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CONSIDERATION OF WAYS AND MEANS OF COMMEMORATING IN 1999 THE TWENTIETH ANNIVERSARY OF THE VIENNA CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

Note by the UNCTAD secretariat

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CONTENTS

INTRODUCTION

1. At its July 1995 session, the Economic and Social Council invited the Commission on Science and Technology for Development (CSTD) in resolution 1995/4 "to give consideration to ways and means of taking advantage of the twentieth anniversary of the United Nations Conference on Science and Technology for Development, held in Vienna from 20 to 31 August 1979, to formulate a common vision for the future contribution of science and technology for development". The Commission on Science and Technology for Development is expected to examine this issue, which is the subject of the present note submitted by the secretariat, under item 5 of the provisional agenda of its third session.

2. The purpose of the note is to initiate and facilitate discussions on preparatory activities for formulating a common vision for the future contribution of science and technology for development. This note sets out the background to the evolution of thinking on science and technology from 1963, the date of the first international Conference, up to the 1979 Vienna Conference and on the issues that have emerged in the 1990s. More specifically, it briefly reviews some of the work done during the pre- and post-Vienna Conference periods as well as its underlying concepts, and raises science and technology-related issues that could be brought to the attention of the international community for its consideration in the years ahead. [1]

3. Pursuant to a recommendation of the Bureau of the CSTD, the secretariat convened a panel meeting in Geneva (20-21 December 1996) with the participation of those members of the Commission who had expressed their interest in formulating a common vision for the future. This was done with a view to discussing how to implement the ECOSOC resolution on that matter. The meeting was expected to review past endeavours for the diffusion of science and technology throughout the world, to draw some lessons from them - their successes and failures - and to discuss new approaches in this area. The participants were Mr. Robert Boroffice (Nigeria), Mr. Bernd-Michael Rode (Austria), Mr. Arnoldo Ventura (Jamaica) and Mr. George Waardenburg (Netherlands). A draft version of the present note was made available to the meeting and subsequently sent to all members of the CSTD Bureau. [2]

4. The secretariat is grateful to the following experts and Commission members for providing valuable comments on the draft version of this report: Mr. Titus Adeboye, Executive Director, African Technology Policy Studies Network, Kenya; Mr. Carlos Aguirre, Academia Nacional de Ciencias de Bolivia, Bolivia; Mr. Carlos M. Correa, Director, Maestría en Política y Gestión, Ciencia y Tecnología, Centro de Estudios Avanzados, University of Buenos

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[1] In this connection, it should be noted that many agencies of the United Nations system have played an active role in this process and continue to make considerable efforts to promote science and technology within their specific fields — for example, the FAO with regard to agricultural technologies, WHO with regard to health technologies, UNESCO with regard to cooperation between developed and developing countries in many scientific disciplines, and UNIDO with regard to industrialization.

[2] A report on the panel meeting is being brought to the attention of the CSTD members as a conference room paper. See "Consideration of ways and means of commemorating in 1999 the twentieth anniversary of the Vienna Conference on Science and Technology for Development. Report by the UNCTAD secretariat on the Panel Meeting" (E/CN.16/1997/CRP.2).

Aires, Argentina; Mr. Messanvi Gbeassor, Doyen, Faculté des Sciences, Université du Bénin, Togo; Mr. Mohd Nordin Hj. Hasan, Institute for Environment and Development (LESTARI), Malaysia; Mr. Sándor Hidas and Ms. Eva Sztankó, Ministry of Industry and Trade, Hungary; Ms. Julia Marton-Lefèvre, Executive Director, International Council of Scientific Unions, France; Mr. Jörg Meyer-Stamer, German Development Institute, Germany; Mr. Masafumi Nagao, Sasakawa Peace Foundation, Japan; Mr. Surendra J. Patel, Director, Institute on Equity and Development, India; Mr. Klaus-Heinrich Standke, President, Internationale Akademie Schloss Baruth, Germany; and Mr. George Waardenburg , Ministry of Foreign Affairs, Netherlands, and Chairman of the CSTD. Although the full extent of the different views could not be reflected here, all the comments made helped shape the final version of this document.

PART A: FROM GENEVA TO VIENNA: APPROACHES TO SCIENCE AND TECHNOLOGY

5. The global nature of science and technology has long been acknowledged. The League of Nations made an early effort to promote international cooperation in this area through its Committee on Intellectual Cooperation; and the scientific community itself established the International Council of Scientific Unions (ICSU) in 1931. Moreover, the role of science and technology has been of concern to the Member States of the United Nations as a form of support for the developing nations' quest for balanced social and economic development. This is in keeping with the overall goal set out in the United Nations Charter, namely "to promote social progress and better standards of life". It was clear to the founding members of the United Nations after the Second World War that peaceful and friendly relations among nations required general conditions of economic well-being. The political, economic and technological environment has changed considerably since those early days, however. Most developing countries have become independent nations and joined the United Nations community; the East-West dichotomy that dominated world politics for decades has ceased to exist; and globalization of production, markets and technologies has brought new challenges. *But how well has the international community adjusted its thinking, development approaches and policies to those trends?*

I. SCIENCE AND TECHNOLOGY AS "PROGRESS": THE UNITED NATIONS CONFERENCE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF THE LESS DEVELOPED AREAS (GENEVA, 1963)

6. The importance of international cooperation in science and technology as one of the elements that could contribute to economic development was emphasized as early as 1949 by the United Nations Scientific Conference on the Conservation and Utilization of Resources, held at Lake Success, New York. The 1950s saw the United Nations addressing the peaceful uses of atomic energy and other specialized areas related to technology. For a long time a *Scientific Advisory Committee* provided advice to Secretary-Generals of the United Nations. In 1961, the Economic and Social Council (ECOSOC) decided that an international technical conference of Governments should be held under the United Nations auspices to explore the application of science and technology for the benefit of the less developed areas. The aim of the conference, which was held in Geneva in 1963, was to demonstrate the means of accelerating development through the application of the latest advances in science and technology. Like scientific congresses, the conference had no authority to take any binding decisions. Its outcome was the conviction that a new and sustained effort was needed to facilitate the transfer of science and technology to developing countries and to help them overcome obstacles to access to knowledge and its application. However, no specific action was taken in this regard. "Geneva" was mainly a technical conference and some critics later compared it to a "science fair". It largely reflected the undiminished techno-optimism of its time. The underlying concept of "Geneva" was that technological progress equalled development. Even in 1963, Secretary-General U Thant included some words of caution in his foreword to the Geneva conference proceedings: applied science could be a powerful force for raising living standards " *if the Governments and people of the world can find the means and the will*".[3]

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[3]"Report of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas", 8 vols., Vol. 1 (New York, 1963), p. vii. For further details on this and on the developments described below, see K.-H. Standke and M. Anandakrishnan (eds.), *Science, Technology and Society: Needs, Challenges and Limitations,* (New York: Pergamon

7. As a result of the conference, ECOSOC established an Advisory Committee on the Application of Science and Technology for Development (ACAST), which met on a regular basis for 16 years, providing advice for ECOSOC's substantive work, supported by a small Office for Science and Technology within the United Nations secretariat. ACAST consisted of individual experts selected in their personal capacity, many of whom belonged to academies of sciences and national research councils in their own countries. Its objective was to develop a strategy for the role of science and technology in development and to give greater impetus to the application of science and technology in United Nations programmes. In 1971, ACAST submitted a *World Plan of Action for the Application of Science and Technology for Development* highlighting such issues as the need for indigenous capacity-building, the gap between the potential of science and technology and the extent of the latter's actual use, the weakness of scientific institutions in the developing world, the problem of access to the world's technology, and the brain drain. However, since it was a group of experts with no direct access to the political decision-making process, ACAST had a limited impact. During the early 1970s, ECOSOC established a Committee on Science and Technology for Development which provided a special political forum for the results of ACAST's work within the United Nations and brought the discussion to a more political level. The new Committee addressed issues ranging from capacity-building to technology transfer and the development of an international technological information system. Already at its second session in 1974, it addressed the possibility of holding another major United Nations conference in the area of science and technology for development. [4]

II. SCIENCE AND TECHNOLOGY IN A "NORTH-SOUTH" CONTEXT: THE UNITED NATIONS CONFERENCE ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT (VIENNA, 1979)

8. Throughout the 1970s, developing countries, particularly the least developed countries, called for better access to the world's stock of science and technology. In response to these calls and growing disagreements between "North" and "South" over such matters, the General Assembly took up in 1976 the proposal by ECOSOC and its Committee on Science and Technology for Development that a second global conference on science and technology be held. This conference involved several years of substantive preparations, regional review meetings and the participation of a large number of non-governmental organizations (NGOs). Each Member State provided a national paper on the status of science and technology. This fact alone provided an unprecedented "package" of information on the state and diffusion of science and technology throughout the world. In August 1979 the United Nations convened the Conference on Science and Technology for Development (UNCSTD) in Vienna. The Vienna Programme of Action [5] adopted by the Conference addressed three major areas: (i) strengthening the science and technology capacities of the developing countries; (ii) restructuring the existing pattern of international scientific and technological relations in the transfer of technology; and

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Press, 1980).

[4] United Nations, Committee on Science and Technology for Development, "Report on the second session (11-29 March 1974)" (E/5473, E/C.8/27). For its part, UNCTAD had set up in 1971 an intergovernmental working group concerned with the transfer of technology to the developing countries. For details, see part B of the present document.

[5] United Nations, "The Vienna Programme of Action on Science and Technology for Development", 1979.

(iii) strengthening the role of the United Nations system in promoting new ways of technology cooperation as well as considerably increasing the provision of financial resources for such purposes.

9. In view of the growing gaps in the area of science and technology between developed and developing countries, the techno-optimism of the 1950s and early 1960s could no longer be sustained, and "Vienna" was a conference about equitable access to the world's technology. It reflected an awareness that issues of international science policy related to economic wealth and access to know-how and technologies. The focus of the conference was political rather than technical and it put science and technology in the context of "North-South" relations. It was the last of the United Nations "mega conferences" of the 1970s addressing issues relating to a new international economic order. [6]

10. The institutional arrangements that were set up after "Vienna" were marked by the creation of a political body - an intergovernmental committee of the United Nations General Assembly - and a separate financing mechanism for funding science and technology projects through voluntary contributions by the industrialized countries. [7] Theoretically, the new committee was a powerful political body in the area of international science and technology policy because it was open to all Member States and reported to the General Assembly. However, it never had any substantial financial means at its disposal and active participation by Member States declined over the years following the initial momentum created by the conference. The Financing System, [8] on the other hand, depended on the voluntary contributions of donor countries, and eventually became an integrated unit of the United Nations Development Programme. During most of the lifetime of these two institutional arrangements, the policies chosen by the IGC and the projects funded by the Financing System remained separate.

III. THE LESSONS OF "VIENNA"

11. It was the impression at "Vienna" that "Geneva's" reliance solely on technical progress had not brought about much change in the developing world in terms of technological capacity-building. Moreover, the pattern of failed technology transfer projects was world-wide. As a result, the underlying concept of "Vienna" was that concerted governmental action at both international and national levels was required in order to build up endogenous capacities within developing countries.

12. The intergovernmental machinery established after "Vienna" produced a substantial number of relevant reports on technology issues, providing advice

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[6] For a critical review of "Vienna" and the process leading up to it, see D. Dickson, *The New Politics of Science* (New York: Pantheon, 1984).

[7] The ECOSOC Committee on Science and Technology for Development was to be open to all Member States in the form of a new Intergovernmental Committee (IGC, serviced by a secretariat, namely the United Nations Centre for Science and Technology for Development). ACAST was replaced by a new Advisory Committee on Science and Technology for Development (ACSTD). In addition, an Interagency Task Force on Science and Technology for Development was established to facilitate a coordinated approach among different agencies.

[8] Later renamed United Nations Fund for Science and Technology for Development (UNFSTD).

to the international community, but did not achieve a major breakthrough in developing countries' participation in the use of the world's science and technology. Furthermore, it never generated the amount of funding that had been agreed upon at "Vienna". The mounting debt crisis in many developing countries throughout the 1980s, moreover, had a negative impact on the dwindling resources within the developing world itself.

13. In preparation for the tenth anniversary of "Vienna", there were several attempts - in 1988 and 1989 - to make a critical assessment of progress in the implementation of the Vienna Programme of Action on Science and Technology for Development: expert group meetings were organized by the IGC's secretariat (the Centre for Science and Technology for Development) as an "end-of-decade-review", by UNESCO and by the Stanley Foundation. Furthermore, the 44th session of the General Assembly in 1989 discussed the implementation of the Vienna Programme of Action.

14. The evaluation carried out at a series of regional and global meetings organized by the Centre for Science and Technology for Development identified the building of endogenous capacities in developing countries as a key element of policies and programmes. The involvement of a broad set of stakeholders was seen as necessary in this process and policy dialogues at various levels were seen as a tool to identify the specific needs of individual countries. [9]

15. The evaluation carried out by UNESCO took a more traditional approach by including reviews of the progress made since "Vienna" within specific scientific areas, ranging from basic sciences to earth and water sciences. Human resources development and international cooperation in scientific and technological research were the central concern of this evaluation. [10]

16. Neither of the above evaluations questioned the continued validity of the Vienna Programme of Action. A far more critical evaluation was conducted by the Stanley Foundation, which brought together a small group of representatives from a number of American institutions dealing with science policy issues, senior United Nations staff and selected diplomats from United Nations missions in New York. This evaluation detected flaws from the outset in the Vienna Programme of Action itself, whose "broad terms and blurred definitions" masked existing disagreements. [11] It identified a number of additional obstacles that stood in the way of efficient implementation of the Vienna Programme of Action, ranging from "bureaucratic jealousies" among agencies, each of which tried to protect its own science and technology-related programmes, to an environment characterized by a shortage of funds. However, participants in the evaluation saw an important role to be played by

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[9] Centre for Science and Technology for Development, "State of science and technology for development in the world: Options for the future", background document for the Intergovernmental Committee on Science and Technology for Development, tenth session, New York, 1989. See also an earlier document: German Foundation for International Development and Centre for Science and Technology for Development, "International cooperation in science and technology for development: Future options" (Bonn and New York, 1989).

[10] UNESCO, "Science and technology for the future: A fresh look at international cooperation in science and technology" (Paris, 1989).

[11] For this quotation and the subsequent ones, see Stanley Foundation, *Science and Technology for Development: 19th UN Issues Conference* (Muscatine, Iowa, 1988).

multilateral approaches in this area. The process of implementing the Vienna Programme of Action would have to "involve the real actors engaged in generating and using science and technology. This includes scientists and engineers and private enterprises, including transnational corporations which produce goods and services developed by the scientific and technological community". Multilateral institutions in science and technology had to face challenges and opportunities in coping with "global change that defies strictly national or private approaches to management".

17. Furthermore, the General Assembly of the United Nations, at its forty-fourth session in 1989, noted "with great concern that the effect of increasing disparities in scientific and technological capabilities between the industrialized and the developing countries as a whole has been to contribute to a widening of the economic gap between them". In this context, it reaffirmed the validity of the Vienna Programme of Action and expressed concern regarding its implementation. [12]

18. All four evaluations contained interesting ideas. However, the fundamental changes that characterize today's economic realities, namely economic liberalization, the accelerated speed of globalization following the end of the East-West dichotomy and the opening of developing countries' markets, were only just emerging when these evaluations of the Vienna Conference were conducted. Thus, the full impact of these realities could not be taken into account by the early assessments. In the years that followed, these realities changed the national and international contexts considerably.

19. Over 30 years after Secretary-General U Thant called attention to the need for the Governments and people of the world to find "the means and the will" to ensure the successful application of "science and technology for development", it has to be concluded that the means found to implement the Vienna Programme of Action were inadequate, and that those who actually had the political will to give effect to the programme had limited access to the necessary resources. Beyond that perception one might want to look at the programmes and approaches chosen and determine why these were unable to attract the necessary means and bring about a true consensus between North and South, and how future programmes might avoid such problems. The fact that both the "technological fix" aimed at by "Geneva" and the "policy fix" implicit in the Vienna Programme of Action did not lead to the expected changes is suggestive of the complexities involved in such a process.

20. Any approach to science and technology now would have to depart from the largely state-led approach of "Vienna". It would have to take into account a broad range of concerns of actors and stakeholders in development, including Governments, enterprises, the scientific and research and development (R&D) community, and NGOs. A combination of effective national policies and international cooperation needs to be pursued. There is a general awareness today that development, especially in a field as complex as science and technology, is not a linear process which results from purely economic measures or blueprints, and that the adaptation and adoption of technology are always embedded in the culture, politics, history and productive system of countries. There is also an awareness that science and technology could play

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[12] Resolution 44/14, Implementation of the Vienna Programme of Action on Science and Technology for Development, Section A of the resolution, End-of-Decade Review of the Vienna Programme of Action on Science and Technology for Development and its Revitalization, 42nd plenary meeting, 26 October 1989. See Official Records of the General Assembly, Forty-fourth Session, Supplement No. 37 (A/44/37), p. 21.

an important role in the process of development, as was the case in countries that have undergone a successful economic transformation.

21. The debate continues. Thus, the United Nations General Assembly, at its forty-eighth session in 1993, [13] reaffirmed the principles of the Vienna Programme of Action for striving to strengthen science and technology in the developing world, since almost two decades after the Vienna Conference, the Programme's aspiration to a more equitable diffusion of science and technology throughout the world remains largely unfulfilled. Furthermore, 13 years after the Vienna Conference one of the key issues at the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, was taken from the unresolved agenda of "Vienna": technology cooperation and the access of developing countries to the industrialized world's advanced technology. Moreover, all agreements at the Rio Conference contain some provisions regarding science and technology. For example, chapter 34 of *Agenda 21* is devoted to the transfer of environmentally sound technologies, cooperation and capacity-building, while chapter 35 deals with the role of science in sustainable development. This has given a new momentum to the discussion of international cooperation in this field. Today, environmentally sound technologies are a test case of technology cooperation for the international community, including Governments, enterprises and development cooperation agencies, given the urgency of global environmental change and the agreements reached at the Rio Conference. Thus, science and technology can play an important role in the long-term global search for balance among the three objectives — development, equity and environment.

22. In summary, new paradigms have emerged with regard to science and technology responding to the challenges of new technologies, changes in the international political climate and the deliberations at the Rio Conference. These reflect a growing awareness of the interrelationship between economic development and ecological sustainability, concern for creating an enabling environment that provides room for enterprise development, and an unprecedented level of global interdependence. A number of new attempts are under way that aim at reviving efforts for technology cooperation between developed and developing countries. These efforts mobilize private enterprises more directly and concentrate on promoting inter-firm cooperation, including the identification of elements likely to build a suitable framework or enabling environment for such cooperation. The scientific community (according to the "Geneva approach") and Governments (according to the "Vienna" approach) are no longer seen as the sole actors in the development of science and technology, for a more complex scenario is emerging that involves a multitude of "stakeholders". At the same time, some of the unresolved issues of the Vienna Conference remain on the agenda.

PART B: THE EVOLUTION OF DEVELOPMENT THINKING IN SCIENCE AND TECHNOLOGY: THE CASE OF UNCTAD

23. This section highlights the evolution of major conceptual approaches in the development thinking in science and technology since the early 1970s. Together with other organizations and bodies of the United Nations system, UNCTAD had actively participated in the substantive preparations for the Vienna Conference and elucidated major issues which Governments considered in the elaboration of the Programme of Action. The Committee on Transfer of Technology had been established in UNCTAD in 1974 and contributed to this endeavour. In the early 1990s, the "Vienna" institutions - the IGC, the ACSTD

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[13] See General Assembly resolution 48/179, Science and Technology for Development, 21 December 1993.

and the Interagency Task Force - were abolished and a new, functional ECOSOC Commission on Science and Technology for Development was established, with UNCTAD becoming its secretariat in 1993.

24. This section provides a selective account of the work done by UNCTAD in the process up leading to "Vienna" and in the post-Vienna efforts concerned with building scientific and technological capacities in the developing world. It thus illustrates the changing paradigms which have shaped work programmes and debates over the past 15 years.

I. ANALYSIS OF TECHNOLOGY TRANSFER ISSUES, TRADE AND DEVELOPMENT IMPLICATIONS OF NEW TECHNOLOGIES AND TRENDS IN INTERNATIONAL TECHNOLOGY FLOWS (1970-1991)

25. The establishment of UNCTAD in 1964, and the setting up in 1970 of the Intergovernmental Group on Transfer of Technology, helped to create awareness and stimulated intergovernmental discussions on technology-related issues. In 1974, the Trade and Development Board transformed the Group on Transfer of Technology into the Committee on Transfer of Technology (CTT). During the 1970s, the Committee focused on issues related to the transfer of technology, including terms and conditions for such transfer, reflecting a major preoccupation of developing countries with improving access to foreign technology and ways and means of acquiring it at fairer prices and on fairer conditions. As at the discussions in Vienna, these issues related to the asymmetries between developed and developing countries in the market for technology; and the need to reduce the imbalance in the bargaining position of the parties to the transfer of technology contracts was also considered. This subsequently led to the launching of negotiations on an international code of conduct on the transfer of technology. In the early 1980s, the Committee's work included the identification of specific measures for strengthening the technological capacity of developing countries, leading to the formulation and implementation of a strategy for technological transformation.

26. In the second half of the 1980s and up to 1991, UNCTAD's work on technology was mostly concerned with the extent to which technological change impacts on trade and development, particularly of developing countries, and the ways in which this impact manifests itself. UNCTAD considered the effects of technological change on raw-material consumption, pointing out that materials substitution and materials saving arising from technological change had contributed to the "dematerialization" [14] of production that has adversely affected the export performance of many producers of primary commodities in developing countries. In the area of manufactures, discussions within UNCTAD centred on the diffusion of technological advances, particularly those brought about by micro-electronics, and their effects on trade and development. These effects included quality improvements, cost reductions and product development, and have contributed to making the comparative advantage of labour cost a relatively less important determinant of competitiveness. In the services sector, work concentrated on reviewing technological change and its trade implications in different service industries, including transportation, banking, construction, telecommunication and computer services. UNCTAD also monitored trends in international technology flows, including their developmental implications, and considered measures to stimulate those flows, particularly to developing countries.

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[14] "Dematerialization" of production refers to a shift in the composition of demand in the industrialized countries away from intensely raw-material-consuming industries and to a diminution in the intensity of materials use in existing manufacturing industries.

II. INTERRELATIONSHIPS BETWEEN INVESTMENT AND TECHNOLOGY TRANSFER (1992-1994)

27. In 1992, the eighth session of UNCTAD marked an important change in the scope and orientation of the organization's work. It laid the foundations of national and international policies aimed at enhancing the development prospects of all countries, particularly those of developing countries. This was reflected in the document which the Conference adopted — "A New Partnership for Development: The Cartagena Commitment" — which considers consensus building to be a key function of UNCTAD. Sharing of experiences, perceptions and views forms an integral part of this process. It calls *inter alia* for closer cooperation with external actors, especially non-governmental organizations and the enterprise sector. Technology issues were addressed relative to their interrelationship with trade in goods and services, investment, finance and environment. Consequently, the Committee on Transfer of Technology was suspended and a new Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer was created, which completed its work in March 1994.

28. Activities carried out by that Ad Hoc Working Group focused on the interrelated areas of investment, technology transfer, capacity-building and competitiveness. Attention was also directed to improving the understanding of how environmental considerations, including the generation and use of environmentally sound technologies, affect the investment and technology policies of countries and firms. More specifically, the activities carried out initially centred on the evolution of investment and technology flows to different countries and on the main factors that affect these flows. The work done showed that after a period of stagnation, investment flows to a number of developing countries expanded. However, only a handful of developing countries were able to attract significant flows of foreign direct investment (FDI), while over 100 developing countries received less than 1 per cent of the world’s FDI flows.

29. Among the factors that were found to encourage firms to increase these flows were political stability, a sound macroeconomic environment, free movement of capital, availability of skilled labour, a transparent legal environment and a reasonably well developed infrastructure. After identifying the determinants of these flows, the Ad Hoc Working Group concentrated on ways and means of making the environment in developing countries and countries in transition more conducive to transfer and diffusion of technology. It also gave further consideration to policies and measures that help host countries develop their technological capacity, including through the contribution of FDI and imported technology. [15]

30. Particular emphasis was placed on the role of education and technical and vocational training in the process of capacity-building, including the institutional set-up required for human resource development. The work carried out revealed that linkages between these activities on the one hand, and the production sector on the other, remained weak in many countries. This also applies to linkages between R&D and the production sector, which in an innovation-system context acquires particular importance, especially if due account is taken of the role of equipment suppliers, subcontracting, user-producers' interfaces, professional associations and rotation of key professionals.

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[15] See "Final Report of the Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer to the Trade and Development Board" (TD/B/WG.5/12), 1994.

31. What may help remedy the problems and deficiencies is appropriate management of the process of technology transfer and diffusion. In this respect, different modes of technology transfer were reviewed, including the most commonly used forms, such as capital goods imports, FDI and joint ventures, as well as the less standard though increasingly used forms, such as management contracts, subcontracting and franchising. Work carried out also focused on ways to strengthen the relationship between foreign technology and local technological development. This relationship was likely to be stronger if host countries invested in human resource development and infrastructure while observing intellectual property rights protection. Foreign technology inputs, whether through FDI or other means, have proved to be a convenient medium for the provision of training opportunities and development of managerial skills. Particular emphasis was placed on the special needs of the least developed countries and the policy approaches that may be required to alleviate the constraints faced by these countries in acquiring foreign technology and building up their technological capabilities. The Ad Hoc Working Group also addressed different policy-related aspects of technological innovation, including the transfer and development of environmentally sound technologies, university-enterprise cooperation, industrial districts and technology partnerships.

32. Finally, the Working Group addressed the determinants of international competitiveness and examined the factors involved, particularly the role of science and technology in influencing the competitive advantage of countries and their enterprises in the rapidly changing international environment. Its work revealed that the upgrading of skills (including organizational and managerial capabilities) production flexibility, and marketing and collaborative arrangements among firms, including networking, are among the influential factors.

III. ISSUES RELATED TO TECHNOLOGY, INVESTMENT AND ENTERPRISE DEVELOPMENT(MIDRAND, 1996)

33. The early 1990s witnessed the restructuring of the institutional set-up of the United Nations in the area of science and technology. In this process, responsibility for the work previously carried out by the Centre for Science and Technology for Development was transferred to UNCTAD, including the servicing of the newly established ECOSOC Commission on Science and Technology for Development. Governments' changing priorities were further reflected in the outcome of UNCTAD IX, particularly as regards the new approach for consideration of technology in relation to investment and enterprise development.

34. The ninth session of UNCTAD (Midrand, South Africa, 27 April - 11 May 1996) adopted a Partnership for Growth and Development, which outlined the orientation of future work and made a significant contribution to reforming the organization. Among the areas singled out for intergovernmental discussions in UNCTAD were the interrelated ones of investment, enterprise development and technology. The strengthening of the capacity of developing countries and countries with economies in transition to improve their overall investment environment was also addressed.

35. Regarding enterprise development, emphasis was placed on facilitating the exchange of experiences in the formulation and implementation of enterprise development strategies, including questions related to privatization and public sector/private sector cooperation as well as ways and means of furthering the participation of developing countries' enterprises in the global economy. The Conference called for science, technology and investment policy reviews to be conducted with interested countries in order to identify options for national action, especially those that foster technological capability and innovation. It also called for an exchange of experiences among countries at different levels of development in the formulation of

policies to promote technological capacity-building and innovation in developing countries. This could include diverse forms of inter-firm cooperation, such as networking, clustering and technology partnerships.

36. UNCTAD IX made comprehensive changes to streamline the intergovernmental machinery and refocus the work of the organization. The Trade and Development Board will have the following three Commissions: the Commission on Trade in Goods and Services, and Commodities; the Commission on Investment, Technology and Related Financial Issues; and the Commission on Enterprise, Business Facilitation and Development. The last two are of particular interest here as they deal with technology-related questions. A new division dealing with investment, technology and enterprise development was created to provide substantive support to the work of the two Commissions. It has taken over the work on science and technology for development. It will carry it out in an integrated manner through conceptual work, preparation of issue papers and policy studies, as well as technical cooperation activities, and in cooperation with other international organizations.

PART C: SCIENCE AND TECHNOLOGY IN A GLOBALIZED AND LIBERALIZED ECONOMY ON THE EVE OF THE TWENTY-FIRST CENTURY: SOME POLICY ISSUES FOR CONSIDERATION

37. The Vienna Programme of Action on Science and Technology for Development was adopted in 1979 in an international context characterized by the North-South debate, the remnants of the Cold War and Governments' preoccupation with fostering technological capabilities, but in which there was little participation by the private sector, particularly in developing countries. Emphasis was placed more on highlighting the asymmetries in science and technology between developed and developing countries than on promoting cooperation among enterprises from those two groups of countries. In this environment, foreign direct investment was viewed by many developing countries and Central and Eastern European countries as a mechanism for control over their economies by firms from developed countries, particularly transnational corporations.

38. The international context changed considerably in the early 1990s. The end of the Cold War was followed by increased cooperation between countries of the former Eastern and Western blocs, and privatization, liberalization and globalization began to span all continents. This was subsequently aided by the progress achieved in the Uruguay Round of Multilateral Trade Negotiations, which culminated in the adoption of international agreements governing trade in goods and services, investment and intellectual property rights. In this environment, an increasing number of developing countries realized the merits of strengthening the private sector, and policies were adjusted to nurture the development of enterprises, particularly small and medium-sized enterprises.

39. As a result, developing country economies became more open to foreign direct investment and have adopted measures to stimulate such inflows with a view to promoting the transfer and diffusion of foreign technology, marketing and managerial know-how. Inter-firm cooperation consisting of a variety of collaborative arrangements, including strategic alliances, different forms of partnerships and networking within and across countries, has expanded. This process has been aided by the increased diffusion of information and communication technology, which altered the system of production and work organization, thereby affecting employment and international competitiveness with far-reaching implications for international investment and trade in goods and services.

40. On the eve of the twenty-first century the role and importance of science and technology appear more relevant than ever. However, perceptions and approaches in the consideration of technology-related issues, including the roles, policies and strategies of different actors, have changed. In this context, a number of unresolved old issues as well as new ones have been the focus of international debates and continue to be relevant. Some of these are briefly mentioned below. [16]

1. Technological capacity-building and competitiveness

41. Among the areas that the Vienna Programme of Action emphasized, the process of technological capacity-building remains a priority issue today. While "Vienna" stressed the role of the State, concern now centres on the complex relationship between such capacity-building and competitiveness.

42. Owing to the pressure put on all firms by the recent trends towards globalization and liberalization, systematic attempts have been made by enterprises, particularly from the OECD and newly industrializing countries, to invest in technology and strengthen technological capabilities with a view to improving competitiveness. The costly investment in such new technologies as information technologies is making enterprises from those countries increasingly demand that such an investment generates pay-offs in terms of competitiveness.

43. This has encouraged a growing number of firms, particularly in the OECD countries, to share the development costs and spread the risks in the adoption of new technologies. New partnerships replacing adversarial relations, including cooperative R&D and collaborative arrangements, have become part of the realities of the 1990s. However, many developing countries have been left behind and their participation in this process has been limited.

44. A host of factors, in addition to technology, affect the competitive advantage of enterprises. These include labour costs and skills, financing, trade barriers, exchange rate fluctuations, marketing know-how, production flexibility, and collaborative arrangements among firms. But labour costs, relevant to the majority of developing countries, particularly the least developed countries, have become a less important determinant of competitiveness. Even in traditional labour-intensive sectors, competitiveness is increasingly a function of technological change, continuous training and adaptation of skills, and technological innovation. Consequently, there is a need to improve technological capabilities and draw on R&D for the adaptation of imported technology and its utilization in product development efforts and production activities. This takes on particular importance in the adoption of new technologies, which are increasingly science-based and R&D intensive, with major opportunities and implications for growth and development.

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[16] In this context see also chapter 6, "Agenda for further research", in UNCTAD, "Fostering technological dynamism - Evolution of thought on technological development processes and competitiveness: A review of literature", 1996 (UNCTAD/DST/9, Sales No. E.95.II.D.21); and chapter 5, "Conclusions and areas for future work", in UNCTAD, "Science and technology in the new global environment: Implications for developing countries", 1995 (UNCTAD/DST/8, Sales No. E.95.II.D.14).

2. Opportunities and challenges of new technologies

45. The increased diffusion of information technologies has given rise to a number of issues affecting the trade and development prospects of all countries, particularly developing countries. [17] This trend is likely to continue and probably accelerate in the twenty-first century, aided by the globalization and liberalization phenomena and the dynamism of the private sector in an increasing number of countries, be they developed or developing. Furthermore, the development and the diffusion of other new technologies such as biotechnology, materials and laser technology have also progressed, although their impact has been felt less than that of information technology. However, on the basis of research and experimental development conducted by enterprises and R&D institutes, there are indications that the diffusion of these technologies will increase in different economic and social sectors.

46. This requires for an assessment of the economic and social impact and implications of those technologies with particular reference to developing countries and countries with economies in transition, including their effects on competitiveness, employment, skill formation and utilization, technological capability-building, inter-firm cooperation and networking. On the basis of such an assessment, policies may be suggested that enable firms from those countries to take advantage of the opportunities that these technologies offer and to respond to the challenges they create at the national and international levels. Thus, there is a need to identify the main issues affecting the growth and development of enterprises in those countries.

3. Issues relating to the interface of technology and enterprise development

47. The changing global environment has created an enhanced role for technology as a crucial factor in enterprise development. Even many small and medium-sized companies, including those in the developing world, cannot escape the need to stay alert to technological change. Innovative strategies, policies and cooperative behaviour of enterprises - so far mainly in the developed countries - have created opportunities and challenges for the enterprise sector. They have also begun to be adopted in the newly industrializing countries and some other developing countries and countries with economies in transition. Governments are thus increasingly perceiving the need to create a policy environment that would enable enterprises of all sizes, particularly small and medium-sized ones, to better understand the innovation process, to take advantage of new opportunities and to contribute more efficiently to the attainment of socio-economic development objectives.

48. However, despite considerable efforts by Governments to adapt to the changing environment, many developing countries and countries with economies in transition continue to encounter difficulties in building a strong segment of small and medium-sized enterprises. This stems, to a large extent, from their weak capability in such specific services as pre-investment and project execution services, management consulting, engineering design, product development, standards and quality control, and technical extension and marketing, which are particularly helpful to the development and growth of private firms. While an increasing number of developing countries have made progress in producing skilled manpower in terms of scientists and engineers, they still do not have enough organizational and managerial skills, which are particularly critical for the development of enterprises. Another constraining factor is the shortage of finance. Many small and medium-sized firms in developing countries have difficulties in raising the start-up

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[17] See "Substantive theme: Information and communication technologies for development. Report of the Working Group on Information and Communication Technologies for Development" (E/CN.16/1997/4).

capital from domestic sources, owing to the insufficient development of financial institutions, including the banking system, and weak linkages between this system and manufacturing and service enterprises. The size of these enterprises is an additional constraint on their ability to self-finance their development, including their limited capabilities for tapping international financial markets. Thus, there is a need for efforts at the firm and industry levels to be supported by macroeconomic policies that take into account the needs and motivations of the productive sector.

4. The new role of the State: Some policy considerations

49. The ongoing trend of globalization and liberalization has raised a number of issues pertaining to the role of the State. For some, this role has diminished drastically and market forces have tended to overshadow the effectiveness of national policies. For others, this new trend requires the Government to play a different active role in developing policies that would help developing countries keep up with the changing global market and the new forms of production organization and competitiveness.

50. This raises the question of the role of government interventions, particularly as regards the promotion of technological innovation and the build-up of technological capabilities. The depth and breadth of such interventions are issues for consideration in the design and formulation of policies in the areas of science and technology, investment and trade. At the panel meeting of the CSTD, which took place on 20 and 21 December 1996, some of the experts argued that science and technology should be addressed at a sectoral level and in specific fields, while others tended to favour a more generic approach. [18]

51. One major dilemma which confronts many developing countries and countries with economies in transition is how to ensure the stability of policies aimed at satisfying the long-term objective of scientific and technological development. Strategies need to be explored and adopted to overcome the limitations imposed by macroeconomic instability and budgetary restraints which are threatening R&D, the transfer and adoption of modern technologies and, not least, human resource development. But before such strategies are elaborated, there must be an assessment of existing science, technology and innovation policies, and of how they interact with development policies, including questions regarding their coordination with investment, industrial and trade policies. The aim of such policy reviews is to evaluate the contribution of science and technology policies to the development of enterprises in developing countries and countries with economies in transition, including their international competitiveness. Their aim is also to integrate science and technology policies with development planning, including the initiation of a more effective dialogue between ministries and agencies dealing with technology, investment, trade and industrialization issues. This will help countries improve their own policies and identify opportunities for international cooperation. [19]

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[18] See "Consideration of ways and means of commemorating in 1999 the twentieth anniversary of the Vienna Conference on Science and Technology for Development. Report by the UNCTAD secretariat on the Panel Meeting" (E/CN.16/1997/CRP.2).

[19] See "Science, technology and innovation policy reviews: Implementation of the Programme on Science, Technology and Innovation Policy Reviews" (E/CN.16/1997/5).

5. Exploring new approaches to technology cooperation, including in the area of environmentally sound technologies

52. While technological capacity has become vital for achieving economic development and sustaining competitiveness, this process is not always instantaneous, costless or automatic, even if the technology is well diffused elsewhere. Apart from physical inputs, it calls for various new skills, technical information and services, contract research facilities, interactions with other firms, equipment suppliers, standards bodies, and so on. The setting up of this dense network of cooperation requires the development of special skills and a favourable economic, institutional and legal environment. [20] The need to keep technologically ahead and to respond to a "globalization of knowledge" obliges companies throughout the world to create new forms of cooperation, relationships and partnerships. Thus, a rapidly growing number of companies, universities and other organizations are contributing to a world-wide pool of commercializable knowledge, and many enterprises are now seeking linkages to other organizations in innovative ways. [21] As part of this trend, new forms of partnership among firms and between firms and organizations in the R&D sector have gradually begun to move into the developing countries. The underlying opportunity afforded by such partnerships is to find new forms of technology cooperation which involve two-way relationships, and determined endeavours to share technological knowledge, and to collaborate on R&D, training, manufacturing and marketing. [22]

53. In this context, the area of environmentally sound technologies appears to offer substantial possibilities for cooperation. The United Nations Conference on Environment and Development, held in Rio de Janeiro, paid particular attention to cooperation in that area. This is one which was not relevant in Vienna, but which now carries weight because of the demonstration effect it could have on other areas of technology cooperation, given the explicit will of countries at the Rio Conference to work in this area. The application of new, resource-efficient and clean technologies is one of the keys to environmental sustainability. The growing innovative capabilities in this area have created a new spectrum of technology choices in fields such as energy, transportation, agriculture, construction and manufacturing. Effectively promoting the application of environmentally sound technologies often requires incentive measures and policies to create an "enabling environment" such as will lead companies to adopt these technologies and to engage in new forms of technology cooperation.

6. The role of science and technology in integrating the least developed countries into the world economy

54. A major unresolved issue since the "Vienna" Conference remains the integration of the least developed countries (LDCs) into the world economy, including their access to the world's advanced technology. Many of the LDCs have encountered considerable difficulties in strengthening their endogenous scientific and technological capacities: technologies have largely remained

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[20] UNCTAD, "Final Report of the Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer to the Trade and Development Board" (TD/B/WG.5/12), 1994.

[21] J. L. Badaracco, *The Knowledge Link* (Boston: Harvard Business School Press, 1991), p. ix.

[22] See UNCTAD, "Technological capacity-building and technology partnership: Field findings, country experiences and programmes" (UNCTAD/DST/6), 1995; and UNCTAD, "Exchanging experiences of technology partnership" (UNCTAD/DST/15), 1996.

external factors, and many universities and R&D institutions barely survived the 1980s. The adverse effect of this situation on the development and modernization process within a region such as Africa is considerable, and endogenous capacities in science and technology with regard to technical training and R&D as well as technology acquisition and adaptation at the enterprise level continue to be rudimentary in most countries of the region. A long-term objective is to improve the policy framework for the utilization of R&D, to create regional information and support mechanisms, and to increase the scientific and technological capacities of the LDCs firms and institutions. Attention may be paid to the needs of small and medium-sized enterprises. Furthermore, access by institutions in LDCs to information networks will be particularly important for avoiding marginalization as regards global technological change. [23]

7. Prospects for South-South technology cooperation: Opportunities and challenges

55. The globalization and liberalization of markets have added a new dimension and created an environment with enhanced potential for South-South cooperation as well as the accelerated development of some developing countries, notably some countries of South-East Asia and Latin America. It may be relevant to consider the opportunities and challenges presented by this new environment for South-South cooperation in the interrelated areas of technology, investment and trade, taking into account the international agreements resulting from the Uruguay Round of Multilateral Trade Negotiations. The discussion of these and other relevant issues could be a first step towards exploring policies to promote South-South technology cooperation in this new environment.

CONCLUDING REMARKS: REVISITING SCIENCE AND TECHNOLOGY

56. This note has reviewed some of the science and technology-related questions considered by the institutions set up after the Vienna Conference on Science and Technology for Development, as well as some of the policy issues facing the international community on the eve of the twenty-first century. In many parts of the world the problems raised at the Vienna Conference have not disappeared. In the meantime, additional countries that were not its focus in 1979, i.e. those with economies in transition, are now seeking new ways of addressing science and technology-related issues in the present socio-economic setting.

57. The Commission on Science and Technology for Development has contributed to this discussion through its inter-sessional work and the intergovernmental discussions at its first (1993) and second (1995) sessions. In this context it has carried out work in such broad areas as basic needs, gender issues, strengthening of linkages between the national R&D systems and industrial sectors, and information technologies for development. [24]

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[23] See UNCTAD, "Midrand Declaration and a Partnership for Growth and Development", adopted by the United Nations Conference on Trade and Development at its ninth session, 1996 (TD/377).

[24] For an account of the Commission's work and its impact, see the report entitled "Implementation and progress made on decisions taken at the second session of the Commission, including follow-up work on technology for basic needs, gender and sustainable development and coalition of resources" (E/CN.16/1997/8).

58. The panel meeting convened by the Commission raised several policy issues for possible consideration, some of which have been addressed in this report. According to the report of the panel meeting, there seemed to be frustration with the limited implementation of the Vienna Programme of Action. In resolution 1995/4, ECOSOC invited the Commission on Science and Technology for Development to give consideration to ways and means of taking advantage of the twentieth anniversary of the Vienna Conference on Science and Technology for Development for the formulation of a common vision regarding the future contribution of science and technology for development. A starting point would be to discuss what has been functional and useful and what has helped to further technological capacity-building efforts in the developing world. [25] Such activities could consider the Vienna Programme and the dynamics surrounding it, for example the lack of political will and of conditions for its implementation. How could a more favourable environment for international cooperation in science and technology be stimulated and mobilized in the future? It is clear that a large section of the population in many parts of the world has not benefited from science and technology, and this may have contributed to social imbalances. Thus any approach for the future consideration of science and technology would have to take into account the concerns of a broad range of actors and stakeholders in development, including Governments, enterprises, the scientific and R&D community, and NGOs. The elements of "a common vision for the future" would need to reflect both the varied interests and perceptions of these different development actors and the changes that have occurred in the international economy.

[25] This activity could be seen as complementary to that of UNESCO in preparing a World Science Conference to be held in 1999. This conference deliberately does not address technology-related issues.