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**SYNTHESIS REPORT ON THE CSTD PANELS ON TECHNOLOGY
DEVELOPMENT AND CAPACITY-BUILDING IN A DIGITAL SOCIETY**

Report by the Secretary-General

Executive summary

The Commission on Science and Technology for Development (CSTD), at its fifth session in May 2001, selected as the substantive theme for its inter-sessional period 2001–2003 “Technology development and capacity-building for competitiveness in a digital society”, with particular attention to information and telecommunication technologies (ICTs) as pervasive tools of global impact with wide applications and growing potential. The Commission's work programme during the period 2001–2003 has been carried out through three panels. These panels covered three main issues: (a) the measurement and benchmarking of technology development; (b) the role of foreign direct investment in transferring technology and in building national ICT capabilities; and (c) policy options of particular importance to developing countries. The present report summarizes the main findings that have emerged from these panels. It concludes with a series of policy recommendations for consideration by the Commission on Science and Technology for Development at its sixth session.

ABBREVIATIONS

CIS	Commonwealth of Independent States
CSTD	United Nations Commission on Science and Technology for Development
FDI	foreign direct investment
GDP	gross domestic product
ICT	information and communication technology (adjective, e.g. ICT services)
ICTs	information and communication technologies (noun, e.g. the uses of ICTs)
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
SME	small and medium-sized enterprises
UNCTAD	United Nations Conference on Trade and Development
WSIS	World Summit on the Information Society
WTO	World Trade Organization

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I. INTRODUCTION

1. The importance of technology for economic development has long been recognized. This may be especially true of information and communication technologies (ICTs), which as infrastructure technologies cut across all economic activities and have a wide range of applications, offering the potential for increased availability of information, new communication opportunities, reorganization of productive processes and improved efficiency in many different economic activities. However, technological research, innovation and capabilities remain concentrated in a limited number of countries. There is growing concern that many developing countries are being left behind, not able to participate in shaping these technologies and deprived of the benefits of technology and ICTs. Such marginalization has led to serious inequalities within and between nations and created what has been termed the “digital divide”.

2. It is in this context that the United Nations Commission on Science and Technology for Development (CSTD), at its fifth session in May 2001, selected as the substantive theme for its inter-sessional period 2001–2003 “Technology development and capacity-building for competitiveness in a digital society”, with particular attention to ICTs as pervasive tools of global impact with wide applications and growing potential.

3. The Commission's work programme during the period 2001–2003 has been carried out through three panels. The meeting of Panel I, on indicators of technology development, took place in Geneva, Switzerland, from 22 to 24 May 2002. The meeting of Panel II, on foreign direct investment and technology capacity-building for strategic competitiveness took place in Colombo, Sri Lanka, from 15 to 17 October 2002. The meeting of Panel III, on enhancing strategic competitiveness in ICTs, took place in Luanda, Angola, from 15 to 17 January 2003. The panels provide measures of ICT development and formulate policies to address national ICT capabilities and the international “digital divide” in the context of globalization. Their work could be used as an important input to the World Summit on the Information Society.

4. The present report is based on the analysis and conclusions of the above-mentioned panel meetings, on national reports contributed by members of the CSTD and on relevant literature on the subject. Its recommendations are directed towards Governments, the United Nations system and intergovernmental organizations.

5. At its sixth session, the CSTD will consider technology development and capacity-building for competitiveness in a digital society. The outcome of its deliberations should serve as an important contribution to the World Summit on the Information Society, which will be held in Geneva, Switzerland, in December 2003 and in Tunis, Tunisia, in 2005.

II. BACKGROUND

6. Modern ICTs provide both opportunities and challenges for developing countries. ICTs are the technologies used to access, communicate and exchange ideas and information through interconnected computer networks. They form a cluster of associated technologies with the power to make vast amounts of information available on an unprecedented scale. They provide at one and the same time a means of information dissemination with worldwide broadcasting

capability, a medium for interaction between individuals and a truly global market place for goods and services.

7. These new technologies have a wide range of applications. For countries that have succeeded in building national ICT capabilities, ICTs offer the potential for more efficient information-sharing, communication and knowledge dissemination. They could transform work methods through their potential for collaborative networking, which could result in wide-ranging restructuring of industries.

8. However, despite the enormous benefits offered by ICTs, developing countries face significant obstacles to their effective use. For example, the telecommunications infrastructure in most developing countries is insufficient. Poor computer and general literacy, lack of awareness and regulatory inadequacy present further problems.

9. The presence of these problems is reflected in highly uneven growth in the use of ICTs across countries. This so-called digital divide between the information-rich and the information-poor is of increasing concern. In absolute terms, the gap between the ICT leaders and the ICT laggards is growing.

10. Technological gaps, uneven diffusion and possible exclusion from the benefits of technologies are not new. For example, telephony and electricity are still far from being evenly diffused. With ICTs, however, the size and scale of the benefits forgone by failure to participate in the new “digital society” could be much greater. It is essential, therefore, that steps be taken to ensure that developing countries have the ability to participate in this information economy.

III. BENCHMARKING COUNTRIES' TECHNOLOGICAL DEVELOPMENT AND THE EXTENT OF THE DIVIDE IN THE DIGITAL SOCIETY

III.1 Indices of Technology Development

11. Indices of Technology Development measure the extent of technological development in terms of investment in research and development (R&D), human capital and export performance.¹ These indices show that different aspects of technological development are related, with high correlations observed between R&D, human capital and export performance for 1995–1999. Classification of countries as “lagging behind”, “keeping up” and “getting ahead” on the basis of index rankings shows that rankings are stable over time, with some apparent regional influences. As a broad generalization, Latin American and transition economies are keeping up while countries belonging to the Organisation for Economic Co-operation and Development (OECD) and some South-East Asian Tigers are getting ahead. However, there is considerable diversity in countries’ experiences; for example, transition economies display notable variation in all indicators except education and human capital, where they are consistently strong. African and South Asian countries were mostly omitted from the analysis of general technological development because of data limitations.

¹ The computations of Indices of Technology Development are based on the analysis of up to 92 countries carried out by the UNCTAD Secretariat in conjunction with CSTD in 2002.

III.2 ICT Development Indices

12. The CSTD analysed and benchmarked ICT development and diffusion across 160–200 countries for 1995–2001. The cross-country study presents data and calculates ICT Development Indices for the following: connectivity (physical infrastructure for ICTs in penetration rates of Internet hosts, personal computers, telephone mainlines and mobile phones per capita); wider access to ICTs (literacy, GDP per capita and cost of local calls, as well as actual number of Internet users); usage of ICTs (incoming and outgoing telecom traffic, as an alternative to Internet data traffic flows in the absence of publicly available statistics on these); and policy environment (a wider policy framework conducive to the adoption and absorption of ICTs, which can be evaluated in terms of the presence of a domestic Internet exchange as well as competition in telecommunication and ICT markets).

13. Country and regional rankings were analysed over time to identify significant trends. Not surprisingly, the findings are similar to those from Indices of Technology Development. Country rankings were stable over time and regional influences are quite apparent. In general, African and South Asian countries are falling behind, Latin American and transition economies are keeping up, and OECD countries and South East Asian Tigers are getting ahead.

III.3 Measuring the “digital divide”

14. The Commission further evaluated the evolution of the digital divide. In absolute terms, the gap between the leaders (primarily OECD countries) and laggards (primarily African and some CIS countries) is growing. Within the OECD countries that are leading in connectivity, there appears to be convergence. Analysis of relative measures such as the population-weighted Gini coefficient for inequality reveals high initial levels of inequality, approximately twice the average country level of income inequality. More mature technologies (e.g. telephone lines) are more evenly distributed, compared to more recent technologies (e.g. Internet hosts). There is evidence of catching-up in mobile phone usage, which has the lowest Gini coefficients. This suggests that mobile technologies could play a significant role in improving ICT access in developing countries. Trends in hardware connectivity indicate that there is some catching-up, primarily owing to remarkable gains made in connectivity by China.² Reducing the digital gap requires not only installing physical infrastructure, but also more open access and more efficient use of this infrastructure so that the benefits of ICTs are spread more widely across countries as well as more equally within countries.

IV. FOREIGN DIRECT INVESTMENT AND TRANSFER OF TECHNOLOGY

IV.1 Role of foreign direct investment in the acquisition of technology

15. Over the past decade or so, foreign direct investment has emerged as one of the most active channels through which the transfer and the acquisition of new technologies take place. The experience of the Asian countries with respect to technology transfer is a case in point. Many of these countries have been among the world’s fastest-growing exporters of manufactured products in the past decade, and this has been accompanied by large inflows of FDI. For those countries, using FDI to insert themselves into international production networks

² For further details, see UNCTAD *ICT Development Indices* (forthcoming).

has proved to be an effective way of building export competitiveness. Through acquisition of skills to adapt and master technology, some firms in East Asia have become leading global players in the development of technology.³

16. When accompanied by appropriate government policies, FDI could increase the level of technology in the host economy in three ways. First, foreign affiliates are in general capable of applying more advanced technology and are hence more productive; second, through "deep integration" between foreign affiliates and local firms, spillover to domestic competitors can occur; and third, FDI can stimulate more competition in the domestic market, thus improving allocation of resources. Evidence from countries in East Asia suggests that technologies have been transferred not only from foreign firms to their subsidiaries but also from their subsidiaries to local firms.

17. The policy challenge is thus how government should target and facilitate acquisition of technology through FDI. Specific policies need to be formulated to attract FDI with high technology content and increase FDI's 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.

18. Issues of technology transfer and spillovers have been widely studied and there exists a voluminous and sometimes controversial literature. The key lessons from this literature are that a country is more likely to benefit from foreign investment if it has a long-term policy integrated into its development and technological plans. In many countries, there has been a strong strategic focus on increasing industrial productivity through building up indigenous technological capabilities while at the same time encouraging inward technology flows through FDI.

19. It is important to note that simply plugging into global production networks at the most (unskilled) labour-intensive end is not necessarily a sustainable strategy over the long term. In order to achieve continual productivity growth, more complex and skill-intensive processes need to be introduced. Existing technologies must continually be improved and it is imperative for countries to enhance domestic capabilities: skills, supplier bases, research and development capabilities and the physical infrastructure.

IV.2 Transnational corporations and technological spillover

20. Transnational corporations (TNCs) that dominate global FDI flows are also the main source of innovation. As major innovators, TNCs play a crucial role in international technology transfer, especially in high-tech industries where extensive use of knowledge-based assets is required.

21. TNCs may enter a recipient country through acquisition/joint ventures or establishment of a wholly owned subsidiary. In technology-intensive areas, acquisitions/joint ventures may be more conducive to technology diffusion than a direct entry (wholly owned subsidiary) since

³ This aspect is important because technology learners in developing countries, with low or no capital stocks to replace, have the potential to drive innovations in new directions, especially in the area of pioneering production methods that avoid causing harm to the environment.

local partners would have an existing network of contacts in the local economy, which would facilitate dissemination of such knowledge to the rest of the economy.

22. Beneficiaries of FDI in terms of technology transfer are not restricted to the TNCs' subsidiaries. With appropriate policies, FDI can provide local firms with opportunities to learn TNCs' advanced production system and management practices. It also encourages the development of specialized services that may become available to local firms but would not have developed without FDI.

23. TNCs require high-quality inputs and well-managed supply chains to meet their market and production requirements. Potential local suppliers to TNCs will often seek to upgrade their technological capabilities to meet the needs of TNCs. This may be achieved through training of suppliers in quality control systems, and stock control and management, and helping the formation of a more skilled workforce. Furthermore, they may introduce the suppliers to international markets and collaborators. Movement of skilled and trained people from TNCs to local firms is also likely to transfer skills and valuable management and technical know-how.

24. FDI can also provide a stimulus for local firms to increase productivity by introducing more competition. Entry of a technologically advanced foreign (multinational) firm into the market could induce local competitors to upgrade their technology and production systems to secure and maintain their market position. At the same time, firms with low productivity could be forced to exit the industry. Also, market forces should be governed by appropriate regulatory regimes to ensure that fair competition practices prevail. Thus competitive stimuli introduced by FDI could lead to a better resource allocation at both firm and industry level.

V. TECHNOLOGY DEVELOPMENT AND STRATEGIC COMPETITIVENESS IN A DIGITAL SOCIETY

V.1 The growing significance of competitiveness

25. International competitiveness is at the core of industrial success more than ever before. Trade liberalization and improvements in transport and communications technology are reducing "economic distance" and bringing economies ever closer. While globalization leaves enterprises to face unprecedented global competition in domestic as well as foreign markets, the potential benefits of attaining competitiveness for economies are also enormous. It opens up opportunities to widen market base by enabling entry into hitherto inaccessible markets and also facilitating access to modern technologies in the form of new products, equipment and knowledge. In this globalized economic environment, developing countries must focus on improving its competitiveness not just by relying on their low-cost labour but also by improving their technologies.

26. The increasing importance of technology has been reflected in the changing patterns of trade, with product segments based on research and development growing faster than less technology-intensive segments. High-technology activities the world over are expanding in both production and trade much faster than other manufacturing activities. At the core of the high technology sector is the group of ICT industries that are the driving forces of the current technological revolution.

27. Another feature of strategic competitiveness is the emergence of international “networking”. A recent trend in technology development is that innovation activities require increasingly large-scale undertakings in R&D. The firms are therefore presented with large costs and associated risks. Hence, TNCs that have the financial strength to take on the expenditures and risks involved are leading the way in innovation activities. The need to spread the cost and risks has also led to greater inter-firm and cross-national collaboration and networking in innovative effort.

28. The growing ability of firms to network far-flung activities as a result of shrinking economic distance allows production chains to be spread over longer distances. TNCs are continually seeking more efficient locations across the globe. TNCs' production systems are tightly knit and coordinated, particularly in technologically sophisticated activities. Thus, for most firms in developing countries, entry into the most dynamic and technology-based activities entails “plugging into” TNC-dominated chains.

V.2 Technology and capacity-building

29. Efforts to build technological capabilities are important even for those developing countries that are not “innovating” at the frontier. These countries may import new technologies in the form of equipment or licensing from more advanced countries, but they have to learn to use these inputs effectively. Using new technologies is not an automatic or simple process. It entails the conscious effort to build “technological capabilities”, a mixture of information, skills, interactions and routines that firms need in order to handle the tacit elements of technology.

30. In developing countries, the bulk of technological activity consists in mastering imported technologies, adapting them to local conditions, improving them and finally using them as a base for creating new technologies. To master more complex technologies, R&D becomes necessary for understanding their underlying principles, adapting them for their needs and developing them further. R&D is also vital as a means of keeping up with new technologies as they emerge. A growing base of R&D capabilities also permits better and faster diffusion of new technologies within the economy, reduces the cost of technology transfer and captures more of the spillover benefits created by the operation of foreign firms. Most importantly, it permits the industrial sector as a whole greater flexibility and diversification of industrial activity by creating a “technology culture”. There are well-known difficulties in appropriating full returns to private R&D, especially in some developing countries, where the legal framework for enforcing patent rights is often weak. Authorities in developing countries need to address this issue and put in place the legal framework, which is conducive to encouraging R&D activities.

V.3 Strengthening institutions in national systems of innovation

31. Technology policy in developing countries should be seen as an integral part of industrial development policy. It should provide the setting in which industrial firms operate, seek technology and learn how they could use and improve it. Governments need to consider measures to stimulate R&D, establish technology institutions and technology parks, and support SMEs.

32. There is a need to strengthen the national systems of innovation that support ICT firms in developing countries. Public-sector knowledge-producing institutions need to constantly update their skills, and improve their understanding of technological trends. Educational institutions need to provide students with not only an understanding of fundamental principles and technological trends, but also applied skills and industry-specific technological knowledge. In their interactions with industry, public-sector institutions need to become more facilitating and supportive of technological knowledge exchange.

33. Demands for economic efficiency, coupled with fast-changing product cycles and customer preferences, require a number of proactive steps, or “technology intermediation”, for speedy conversion of knowledge and technological competence into investment and products. There is a need to strengthen institutions that can “spot” and assess technology, forecast the kind of technology that might take place, and bring together the potential technology receivers and sellers. Many countries have set up “Technology Watch Centres”, which undertake the role of technology intermediation. In the initial period of “catching up”, Governments could take on a greater role in creating technology intermediaries.

V.4 Strategies at the firm level

34. Developing country firms can deploy a range of technological learning and innovation routines that go beyond traditional R&D-centred approaches. For the majority of developing country firms, importation of technological inputs from international firms is a primary source of technology. Therefore, those “technology-learning” firms should interact with the suppliers of technology from advanced countries for their technological capability development. They need to be proactive in their technological search and become involved in a broader range of technological functions in partnership with suppliers of equipment and services.

35. Firms should develop mechanisms for more effective interaction with institutions in the national systems of innovation, which are important sources of technological inputs. These include knowledge-creating institutions such as universities, technical vocational colleges, training institutes, national research centres, policy-making bodies and regulatory authorities. Such interaction allows firms access to codified and tacit knowledge, and improves their understanding of technological trends and patterns. These institutions can provide the right kind of skills and experience required by operating companies. The firms can also jointly develop technological training courses with universities and technical colleges. Another possibility for those institutions is to improve cost efficiency in technological research activities by providing common information services to all firms, thus reducing the duplication of research expenditures.

V.5 Domestic capabilities and international rules for trade and investment

36. In order to build domestic technological capabilities, developing countries need to adopt and implement targeted policies. The Republic of Korea and Taiwan Province of China adopted interventionist strategies on trade and domestic resource allocation, with a clear preference for promoting indigenous enterprises and deepening local capabilities. They imported technology vigorously from leading TNCs, but assigned FDI a secondary role. Their export drive was led by local firms. Comprehensive policy support allowed local firms to build impressive technological capabilities. The domestic market was not exposed to free trade; a range of quantitative and tariff measures were used over time to give infant industries “space”

to develop their capabilities. The deleterious effects of protection were offset by strong incentives (in the case of the Republic of Korea, sometimes strong pressures) to export and face full international competition. In the process of trade liberalization, the same careful strategic approach was used to ensure that no damage resulted to local enterprises; concomitantly, these enterprises were encouraged to go transnational and set up integrated production systems of their own.

37. The emerging rules for international trade and investment limit the ability of countries to take interventionist measures to build technological capabilities. The increasing erosion of national policy space has implications for technological learning and technology development in developing countries. The policies being ruled out, such as infant industry protection, local content rules, selection of FDI, export subsidies or lax intellectual property rights, are all ones that countries in South-East Asia have successfully used to promote some industries at the early stage of development. They are also policies that the industrialized countries used at crucial stages of development. Therefore, it may be important for international agreements on liberalization of trade and investment to take into consideration the aspirations of the poor and technologically backward economies. The fourth WTO Ministerial Conference recognized this challenge and called for the setting up the WTO Working Group on Trade and Transfer of Technology to address issues related to trade and technology transfer. The aim of the Working Group is to provide the General Council with recommendations on steps that might be taken to improve the flow of technologies to developing countries.

V.6 Role of the international community

38. Many developing countries do not often have access to information relevant to their development needs that is available elsewhere in the world. It is important that the international community assist in facilitating knowledge flows and sharing at the international level. The efforts of developing countries to meet the global challenge need the support of the international community. There is a need not only for technical assistance and support in capacity-building, but also for flexibility in implementation of international agreements and compliance with commitments. The international community should assist developing countries in dealing with possible conflicts between the national development strategy and the established international rules of trade and investment.

V.7 Enhancing strategic competitiveness through improved access to ICTs

39. Developing countries face many common challenges in reaping the potential benefits of ICTs. It is necessary to ensure that ICT applications are affordable and encourage design and diffusion of ICT services and applications that tackle major socio-economic problems.

40. In identifying appropriate strategies for the provision of ICTs for developing countries, it is important to note that models of infrastructure provision are likely to be quite different from those in developed countries because of the low income levels, limited formal business activities and large rural population. Moreover, financial and human resources are limited, institutional infrastructures are insufficient, grid electrical power is irregular or unavailable and literacy levels are low. It is therefore necessary to apply innovative approaches, which focus on shared infrastructure, public access facilities and providing access to individuals who may not have functional literacy.

41. In African and other developing countries, where a large proportion of the population live in rural areas, network infrastructure rollout and usage costs have already declined significantly. Costs are expected to fall even further with the expansion of large quantities of fibre, wireless and satellite bandwidth, which can make rural areas almost as easy to reach as urban ones. Also, technology convergence means that the same infrastructure can be used to provide many more services than just voice calls. In particular, the use of the Internet for transaction purposes vastly increases the commercial potential of the infrastructure and thus the incentives to build it. The traditionally held view that rural communications services are unprofitable needs to be reassessed.

42. ICTs can increase access to market information and reduce transaction costs for poor farmers and traders. The bulk of developing country production may also be concentrated in small and medium-sized enterprises (SMEs). The ability to exploit on-line information in terms of market access requires a coordinated approach to ICTs, with targeted training programmes and support with funding. State action may be required in order to enhance the ability of developing countries to participate in the global economy, for example the establishing of on-line information portals and trading exchanges for products.

43. In e-commerce, there is scope for State initiatives in establishing on-line information portals and trading exchanges for products. Furthermore, the SMEs that make up a large proportion of developing countries' industrial production are unlikely to be able to participate in business-to-business (B2B) e-commerce without active policy intervention and targeted training programmes. Cash economies and the prevalence of cash-based transactions, as well as low credit card penetration, mean that business-to-consumer (B2C) e-commerce may be slow to realize its potential in developing countries. The adoption and use of ICTs for services such as e-commerce present significant challenges as well as opportunities. It is essential that policy makers take both into account in their formulation of ICT policy.

44. ICTs and the Internet may be particularly important in tourism, which makes extensive use of advertising, marketing and information about destinations. Tourism is important to many developing countries as an earner of hard currency. ICTs have been proved to be important tools for publicizing and promoting tourism. Their role in brand development and management is illustrated by the importance of building an on-line brand, and the possibility of moving real world "bricks and mortar" brands on-line. Given the heavy reliance of developing countries on primary commodities, further work is needed to determine how ICTs can be adapted to facilitate on-line trade in those areas.

VI. FINDINGS AND RECOMMENDATIONS

VI.1 Main findings

45. ICTs have created new opportunities to tackle the problems of poverty, poor communications, economic stagnation and environmental degradation. At the same time, they have generated new challenges, especially for those countries in which technological capability, skill capacity and supporting infrastructure are not sufficiently developed.

46. The diffusion of ICTs throughout the world is extremely uneven, although there are some signs of catching-up in diffusion of mobile phones. In general, however, developing countries face significant barriers in access to and effective applications of ICTs owing to

limited telecommunications infrastructure, low computer literacy levels and lack of regulatory framework. In identifying appropriate strategies for ICT diffusion, it is therefore necessary to apply innovative approaches with a focus on shared infrastructure, public access facilities and the use of intermediary and other services to interact with individuals who may lack functional literacy.

47. ICTs will continue to play an increasingly important role in the development of industries. Most developing countries are not in a position to compete with industrialized countries at the frontier of innovation. The most effective way of raising the level of technology in developing countries is therefore through acquisition of existing technology from the industrialized countries. The experience of successful economies suggests that FDI has a crucial role to play in transfer of technology to developing countries.

48. Mere transfer and imports of new technology through FDI and other channels do not ensure technology acquisition. In order to build capacity to acquire and master technology, it is essential that Governments build a sound human resources capital and put in place credible and more focused long-term policies and regulations that encourage the active international transfer and effective diffusion of technology.

49. In order to facilitate and promote ICT use in developing countries, there is a need for an enhanced partnership between Governments, the private sector, academic institutions and non-governmental organisations. Relevant bodies of the United Nations system should facilitate cooperation between the various stakeholders and assist developing countries in the design and implementation of national ICT strategies.

VI.2 Recommendations

50. The three CSTD panels have put forward the recommendations set out below for consideration by the Commission at its sixth session. These recommendations are directed to Governments, the CSTD and the United Nations system.

VI.2.1 Benchmarking technology development

- The CSTD should make available its work on ICT Development Indices to both the United Nations ICT Task Force and the World Summit on the Information Society.
- The United Nations system should call for more extensive and more appropriate data to be collected, taking into account that developing countries typically have a large informal sector and that there is a lack of data relevant to developing country purposes, for example on shared access and the use of ICTs for long-distance education in developing countries.

VI.2.2 Linking FDI and technology development for strategic competitiveness

Governments may consider adopting the following policy options:

- Establishing and/or strengthening institutions to attract the right kind of FDI;

- Improving their efficiency and transparency through e-government and taking concrete measures to build up physical and institutional infrastructure;
- Promoting computer literacy and lifelong learning;
- Raising awareness of the importance of science and technology for development;
- Promoting sustained measures to ensure the mastery and adaptation of technology by creating and/or strengthening local R&D units, linking them to commercialization, and fostering collaboration in R&D between TNCs and domestic research institutions;
- Designing policies to support the creation of innovative enterprises through *inter alia* technology incubators and parks;
- Elaborating and implementing policy and programmes that tap into ICTs for new business opportunities, technology upgrading of human resources and e-governance;
- Creating and/or strengthening centres of technology intermediation at the national, regional and international levels;
- Endeavouring, with the facilitation of the CSTD, to share experiences with regard to technology transfer via FDI; and
- Promoting R&D not only in high-tech industries but also in traditional industries for the purposes of technological upgrading.

The United Nations system may:

- Call for more flexibility for developing countries under international regimes, such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement);
- Assist developing countries in making targeting decisions, including helping to identify sectors to be targeted for upgrading and development, and to assist developing countries in partnering with other countries for mutual benefit.

The CSTD may consider:

- Creating mechanisms that facilitate the sharing of knowledge and experience in science and technology for development by using the Science and Technology for Development Network (STDev) (<http://www.unctad.org/stdev>) to promote networking, especially between SMEs and TNCs, and knowledge-sharing;
- Establishing linkages with existing databases of experts from various scientific and technological fields, and when necessary, creating a database to promote experience-sharing and North–South and South–South networking;

- Undertaking analytical studies to determine the extent and effect of FDI in transferring technology to developing countries;
- Ensuring wide dissemination of its work on FDI and technology transfer at the regional and international levels; and
- In cooperation with other United Nations entities, especially UNCTAD, assisting developing countries in preparations for negotiations that take place at the WTO, especially with respect to the TRIPS Agreement.

VI.2.3 Enhancing strategic competitiveness of ICTs

The CSTD may consider:

- In cooperation with UNCTAD, developing an ICT policy review mechanism, modelled on UNCTAD's Investment Policy Review programme, to help developing countries, and in particular LDCs, to formulate/update national strategies and action plans for ICTs;
- In cooperation with the United Nations ICT Task Force, updating its publication *Knowledge Societies: Information Technologies for Sustainable Development* in order to raise awareness about the importance of ICTs for economic and social development;
- Encouraging South–South cooperation in ICT development and information exchange, especially with the LDCs;
- Ensuring that all its programmes take into account the need to meaningfully and systematically integrate gender equality principles, and improve its collaboration with its Gender Advisory Board;
- In collaboration with the United Nations ICT Task Force and other United Nations entities active in ICTs, supporting the ability of developing countries to effectively participate in international ICT policy development and harmonization; and
- Feeding the outcome of the current inter-sessional work into the World Summit on the Information Society process, the United Nations ICT Task Force and UNCTAD XI.

National Governments may consider adopting the following policy options:

A. Developing a facilitating environment and institutional framework

- Creating specific mechanisms for generating and allocating funds for all aspects of ICT development, including support for human resource development and R&D;
- Developing a regulatory framework that supports infrastructure development, and accelerating deployment of appropriate and cost-effective technologies;

- Defining and articulating technological capability development objectives as part of ICT policies and regulatory frameworks;
- Accelerating investment in ICT human capacity-building;
- Using formal and informal delivery platforms and approaches, particularly at secondary and tertiary levels. The examples of Tunisia and Costa Rica suggest that the pool of trained personnel helps to attract ICT investment and provide the foundation for the development of strategic competitiveness;
- Creating ICT centres of excellence devoted to training and research, and the institution of scholarships and industrial exchange programmes and internships for students;
- Adopting common standards for ICT applications training through skills certification schemes;
- Creating and supporting diaspora networks of ICT professionals to widen the pool of ICT skills and capabilities so as to reduce the adverse effects of brain drain and to identify opportunities and constraints to teleworking;
- Involving broad-based consultations in articulating ICT visions, policies and strategies. Developing countries have achieved success in the implementation of meaningful ICT strategies when mechanisms for management of strategy implementation involve partnership between central government, the private sector and innovation system institutions. A prerequisite for the success of any ICT strategy is the support and commitment of senior political decision makers in government and the availability of national “champions” from other sectors of the economy;
- Establishing mechanisms for the ongoing review, evaluation and analysis of ICT strategies, programmes and projects. These bodies can take different forms, depending on the specific context in the country, but should be adequately resourced, staffed by competent professionals and given a secure mandate to carry out strategic tasks with minimal interference and with sufficient continuity;
- Developing strategies to facilitate access and connectivity through, for example, elimination of import duties on all ICT equipment and software, promotion of low-cost ICT equipment such as the Simputer, and provision of soft loans and subsidies to support acquisition of computers by individuals and SMEs; and
- Promoting information exchange on the opportunities and benefits of adopting Free and Open Source standards.

B. Facilitating interaction between S&T institutions and ICT firms

- Supporting national science and technology (S&T) institutions with adequate evaluation and performance criteria and review systems that promote interaction between S&T system and the productive system; and

- Strengthening national S&T system organizations to ensure that they are able to provide technological knowledge to other actors in the country. Public-sector organizations play a unique role in the knowledge pipeline that cannot be replaced by commercial relationships between firms and suppliers of technological components.
- C. Facilitating interaction between national S&T innovation systems and the international knowledge system**
- Encouraging and facilitating open interaction between national S&T systems and organizations in the international knowledge system, including through collaborative research, informal networks and technological communities of interest;
 - Formulating a mechanism through concessionary funding to encourage the involvement of a developing country, particularly one of the LDCs, as a third country, in ICT ventures between developed countries and more advanced developing countries; and
 - Facilitating access to specific scientific websites and digital libraries.
- D. Policy analysis and implementation requirements**
- Developing the capability to monitor trends in ICT production and use, and to analyse the impact of ICT investment and diffusion of technologies; and
 - Promoting the sharing of best practices and experiences in this area among developing countries.
- E. Stimulating and supporting investment in production of ICT equipment and services**
- Identifying policy frameworks that support private-sector investment and production of ICT equipment and services. These policy instruments might include tax incentives, technological services, industrial assistance, trade promotion services and financial investments (seed funding, venture capital etc.);
 - Encouraging establishment of ICT producer networks and professional associations;
 - Promoting the establishment of and support for ICT incubators and multimedia parks;
 - Developing strategies for local content development, including by integrating traditional mass media – print, TV and radio – with electronic media; and
 - Ensuring that the protection and the promotion of indigenous knowledge are taken into account in ICT development strategies, including appropriate intellectual property protection.

REFERENCES

In addition to contributions from panel members, the following publications have been drawn upon for this report:

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