; however, in developed countries, the private sector funds more than half of R&D activities and actually carries out more than two thirds of projects. According to UNCTAD, private sector finances roughly 70 per cent of total R&D activities in the ten leading countries with highest R&D spending. By contrast, in many developing countries, the public sectors share in research activities is more that 70 per cent, resulting in under-commercialization of the research results.

Most Asian tigers allocated a large share on their GDP on R&D activities, as well as subsidized and tax-exempted such activities, raising the private sector's contribution and share in overall R&D activities. Policies aimed at encouraging more private sector involvement in R&D and policies towards commercialization of public research results via public private partnerships and other policies may substantially raise the technological capabilities.

Participants discussed some of the key elements of National Innovation Systems (NIS), and underlined that a well-functioning NIS includes not only institutions and industry related to infrastructure, education, training and R&D activities, but also government legislations, standard-setting institutions, industry structure and aspects facilitating international technology transfer and its absorption, as well as the interaction among all these institutions.

Participants recalled some of the common problems of the NIS in many developing countries, as identified by the CSTD: (1) a lack of a clearly defined set of objectives for the development of science and technology and innovation; (2) the absence of the integration of S&T in the country's development policy objectives; (3) lack of networks of S&T institutions (such as universities, research institutes, standards institutions); (4) isolation of the preceding from the productive sectors of the economy; (5) insufficient horizontal coordination between the main areas of public policy – fiscal and monetary, foreign investment, intellectual property, competition, trade, agricultural and industrial development, environment, health, etc. – that may be interrelated with investment in S&T development; (6) insufficient vertical coordination between S&T policies at the national, regional and community levels; and (7) lack of consultation with, and participation of all main actors – government agencies, business, academia, S&T institutions, consumers, labour and civic groups – in the formulation and implementation of S&T and innovation policies.

Since many developing countries' systems are focused on effective usage and improvement of existing technologies rather than innovating at the frontier, one expert called for greater attention to the *national technology system*, which places greater emphasis on policies and measures that facilitate access to foreign technologies, and support domestic efforts, especially at the firm level, to master technologies and learn. The diagram below illustrates some of the most important elements of technology systems.[2]



[2] Carlo Pietrobelli, "National Technology Systems for Manufacturing in Sub-Saharan Africa", powerpoint presentation.

C. Strategies adopted/ to be adopted

From the presentations and session debates of the participants, a number of themes and sub-themes emerged as important national and international strategies aiming to facilitate national capacity-building and technological upgrading.

Participants noted that economic stability, strong government commitment for bridging the technology gap and the need to address wider economic issues (such as global competitiveness, trade barriers and distortions, and increasing consumption behaviors), are preconditions for technological development. Further, they emphasized the critical importance of the following themes:

a) Human capital and skills
Raising human capital and technical skills[3] emerged as the most important strategy in technological upgrading. To this end, participants highlighted the role of formal education at all levels, as well as the role of workshops and on-the-job training. They also underscored the importance of tertiary education and technical subjects at the tertiary level. Panelists also underscored that young people, especially women and girls, should be encouraged to study science and technical subjects. They highlighted the need to create attractive work environments and employment conditions so as to reverse the negative impact of the brain drain.

b) Infrastructure
Participants emphasized the need to set up and upgrade physical infrastructure such as universities, technology parks, and ICT infrastructure. They also emphasized the need to establish and upgrade the quality of services infrastructure, such as investment funds for technology transfers, incubators, technology foresighting and modeling, and technical consulting services. Panelists stressed the need to raise the efficiency of technology markets and to create a demand-pull effect via raising public awareness on available technologies through exhibitions, publications or electronic media.[4]

c) Private sector, domestic partnerships and clusters
Participants addressed the issue of stimulating the participation of the private sector in R&D activities, possibly through industry-university-research institute partnerships and collaborative R&D projects, and commercialization of public R&D activities and findings. They highlighted the role of government policy in stimulating the formation of technology clusters and regional networks[5].

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[3] Within this framework, the Chinese government has shifted its priority from supporting S&T itself to supporting capacity/skills-building activities. Between 1993 and 2003, Chinese national R&D expenditures ncreased, on average, by 15.8 per cent annually. The number of R&D teams, its structure and quality has been increased. The number of researchers increased by 10.9 per cent from 1999 to 2000 and reached to 922,000 persons.

[4] By the end of 2002, China built 425 S&T exhibition halls and produced 7,000 to 8,000 scientific and educational publications in order to raise public awareness of science and technology issues.

[5] For example, under the InnoRegio Programme, Germany spent Euros 65 million in 2003 to subsidize cooperative networks and strengthen regional focus. The total funding for the designated period 1999-2006 is estimated to be Euros 255 million. The programme targets large companies, SMEs, research institutes, universities, public authorities and individuals as long as the projects include a region-specific profile and creation of a regional network.

d) International partnerships

International partnerships have been emphasized as a way of facilitating technology flows into developing countries, as well as an opportunity to address the problems and issues that are unique to developing countries. Panelists concluded that student and researcher exchange programs should be facilitated at the international level, as this is an important channel for the upgrading of scientific and technical capabilities. A special emphasis was given to South-South cooperation among developing country governments as a way of increasing the bargaining power of developing countries in trade negotiation, which in turn can facilitate faster technology transfers to developing countries.

III. MAIN FINDINGS

1) A technology gap exists between and within nations. It exists in all dimensions from accessing knowledge to effective use and creation of knowledge. Technology gaps severely constrain the efforts of developing countries in meeting the MDGs.

2) Technology creation, diffusion and effective use is not an automatic process and requires carefully designed strategies and policies. Hence, S&T policies are central to the achievement of MDGs.

3) ICTs are a key sector in S&T policies as they play a major role in accessing, processing and communicating knowledge and information.

4) Many developing countries do not innovate at the frontier. For them, accessing, acquiring, locally adapting, effectively using, and improving upon existing technologies are the main challenges.

5) International technology transfers and international collaborative projects are important channels for developing countries to access to and acquire technologies developed in other countries. It is therefore recognized that stimulating these channels will be a right step in technological upgrading efforts.

6) It is also recognized that local adaptation, effective use and improvement upon existing technologies require more than technology transfer. It requires domestic capacity-building and increasing human capital.

7) Economic stability and government commitment are crucial parts of successful S&T policies. The global economic environment should also be considered in designing such policies.

8) Raising human capital and skills through education and training are essential strategies in raising domestic capabilities. Special attention should be paid to encourage young people, especially women, to enter the fields of science and technology. Efforts should also be made to reverse the impact of brain-drain.

9) Upgrading both physical and services infrastructure are important strategies for domestic capacity-building. A special emphasis is placed on services such as financial

services, technical consulting, technology foresighting, incubators and public awareness units.

10) Policies should be in place to encourage active participation of the private sector in R&D activities. Partnerships among the industry, university and the public R&D institutions should also be encouraged.

11) International collaborative projects and partnerships should be encouraged with the aim of facilitating technology transfers to developing countries, addressing issues and problems unique to developing countries, and developing human resource capacity in those countries.

IV. RECOMMENDATIONS OF THE PANEL

The Panel

1 *Encourages* UNCTAD to continue providing its expertise and analytical skills for science, technology and innovation policy reviews (STIPs), with a view to assisting developing countries in the identification of appropriate measures that are needed to integrate science, technology and innovation policies in national development strategies to ensure that they serve as effective tools for achieving the MDGs.

2 *Invites* UNCTAD to continue to collaborate with the International Telecommunication Union to update its annual publication on the Digital Divide, with a view to identifying best practice case studies aimed at assisting developing countries adopt appropriate ICT policies that would help them narrow the digital divide and benefit from the potential of ICTs.

3 *Encourages* the relevant bodies of the United Nations system engaged in biotechnology to work cooperatively in the context of the UN-Biotech,[6] and within an integrated framework on biotechnology, to help developing countries in building productive capacity in all areas of biotechnology in industry, health and agriculture, as well as in risk assessment and management of biosafety. Such a framework should take advantage of existing programmes, such as the newly-established UNCTAD network of centres of excellence, the International Centre for Genetic Engineering and Biotechnology affiliate centres and UNIDO, UNEP, FAO and WHO national offices.

4 *Welcomes* UNCTAD's new collaborative initiative with other multilateral organizations such as the World Association of Industrial and Technological Research Organizations (WAITRO) in carrying out a series of regional symposiums on the application of science and technology to meet the MDGs, especially on themes that relate to the special needs of developing countries, such as in food security, water, renewable energy, forestry and climate change.

5. *Encourages* UNCTAD to compile, and disseminate examples of good practice from developing countries that have been successful in promoting linkage between government, research institutes and the private sector and in promoting technology foresight and prospecting through multi-stakeholder partnership.

National governments should consider:

1. *Undertaking* needs assessment exercises to determine whether existing science, technology and innovation policies effectively serve the needs of national development goals, especially in the context of meeting the MDGs;

2. *Involving* representatives from industry, academia and public sectors in carrying out a comprehensive technology foresight exercise with the purpose of identifying technologies that

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[6] UN-Biotech is a United Nations inter-agency cooperation biotechnology network set up in March 2004 in response to General Assembly resolution A/RES/58/200. The UN-Biotech has met twice at UNCTAD in conjunction with annual regular sessions of the Commission on Science and Technology for Development.

are likely to help address pressing socio-economic issues and establish priorities in S&T policy and governmental programmes on research and education accordingly;

3. *Strengthening* linkages between public research and private industry, and tap into regional and international R&D networks;

4. *Improving* national mechanisms for the promotion of knowledge-based and innovative enterprises through various interventions and incentives, as well as for the transfer of knowledge and technology.

ANNEX I
LIST OF PARTICIPANTS

1. CSTD members

Mr. Pedro Sebastiao Teta	Angola
Mr. Bernd Michael Rode	Austria
Mr. Jorge Norambuena	Chile
Mr. Luo Delong	China
Mr. Shumu Tefera	Ethiopia
Ms. Vivien Lo	Germany
Mr. Arturo Falaschi	Italy
Mr. Arnoldo K. Ventura	Jamaica
Ms. Rolanda Predescu	Romania
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Mr. Sarh Johnny	Sierra Leone
Mr. Štefan Morávek	Slovakia
Mr. David Woolnough	United Kingdom

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Mr. Zayer El Majid
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Mr. Ahmed El Hattab
Director of Science, Ministry of Education

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Mr. Fernando Zarauz
Field Officer, UNESCO Rabat Office, UNESCO

Dr. Joan Dzenowagis
Project Manager, e-Health, WHO

6. Secretariat

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Ms. Dong Wu
Economic Affairs Officer, UNCTAD

Mr. Cagay Coskuner
Associate Economic Affairs Officer, UNCTAD

ANNEX II

LIST OF DOCUMENTS AND PRESENTATIONS

Issues paper by the UNCTAD secretariat, "Bridging the technology gap between and within nations".

7. Presentations by resource persons

C. Pietrobelli, "National Technology Systems for Manufacturing in Sub-Saharan Africa"

D. Kirrane, "The Gap: Data, Knowledge Awareness, Dissemination, FP7 - Close the GAP"

A. Mdaghri, "Digital Divide: A Challenge for Cooperation and Development"

8. Country reports

Chile
Germany
Italy
Jamaica
Morocco
Romania
Slovakia

9. Reports of international organizations

World Health Organization