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Expert group meeting on a common vision for the future contribution of science and technology for development

Geneva, 8-10 December 1998

Summary report by the UNCTAD secretariat

Contents

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Introduction

The Commission on Science and Technology for Development (CSTD) addressed the issue of a common vision for the future of science and technology for development at its second and third sessions. A panel of members of the Commission, having indicated a priority for this subject area, and other selected experts had identified four main issues that could be considered in the formulation of a common vision at meetings held in Geneva (1996), Ocho Rios (1997), and Addis Ababa (1997).[1] The session held in Geneva from 8 to 10 December 1998 (the last of the series of substantive panel meetings) was attended by members of the CSTD and invited experts.[2] The objectives of the December 1998 meeting were to synthesize the results of previous sessions and to identify any gaps, with an emphasis on capacity-building and international networks. It was also to outline elements not yet discussed in previous sessions which may form part of the common vision to be discussed by the Commission at its fourth session in May 1999. The discussions were facilitated by short notes prepared by participating Commission members and experts as well as by a background note by the secretariat.[3] A final report of the work of the panel, synthesizing results from all four sessions conducted since 1996, as well as the results of a study on the experiences of North-South research networks conducted by UNCTAD,[4] is to be prepared separately prior to the fourth session of the CSTD in consultation with the Commission's Chairman. This will include proposed elements which could be considered by the Commission in formulating a possible common vision for the future contribution of science and technology for development.

The exchange of views at the meeting followed the suggested programme of work and covered the following: (a) views on elements of a common vision: country perspectives; (b) global entitlement to knowledge; (c) the changing role of the State in the development of science and technology; (d) the role of networking and partnership in a multidisciplinary approach to science and technology; (e) other issues for consideration; and (f) towards a common vision. The sessions were moderated by members of the Commission in a rotating order.

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[1] The four main themes identified by the panel at its first session (Geneva, December 1996) were: (a) the concrete impact of science and technology on development; generic and sectoral policies; (b) capacity-building in science and technology, including aspects relating to conceptualization, experiences, management and the examination of new opportunities; (c) the interaction of private enterprises, Governments, academic institutions and civil society groups with science and technology for development; and (d) assessment of international networks and work of organizations active in the field of science and technology.

[2] See list of participants in Annex 1.

[3] See list of documents in Annex 2.

[4] Project being carried out with the support of the Government of Austria.

I. Views on elements of a common vision: country perspectives

The discussion under this item consisted of presentations made by members of the CSTD. It included consideration of policies and issues likely to foster scientific and technological capacity-building at the country level. The Secretary of the Commission, in welcoming the participants, outlined the objectives of the session of the panel in the context of prior work undertaken on a possible common vision. The secretariat also referred to the notes prepared by participating members of the Commission on the basis of their own and their country's experience and to the background note containing a synthesis of work done so far by the panel.

Members of the Commission presented their views of a common vision in a round-table fashion. In his introduction, the moderator to this initial session indicated that achieving a common vision on the future contribution of science and technology for development was a difficult task and recommended that participants concentrate on elements that could be widely shared, stressing that idealism and courage, as well as social awareness, were needed. A common vision could not be "the lowest common denominator" or very general guidelines; accordingly, the panel had to be open in dealing with critical statements. Referring to differences in approach in classical Aristotelian and Eastern scientific concepts, he emphasized that it was indeed possible to unify views that at first glance appeared contradictory: eventually, something contradictory could become complementary. It was important to understand others' viewpoints and the fact that countries were at different levels of development with different needs. Finally, the session's exchanges had to be practical and operative.

In presenting his country's perspective, an expert from a developing country warned of the danger of developing countries becoming "isolated fortresses" if the free market economies now in place in many developing countries did not prevent poverty and social gaps from widening. He emphasized that a possible common vision would require searching for scenarios providing for a transition to sustainable development. Therefore countries must improve "governance" at all levels and address the issue of non-equity. Science and technology could provide tools to enhance good governance: a modernization of the education system, the use of information technology and forward-looking thinking were among the factors that could support the role of national innovation systems and the emergence of "knowledge societies".

In referring to the large potential of science and technology, an expert from an economy in transition described how the new international economic environment had affected the scientific community in her country in terms of organizational structures and patterns of knowledge transfer. In that context, it had been particularly important to identify and prioritize the elements that were critical to development. Countries should especially support those innovations which combined aspects relevant to economic and social development. To that end, different types of businesses and scientific partners should be encouraged to work together on innovation projects that would bring basic and applied sciences closer together. However, financial needs were important to those endeavours, and international programmes could help through sharing research findings and introducing progressive technologies.

An expert from a developing country emphasized the need for the technological development of small and medium-sized enterprises and accordingly stressed the importance of intensifying linkages between industry and the scientific community. The lack of finance for implementing adequate policies at the level of research and innovation was a problem for developing countries. The expert outlined several elements of policies that would continue to be important, particularly those concerning international cooperation, funding mechanisms for the development of technologies, and the popularization of science and technology and its diffusion. Another expert from a developing country emphasized the role of education at all levels, including the continuous education of managers and workers at the enterprise level as a condition for applying innovation concepts. Closely connected to that element was the importance to develop quality control systems in order to remain competitive and attain higher productivity and efficiency. Remaining competitive should include raising consumers' awareness.

An expert from a newly industrializing country referred to the substantial science and technology (S&T) capacities that had been built in his country. Nevertheless, the transfer of research and development (R&D) results from the public to the private sector was not always easy. A perspective that looked forward to the twenty first century required the continual boosting of technological activities, especially through partnerships and networking among firms, as well as through stronger linkages among S&T institutions. Such elements could help to spread knowledge from the public to the private sector and vice versa. It would also be important to focus on the management of S&T policy, including issues of consensus-building, policy options, effective implementation and policy evaluation. The role of government would continue to be important in S&T development in the newly industrializing countries. At the global level, knowledge and information would play a crucial role.

An expert from a developed country saw "governance" as a major issue in a possible common vision. Experience in the European Union with international cooperation had proved to be complex and involved several levels of governance: government patterns and structures had to be re-invented so that they leaned more towards decentralization, public participation and consensus-building. A second question related to development cooperation policies. In the past, the emphasis had been on institutional capacity-building, whereas the major trend was currently to support countries in creating or facilitating linkages between institutions and actors. However, synergy and worldwide innovation systems were still missing. Governments did not create innovation systems overnight and much work was needed to introduce and enhance organizational knowledge.

An expert from a least developed country emphasized the interaction between economic activities and the need to prevent further degradation of the environment and depletion of natural resources. The problem of poverty was at the core of that issue. Much was needed in terms of education of the population in order to apply science and technology properly. Access to knowledge and information was crucial in that respect. Capacity-building was needed at all levels, including literacy for scientific knowledge.

An expert from an economy in transition stated that at the global level the contribution of S&T to development had basically two dimensions: first, the generation of scientific and technical progress, with direct repercussions on the overall economic and social development; and, second, providing solutions to critical development problems, which concerned the protection and preservation of the environment, and the direct needs of people, such as health and food safety or energy and water supply. The expert also emphasized that in order to transform scientific and technological knowledge into a rapid vehicle for economic growth, with a view to achieving sustainable development, public S&T policies that were strongly focused on innovation and technology diffusion should be put in place within a unifying framework for policy formulation and implementation. The framework should be based on generally accepted policy targets, tools and indicators of achievement, serving as proactive constraints for the proper generation, distribution and use of scientific and technical knowledge, with particular emphasis on increasing the efficiency of distribution and use. Countries from Central and Eastern Europe were making efforts to introduce new S&T policy mechanisms aiming at harmonizing them with those of the European Union.

An expert from a small developing country said that the future of science and technology in the next millennium would depend to a large extent on developments in areas such as globalization and environmental degradation. Governments would be faced with the challenge of managing science and technology in a way that responded to the need for a better life for future generations. Aspects such as solidarity and social equity would be relevant in that context. There would have to be greater participation of non-governmental organizations and the private sector in identifying priorities and carrying out training and human resource development.

An expert from another small developing country expressed the view that a crisis in values rather than in technology would have to be faced. While countries were facing problems such as poverty and malnutrition, it was apparent that more knowledge alone would not help; many problems were of a social and behavioural nature. In his own country, for example, there were many well-educated graduates, but no economy to absorb their skills.

The moderator of the session identified several major issues that had emerged from the diversity of contributions that could be relevant to all countries. The first was a need for education for all: how could the industrialized countries contribute to providing the education needed for the development of industrial capacity in developing countries? A second issue was the need to focus on basic science, not only on the application of technology. Basic science should not be regarded as a luxury item; where education and training were integrated with research, the rational for basic science was clear and compelling. Links and networking were also among the issues to consider. Access to information was another critical issue; in theory, such access was available, but, in practice, it was still not available in many developing countries. The main question was not one of technical access, but affordable access.

In the subsequent discussion, an expert from a developed country emphasized the importance of gender when dealing with science and technology and the need to include girls and young women in education. The Government continued to provide support at the level of basic science and to areas of application such as agriculture and health in which society had a considerable interest and in which the results of research were not easily appropriable to specific companies. Extension services to disseminate research findings and public understanding of science and technology were also important areas for government support. However, science and technology were not a major aspect of her Government's foreign policy. An expert from a small developing country indicated that obtaining information itself was not a major problem, but the way in which the information was used, and the quality, type and nature of the information available, were important. It was suggested that education and university models dating from the nineteenth century were often still in use and that they might not be appropriate for the coming century. In the view of one expert, a science and technology policy was a basic requirement for the development of a framework for innovation, including the setting of basic targets and developing tools and indicators of achievement. Another expert emphasized the need to go beyond short-term thinking: strategic and forward-looking thinking would have to be developed, on, for example, the kind of education required. In that context, the need to create and maintain centres of excellence in the developing world, even in the face of scarce resources, was emphasized. It was observed that science itself was responsible for many of the problems currently being experienced, and science would have to solve them as it worked to foster development and address critical questions such as soil erosion or the loss of biodiversity.

In his summaring up, the moderator again underlined the complexity of the issue and the need to ensure that all countries had easier access to science for development.

II. Global entitlement to knowledge

The exchange of views under this item covered the generation, transfer and diffusion of science and technology, and the notion of knowledge as a basic entitlement for all. The discussions endeavoured to identify elements of science and technology for development that were of a global nature, and also focused on the role of education and equitable access to it. Global entitlement to knowledge could be used as a concept to provide the basis for the sharing of knowledge by all humankind. Special reference was made to the consensus in the international community that the alleviation of poverty should receive top priority in international cooperation. The 1.3 billion people affected by poverty in the world should be a central concern in the provision of S&T support. The concept of global entitlement to knowledge was considered to be useful in highlighting their needs. Every effort should be made to ensure that poor people had full access to global knowledge relating to programmes and projects designed for poverty alleviation. A scheme for the global mobilization of non-proprietary technology could be worked out. Practical approaches to such a scheme could include an alliance of non-governmental organizations entrusted with the task of mobilization work with public financial support.

Entitlement, however, would not by itself guarantee the effective use of knowledge. A long-term solution to poverty alleviation has to be based on learning acquired by the people actually affected by poverty. A long-term "S&T compact" would be one way to develop a structure for enhancing their learning capacity through S&T planning exercises in their respective countries with the participation of funding agencies or other countries. Once such compacts had been established, it would be essential to monitor and evaluate their development. The compacts could represent the S&T dimension of a new strategy for human and social development. The concept of a global entitlement to knowledge would therefore have to include some form of long-term commitment. Decision-making was seen as a key issue in questions regarding the global entitlement to knowledge.

With regard to a common agenda for developed and developing countries on the global entitlement to knowledge, the experts identified the following issues for further consideration: (a) basic education, including an emphasis on science in basic education; (b) the isolation of scientific communities; (c) public understanding of science; (d) public or private appropriation of knowledge; (e) changes in science that affect the processes for the appropriation of knowledge, including institutional and ethical issues; (f) social learning and learning of "local realities", involving improving "social intelligence" and supporting the creation of national consensus; (g) the development of learning organizations; (h) intermediation and the management of knowledge; (I) new ways to organize the scientific communities, such as research and innovation network, research consortia, virtual centres, alliances (R&D centres, enterprises), joint R&D projects, and innovation/technology networks. In the above areas of concern, the modernization of education at all levels, the further development of basic sciences and access to information were all found to be critical. Scientific activities in developing countries would have to be increasingly geared to those countries' specific needs.

III. The changing role of the State in the development of science and technology

The consideration of this issue focused on both the old and new actors and stakeholders in science and technology: the role of the State and its limitations, its interactions with other economic actors, such as the R&D community, the private sector (enterprises, business associations, etc.), and non-governmental organizations. The question of the role of civil society was also taken up, and a good deal of emphasis was placed on central themes such as education, information and basic research.

Participants highlighted the evolution of the role of the State in the development of S&T, from being a coordinator of supply-oriented scientific and technological activities to being more of a facilitator for expanding more demand-driven scientific and technological activities and services, as well as its move into something of an accountancy role with respect to R&D expenditures, which were seen as services to be procured from public money and as investments aiming at economic and social outcomes.

It was noted that, in many developed countries, such as the United States or certain European countries, the importance of the State's role in providing guidelines and incentives for S&T was significant. However, in many developing countries the role of the State appeared to have become less important and, in many cases, the State had not been providing any real and coherent support. There were many areas in which the State's role was critical and needed to be further enhanced - for example, with respect to taxation, fiscal incentives, enhancing the transfer of technology, establishing rules of accountability (through, for example, peer reviews for science), defining legislation for property rights or technology transfer, control of monopolies, or defining indicators for innovation. The Government also had a role to play in contributing to the creation of a “culture of innovation”, as well as in the areas of procurement, quality control and standards. Another issue concerned the rules of the World Trade Organization (WTO), including those allowing for subsidies for R&D, of which developing countries were not yet fully aware.

Domains in which the role of the State would be critical were highlighted. One of them was the adoption of *information policies* allowing free access, or facilitating easy and affordable access, to information for everybody on databases or other repositories, through the use of Internet. Issues such as the creation of property rights on databases, being discussed in the World Intellectual Property Organization (WIPO), could be of importance in that context. The recent development of S&T would require that both donor and recipient countries review their *cooperation policies*. Improved mechanisms to determine priorities, for example, could be a good starting point in such exercises. Cooperation policies would have to take into account the different sizes and situations of developing countries. When dealing with the role of the State, two kinds of concerns needed to be clearly distinguished: (a) *national concerns*, such as those related to improving the environment for innovation; and (b) *global concerns*, such as those related to environmental matters requiring closer linkages with science and technology. A particularly important issue requiring action was the protection of both vegetal and human genetic resources. *Education*, especially in the university sector, remained a central task of the States. The indications of *differences in country situations and sizes* were discussed, and questions were raised about the *role of the State, and whether it had really changed over time*, since in small developing countries the State was still the sole source for funding and establishing policy guidelines even when S&T was not a main policy concern. The *institutional aspects of S&T* at the national level were still considered important: in that context, recent developments in the United States and in Brazil (where the President presided over the national S&T organization) aroused interest in the possibility of high-level coordination at the public level. Issues related to the *contribution of S&T to governance capacities* would have to be further investigated; the latter included the need for further development of policy management capacities. *Funding for S&T* remained a key role of the State, in particular in basic research, high risk areas and for new technologies. Governments had a responsibility to build *consensus*, especially in the current wave of decentralization and the increasing presence of civil society in policy dialogue. Governments could play a particularly important role in creating *networks of nationals living abroad* who could contribute to training, establishing new linkages, etc. Certain decisions were being taken randomly by Governments; *social and other studies* would be needed to enable them to take scientifically-based decisions. Such studies would also help to provide a basis for the new, coherent policies that would be necessary in the coming century. A key role of the State was to create an *improved environment for initiating and sustaining private-sector firms of all sizes* and to provide conditions and assistance for the development of the S&T capacities of those firms.

IV. The role of networking and partnership in a multidisciplinary approach to science and technology

In the context of the substantive theme chosen by the Commission, experts discussed new approaches to S&T cooperation through networking and partnerships. It included a presentation by an expert on the ongoing UNCTAD project on networking experiences funded by the Government of Austria.

The moderator introduced the item referring to new approaches to science and technology through networking. The Vienna Programme of Action on Science and Technology for Development, adopted in 1979, called for North-South research relationships involving projects meant to benefit developing countries. Following the Vienna Conference, several countries had established or strengthened mechanisms to promote such research relationships, such as the International Development Research Centre (IDRC) of Canada, the Swedish Agency for Research Cooperation with Developing Countries (SAREC) and similar mechanisms in Denmark and the Netherlands.

In response to the decision to explore the issue of networks and partnership as part of the work on a common vision, a project was being carried out on the experiences of research networks that had evolved over the previous two decades, including the role of different actors in such networks - non-governmental organizations, universities and donors. The results of the project were to be presented at the fourth session of the CSTD. The resulting study was to include an empirical analysis of three networks in the area of biosciences. The invited expert in charge of implementing the project described several characteristics common to networks in terms of membership and governance, as well as a variety of factors and circumstances influencing their shape. Research networks could roughly be divided into three categories: (a) information exchange networks; (b) organizations with networking functions; and (c) research partnerships formed around specific programmes and projects. The expert described current trends in the policy and operational environments of North-South research networks, including the evolution of donor policies and the emergence of new technologies at the disposal of such networks. Donor policy had been shifting towards creating equal partnerships; however, that was not always easy and partners from the North often continued to dominate such partnerships. That asymmetry reduced the development relevance of many networks and needed to be addressed. While big strides were being made in research into new technologies, such as biomedical technology and biotechnology, and information and communication technologies, the focus of the majority of research networks remained in more traditional areas of R&D cooperation. The Internet was still underutilized by most networks and its opportunities were not being exploited.

The study under way aimed to identify the causes of the slow adoption of Internet technology by existing research networks, as they might reveal policy and operational issues that needed to be addressed. It also aimed to identify factors in the success of currently operational networks. A major output of the study would be a set of practical recommendations on how to create, maintain and run research networks. It would further contain a discussion of policy recommendations.

The presentation was followed by an exchange of views and comments on the study, as well as on other topics relevant to networking and partnership. One such topic referred to the role of partnerships and networking in S&T in strengthening national innovation and technological capacity. A participant from an industrialized country emphasized the need to evaluate both the strengths and weaknesses of networks in very practical terms, in order to provide guidance to bilateral and multilateral agencies wishing to support networks.

A participant from a developing country noted that a common vision for the future contribution of S&T to development could include a reference to the opportunities for the participation of developing countries in networks. Several examples of such participation were mentioned, such as the involvement of Latin American researchers in a physics research facility in the United States, and the recent European Union framework programme allowing for the participation of other countries in European research projects. He also referred to several South-South research networks described in the latest *World Science Report* of the United Nations Educational, Scientific and Cultural Organization (UNESCO).

A participant from an industrialized country described a network of 43 European-South-East Asian universities (ASEA-UNINET) which had developed from a number of bilateral partnerships in a bottom-up procedure for reasons of economy and other benefits of multilateral project planning. All partners made a “balanced contribution” to the network according to per capita income. While in terms of supply the institutions from the industrialized countries might dominate, demand was largely determined by the needs of the institutions from developing countries. There was a need for a “fair principle of balanced contributions” which could serve as a model for cooperation between industrialized and developing countries.

The ensuing exchanges focused on how African institutions could be included in such research networks. Many developing countries did not yet participate in a number of scientific programmes, a situation that needed to be reviewed so that the small scientific communities from those countries could participate in global research efforts. There was agreement that many networks did not fully use the potential of the Internet, which was a very useful instrument for networking activities, and that they should make greater use of it.

The policies of both donors and recipients would need to be reviewed in order to provide further support for networks. Participants provided several examples of existing networks, whose interesting experiences could be needed to illustrate the issues surrounding networking. They included the Europe-South-East Asian University Consortium, the Ibero-american S&T Programme (CYTED), specific sectoral programmes in Latin America, the Ibero-american Consortium for Higher Education S&T (ISTEC) and the MERCOCYT Programme, under the auspices of the Organization of American States.

V. Other issues

In addition to the issues discussed above, the experts considered other elements relevant to a common vision. They include: (a) the role of intellectual property rights protection; (b) the implication of new technologies: the case of biotechnology; (c) science and technology in health research; and (d) the gender dimension of S&T, as well as other cross-sectoral issues.

In discussing the role of *intellectual property rights* (IPRs) a significant asymmetry in the distribution of world R&D expenditures was noted. Developing countries accounted for around 6 per cent thereof, and most patents applied for and granted in those countries belonged to foreigners. However, IPRs might be important to protect local creations in developing countries, such as in the field of music and films. They were likely to be one of the factors considered by foreign firms willing to transfer technology in those sectors where IPRs were most relevant.

The Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement), that emerged from the Uruguay Round of Multilateral Trade Negotiations had set forth minimum standards for the protection of IPRs, but it also left signatories with room for manoeuvre to legislate on issues such as the patentability of biotechnological inventions and the exceptions to exclusive rights at the national level. In the implementation of the TRIPS Agreement, particular attention would have to be given to the relationship between IPRs and competition law. Although in developed countries that relationship was well developed, in developing countries that relationship was often a lack of effective anti-competitive legislation to prevent abuses of market power based on the exercise of IPRs. Article 66.2 of the TRIPS Agreement obliged developed countries to adopt measures to facilitate the transfer of technology and the strengthening of R&D capabilities in least developed countries, but no specific monitoring on the degree of compliance with that provision had yet been carried out. It was also pointed out that neither the Agreement on Trade-Related Investment Measures nor the General Agreement on Trade in Services prevented a signatory from establishing performance requirements in the area of R&D and transfer of technology. This meant that a country could request investors to comply with certain obligations aimed at enhancing the technological capabilities of the country.

Legislation on IPRs should aim at promoting innovation and competition. One exception to the exclusive rights that patent laws could provide for related to experimentation by third parties, for commercial purposes, on a protected invention. The prevailing system of incentives for innovation perhaps did not strike the right balance between the encouragement of future production of knowledge and the free flow of information. In particular, the IPRs system needed to be adapted to the prevailing "incremental" mode of innovation. The protection conferred should better distinguish between cases in which a significant, major advancement had been made, and those in which only minor additions to existing knowledge were involved.

The legal patentability of biotechnological inventions had been an intensively debated issue, on which considerable differences of opinion still existed. Current laws and policies in developed countries generally allowed for the protection of DNA and other natural substances, if isolated or purified. Genetically modified plants and animals, as well as parts thereof, were similarly patentable in many jurisdictions, often on the basis of broadly defined claims. The patentability in that area had in some cases been extended to products that were well-known and had been used for a long time by local and indigenous communities or to other resources collected in developing countries.

Relevant policies in developing countries were evolving, but in many cases the patentability of substances found in nature was not admitted nor was the potentability of plants and animals. Concerns had been expressed in those countries on the slowing down of the dissemination of the latest scientific results. A point of further concern was the extent to which the findings of the mapping of organisms' genomes, particularly of the human genome, could be appropriated under patents when the function of a particular gene (or group thereof) was identified. Those were issues which would need to be resolved in the twenty-first century.

Health interests should have priority over trade-related interests, including IPRs. Health was an end in itself; trade was an instrument to attain it as well as other objectives. The same applied to food security and the protection of the environment.

The development of *biotechnology* had opened new ways for exploiting knowledge of live material to obtain a wide range of products and processes in several areas, such as pharmaceuticals, agriculture, mining and food production. The benefits for people from such developments could be enormous. The first area in which biotechnology had a commercial impact was pharmaceuticals. Applicable results in agriculture had just started to appear on the market. Transgenic varieties, in particular, could have a significant impact on the production of different crops in the years to come, as already illustrated by the diffusion of such varieties in the United States and other countries.

The application of modern biotechnology had highlighted North-South asymmetries in science and technology. Despite some advances in developing countries, the world research and productive capabilities in that field were concentrated in a few industrialized countries. As pointed out by one of the experts, 70 per cent of patents granted worldwide in biotechnology had been granted to applicants from the United States and Japan (about 35 per cent each), 18 per cent to European countries, 6 per cent to countries of the former Soviet Union and the remaining 6 per cent to the rest of the world. That meant that, despite the promises of biotechnology for developing countries and the maturity of genetic engineering techniques, developing countries (with some exceptions, such as Cuba) had not been able to exploit the commercial potential of that technology. That failure could be attributed to barriers resulting from the need to scale up operations and market the products.

The widening of the range of application and the diffusion of biotechnology posed a number of complex challenges to society. Of outstanding importance were the long-term effects of the introduction of genetically modified organisms (GMOs). At the international level, the preparation of a biosafety protocol to the Convention on Biological Diversity still reflected substantial divergences of opinion, which had delayed the putting into practice of a harmonized biosafety regulation. While the introduction of GMOs should not be rejected on the basis of non-scientific considerations, human knowledge of ecosystems was often so fragmentary that some of the effects of introducing them could go unrecognized.

The social and economic implications of the use of biotechnological products and processes were also a cause for concern, as illustrated by the development of a genetic technology that made seed sterile, thereby preventing the traditional saving and re-use of seed by farmers and farming communities. The introduction of that technology in important crops could create a threat to food security and the sustainability of agriculture. The threat could be particularly worrying if there were no systems to monitor the effects of the dissemination of that trait in different species. In addition, given the fragility of the management, transportation and distribution and financing systems in most least developed and many developing countries, it could be difficult or even impossible to ensure that farmers had access to seeds on a yearly basis at affordable prices. Equally important were various ethical issues associated with the development and use of biotechnology, including problems of dignity, intimacy, confidentiality, consensus and free will, family coercion, choice in the areas of reproduction and eugenics. Human cloning, the creation of animal and human chimeras and the determination of traits in progeny were examples of the issues to be faced. The appropriate use of the vast potential of biotechnology required serious and informed reflection, taking into account ethical principles and basic human rights. Non-governmental organizations, such as professional organizations, could play an important role in that respect, including through the adoption of self-regulation schemes.

Attention was also paid by the experts to the issue of *health*. The ratio of resources for R&D in the health area in developed countries to those in the poorest countries, expressed in per capita terms, might be more in the order of 100:1 than 10:1. Research capacity-building was therefore of paramount importance, but in view of the long time-lags involved, the Advisory Committee on Health Research (ACHR) of the World Health Organization believed that full advantage had to be taken of modern information and communication technology. It had responded to the request to assess new and emerging areas of science and technology, to investigate evolving problems of critical significance to health, to identify appropriate methodologies for trend assessment and forecasting, and to develop a clear and well-defined health research strategy.

In order to complement the overall policy development process, the ACHR had undertaken over the past four years, a "research policy agenda" to provide a scientific background to the policy formulation process, which pursued three major thrusts. The first examined the global health situation in the light of trends which might not seem, a priori, to be directly related to health, such as population dynamics, including migration and urban growth, industrialization and changing value systems. Its orientation reflected the notion of "evolving problems of critical significance to health". The second component was a call to harness the extensive potential of science, technology and medicine that was already available worldwide. The third argument was that there was a need to reorient at least part of "frontier-type" research towards global problem-solving and the promotion of health development for underprivileged communities. In the following parts of the agenda, research imperatives and opportunities were discussed in terms of substantive domains (domain vs. inter-domain types of research), as well as in respect of methodological needs (e.g. utilization of knowledge, methods for intersectoral research, methods for behavioural research, health measurement and monitoring, modeling and simulation, priority-setting methodologies, and constraint-logic programming and resource allocation. Implementation aspects in the final section were discussed. Intelligent research networks that made full use of advanced information and communications technology were proposed to link up proactively all relevant partners, including foundations, governmental sponsors, research councils and scientific unions and colleges, while making full use of modern communication technologies.

In considering the diverse aspects of health matters, the participants discussed the scope and content of the ACHR report and considered it a good prototype for a vision statement on future S&T in the health area. Several experts intervened on health-related matters and advised on the need to give more emphasis to problems of violence, to gender-related issues and to research into medicinal plants, while always keeping in mind grassroots issues. Participants also recommended that the report of the ACHR should be brought to the attention of the Commission in the most appropriate way.

With respect to the *gender dimension of science and technology*, various points of view were presented, concentrating in particular on aspects concerning education. There was a consensus among the participants that gender should not be dealt with as an isolated issue. It constituted, in the opinion of the participants, a central cross-sectoral aspect with regard to all the S&T matters being discussed.

In the following exchange of experiences on other issues for consideration in the possible formulation of a common vision, participants proposed a long list of additional topics.[5] Of those topics, the following five were selected and briefly discussed during the session: (a) gender aspects; (b) institutional management, especially governance; (c) the specific problems of rural areas; (d) the question of quality and competitiveness; and (e) technical education and retraining.

VI. Towards a common vision

A brief final session was held to outline the main direction to follow in addressing the elements identified above in a common vision. The moderator summed up the mainstream directions in science and technology that had emerged from the substantive exchanges as follows. Sustainable development should be thought of as composed of elements such as (a) economic growth, (b) social equity, and © an adequate use of the environment. A key articulator of those

[5] New institutional arrangements to support S&T; reconnecting S&T with United Nations and country activities; getting science to those people who need it and forms of public participation; the contribution of S&T to the worldwide quality of life (transport, living conditions, communication); an adequate environment for investment; funding for entrepreneurs in the least developed countries (LDCs); the importance of global issues - global integration vs. marginalization, and the role of S&T as a binding agent; S&T policy in LDCs - mobilization schemes for S&T resources; public participation in S&T policy-making; governance - the contribution of S&T to societal governance and governance of S&T; the gender dimension of S&T; peace and science, conversion, non-proliferation; the transfer and diffusion of technology to LDCs; the popularization of S&T in rural areas and its diffusion/application/extension; support to SMEs in developing countries in the implementation of total quality management and ISO 9000 to make them competitive and contribute to developing those countries' economies; publicize success stories of S&T policies; international cooperation in R&D and training of human resources; efficiency and effectiveness of the public sector and government failure in R&D activities; education, vocational and technical training, retraining; democratization of scientific knowledge/access for citizens to such knowledge; LDCs - specific means of support; adapting science to the conditions in specific countries with a limited capacity for top quality research; commitment to children/humankind; S&T for enterprise development and competitiveness; S&T for local and regional development; S&T for the sustainable and ecological supply and use of energy; institutional arrangements, participation, governance; rural areas' concerns; quality and competitiveness issues.

elements of sustainable development was governance at the national and international levels. The capacity of governance was the key element for the transition to a scenario of sustainable development. Therefore, strong efforts might need to be made by the international community to promote S&T policy frameworks able to sustain a long-term consistency in approaches. One projection of the current global market pointed to a scenario of a growing gap between rich and poor, adding the pressures of increasing human population, overproduction and other problems, and which might lead to new protectionist measures that could lead to the collapse of the current economic system.

In that context, it was important to consider the contribution that S&T could make to the capacity of governance. That contribution could be made in two ways: (a) directly, using information technologies forecasting techniques and other instruments to support the different factors that made up governance capacities, mainly communication, long-term vision, consensus, compromise and coordination; and (b) strengthening the economic dimension of cultural policies and those of competitiveness by generating innovation and technical progress, the latter implying the strengthening of national innovation systems. Also, along those lines, consensus-building would be critical.

The concept of innovation systems was closely related to the knowledge system. The latter was understood to be "capable of generating knowledge on the reality and the environment and capable of providing such knowledge for its use in the process of conceiving and constructing society's future". Three challenges in particular could be considered as part of the policy development in a possible formulation of a common vision: (a) the modernization of the educational system, including continuous human resource development; (b) the development of an increased capacity for the social appropriation of knowledge; and (c) the development of strategic and forward-looking thinking. Meeting those challenges would constitute to the achievement of sustainable development.

ANNEX I

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ANNEX II

LIST OF DOCUMENTS DISTRIBUTED AT THE EXPERT MEETING[6]

UNESCO letter on consultations concerning the World Conference on Science for the Twenty-First Century (CSTD/COM.VIS./EM/1)

Contribution by Professor Bernd Michael Rode, Austria. "A few thoughts on the Commission's theme on Common Vision on the future of Science and Technology for Development" (CSTD/COM.VIS./EM/2)

Background note by the UNCTAD secretariat on the formulation of a common vision for the future of science and technology for development (CSTD/COM.VIS./EM/3)[7]

List of participants (CSTD/COM.VIS./EM/4 and Rev. 1)

Proposed programme of work (CSTD/COM.VIS./EM/5)

Contribution by Mr. Masafumi Nagao, Center for the Study of International Cooperation in Education, Hiroshima University, Hiroshima, Japan (CSTD/COM.VIS./EM/6)

Contribution by Ms Rolanda Predescu, Romania, on "Pro-active constraints on scientific and technical knowledge production, distribution and use: a possible future framework for S&T policies" (CSTD/COM.VIS./EM/7)

Contribution by Mr. Teodoro Kunin, Uruguay (CSTD/COM.VIS./EM/8)

Contribution by Mr. Kong Rae Lee, Republic of Korea (CSTD/COM.VIS./EM/9)

Contribution by Dr. Galina Butovskaya, Belarus (CSTD/COM.VIS./EM/10)

Contribution by Ms Shirley M. Malcom, Directorate for Education and Human Resources Programs, American Association for the Advancement of Science, Washington, United States (CSTD/COM.VIS./EM/11)

Contribution by Dr. Vito Quevedo Rodríguez, Cuba (CSTD/COM.VIS./EM/12)

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[6] The symbols in brackets following the titles of documents do not refer to official documents of the United Nations, but were devised for ease of reference.

[7] See annex III.

Contribution on the development of biotechnology by Dr. Carlos M. Correa, University of Buenos Aires, Argentina (CSTD/COM.VIS./EM/13)

Contribution by Mr. Rutger J. Engelhard, Cont@ctivity, Leiden, The Netherlands and Mr. Louk de la Rive Box, Director, European Centre for Development Policy Management, Maastricht, The Netherlands (CSTD/COM.VIS./EM/14)

Background information: "How the Terminator terminates: an explanation of the basic technology and possible consequences" by Martha L. Crouch, Associate Professor of Biology Indiana, University Bloomington, Indiana, United States (CSTD/COM.VIS./EM/15)

Contribution by Dr. Vito Quevedo Rodríguez, Cuba, on "Considerations for a Common Vision for the future contribution of Science and Technology for Sustainable Development" (CSTD/COM.VIS./EM/16)

Contribution by Dr. Carlos M. Correa on "Some issues for discussion by the Expert Group Meeting on a Common Vision of Science and Technology for Development" (CSTD/COM.VIS./EM/17)

Contribution (supporting slides for presentation) by Ms. Rolanda Predescu, Romania (CSTD/COM.VIS./EM/18)

Contribution by Dr. Amani Kouadio, Côte d'Ivoire (CSTD/COM.VIS./EM/19)

Contribution on the domain of health by Dr. Boutros Mansourian (CSTD/COM.VIS./EM/20)

Selected contribution from ATAS XI (UNCTAD/ITE/EDS/6) on new dimensions in local enterprise cooperation and development; beyond competitiveness; science and technology in Ukraine; institutional transfer in a post-socialist country; cooperation between R&D institutions and enterprises in the United Republic of Tanzania, and South-South partnering in biotechnology (CSTD/COM.VIS./EM/21)

Contribution by Mr. C. J. Okulo, Uganda (CSTD/COM.VIS./EM/22)

Contribution by Dr. Joerg Meyer-Stamer, Germany (CSTD/COM.VIS./EM/23)

"Défendre l'autonomie des scientifiques?" by Bruno Latour in La Recherche 315, December 1998 (CSTD/COM.VIS./EM/24)

Supporting slides for presentation on the domain of health by Dr. B. Mansourian (CSTD/COM.VIS./EM/25)

"The Science and Technology Sector in Romania", Ministry of Research and Technology, Romania (CSTD/COM.VIS./EM/26)

A Research Policy Agenda for Science and Technology to Support Global Health Development, The Advisory Committee on Health Research, World Health Organization, 1998 (WHO/RPS/ACHR/98.1)

ANNEX III

Background note by the UNCTAD secretariat on the formulation of a common vision for the future of science and technology for development[8]

[8] This background note was prepared for the Expert Group Meeting on a Common Vision for the Future Contribution of Science and Technology for Development, held in Geneva from 8 to 10 December 1998.

The Commission on Science and Technology for Development (CSTD) addressed the issue of a "common vision for the future of science and technology for development" at its second and third sessions. In addition, a panel of members of the Commission and other experts discussed various issues that might be considered in the formulation of a common vision at meetings held in Geneva (1996), Ocho Rios (1997) and Addis Ababa (1997). The meeting to be held in Geneva from 8 to 10 December 1998 is the last of this series of panel meetings. Its objectives are to synthesize the results of previous sessions, identify gaps in previous exchanges and outline elements that could form part of a common vision at the Commission's fourth session.

I. Background to the evolution of thinking on science and technology over the past 20 years (1979-1999)

It should be mentioned at the outset that the importance of international cooperation in science and technology (S&T) 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. This was followed in 1963 by the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, convened in Geneva, and in 1979 by the United Nations Conference on Science and Technology for Development held in Vienna. The latter led to the adoption of the Vienna Programme of Action on Science and Technology for Development.

This programme addressed the following major areas: strengthening the S&T capacities of the developing countries; restructuring the existing patterns of international scientific and technological relations in the transfer of technology; and strengthening the role of the United Nations system in promoting new forms of technological cooperation and increasing the provision of financial resources for this purpose.

Throughout the 1970s, developing countries, particularly the least developed countries, called for better access to the world's stock of S&T, a call which was reflected in the approach adopted in Vienna.

The Vienna Programme, however, in reflecting considerations of the time, was largely characterized by a State-led approach and gave relatively little attention to a broad range of influential actors, including enterprises, the R&D community and non-governmental organizations. It should be remembered that the Vienna Programme was adopted in an international context characterized by the North-South debate, the fall-out from the cold war, and Governments' preoccupation with fostering technological capabilities; there was limited participation by the private sector, particularly in developing countries. At the same time, more emphasis was placed on highlighting the asymmetries in S&T 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.

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 recognized the merits of strengthening the private sector, and policies were adjusted to nurture the development of enterprises, particularly small and medium-sized enterprises.

As a result, developing country economies became more open to foreign direct investment and adopted measures to stimulate such inflows with a view to promoting the transfer and diffusion of foreign technology, marketing and managerial know-how. Other objectives of foreign direct investment are to facilitate and promote employment and market access. Inter-firm cooperation through 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 have 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.

On the eve of the twenty-first century, the role and importance of S&T appear more relevant than ever. However, perceptions and approaches in the consideration of S&T-related issues, including the roles, policies and strategies of different actors, have changed. Also, S&T has come to be considered less for its own sake and more in terms of its interrelationships with innovation, investment, enterprise development, trade and environment-related questions.

Some of the main issues that transpire from those interrelationships are raised below to facilitate discussions on policy at the meeting and to hold the Commission to draw up a vision statement on the twentieth anniversary of the Vienna Conference.

II. Outcome of previous expert meetings of the panel on a common vision

A number of issues were raised at meetings of the CSTD panel on a common vision for the future contribution of science and technology for development in Geneva in December 1996, Jamaica in April 1997 and Addis Ababa in November 1997, as well as by the panel on partnerships and networking held in September 1998 in Malta. Discussions at those meetings provided further insights into the content and form of a common vision. More specifically, they have helped to identify areas and orientations of policies and strategies that would harness science and technology for development. These are mentioned below.

A. Characteristics of a common vision

A common vision would have to be a long-term concept with a minimum time framework of one generation. Experience has shown that S&T can be useful, particularly when it is applied in a constructive manner. However, often decisions on S&T applications and choices of technologies, especially those with wider social and environmental implications, are not made on the basis of well informed debate, particularly when it comes to their impact on society as a whole. Continuous consultation with those directly involved in the generation of technology and those affected by the results of scientific research and the pattern of technological trajectories in transparent management is essential. Too often that has not been the case; while great progress has been made over the past 50 years, the absolute numbers of people now living in poverty are greater than ever before and gaps between the rich and poor have increased. In many countries, this has led to great conflict and social destabilization.

S&T is no longer restricted to the formal system of research but also encompasses learning and innovative processes that create functional knowledge, which is partly tacit, and can be partly codified. S&T is seen as not just incorporating the natural and physical sciences but social sciences as well. A common vision for the future of S&T would have to take such a comprehensive view and also anticipate the goals to which innovation or learning should ultimately lead (e.g. in terms of social development). Such a vision would be a shared responsibility of people and institutions. In this context, technology is not value-free, particularly in countries that cannot afford to make more mistakes; rather, it is context- and application-specific.

An important element in finding useful applications for S&T in a country is the ability to organize knowledge, to use data effectively and to make life more predictable for those at the poorer ends of society. At a time when Governments and civil society are struggling to face the demands of global transformation, S&T could be an important tool. Only if S&T is at the service of people the marginalization of large parts of the world population be prevented. Access to knowledge remains a crucial factor in development. Japan has an article in its constitution guaranteeing every citizen access to a basic level of education and well-being. Could this concept be elevated to a global entitlement for the least developed countries to enable them to reap the benefits of S&T? How might such a notion be translated into practical steps? The above considerations, demonstrate the need to popularize S&T, to increase S&T literacy, to make S&T a shared learning activity and generally to link to society.

There seem to be two stages of development, and in both cases S&T has a crucial role to play. First, there is the early stage of the development effort when a minimum infrastructure, capital, capacity, etc. are needed. In the second stage, countries that have reached a certain level of development need very specific innovative measures to continue on that path. While the common vision should be global, it should particularly address the needs of the least developed countries. However, it should not be forgotten that even some of the countries in the second stage of development face considerable levels of poverty that need to be overcome. Nowadays, the global financial institutions no longer view development in purely mechanistic terms, but recognize the need for a holistic view of societies that encompasses measures such as poverty alleviation as a means of advancing economic development. The role of S&T should be viewed in a similar fashion.

B. Global entitlement to knowledge

There is no lack of knowledge in the field of S&T. Often, the problem is one of access to that knowledge; perhaps the technical knowledge is patented or a military secret and is too expensive to be acquired, or perhaps it is "tacit knowledge" and therefore not easily transferable and adaptable in different contexts. Here, very practical steps are necessary to operationalize the concept of global knowledge entitlement. One reason that international initiatives have sometimes failed is that proposed solutions were too general, badly timed or difficult to translate into action. Specific needs in areas such as food security, energy or health have to be identified and become part of the common vision.

Different notions of what science is according to, for example, western, Indian or Chinese concepts - could be considered in developing a common vision. How is knowledge generated in different societies? What are the biases and perceptions? Discussion on sustainable development has added the further notion of intergenerational equity, which also needs to be reflected in the common vision.

C. The role of networking and partnerships in a multidisciplinary approach to S&T

Any approach to S&T now would have to take into account a broad range of concerns of the actors and stakeholders in development, including Governments, enterprises, the scientific and research and development (R&D) community, and non-governmental organizations. Therefore, the elements of a common vision for the future would have to reflect the varied interests and perceptions of these different development actors. Account should be taken of the fact that in the 1990s more S&T is in private hands, and that the role of the United Nations has not been strengthened after the Vienna Conference, contrary to its programme's objectives.

Economically, politically and technologically, we are shifting towards global markets and global actors. The dynamics of technological change linked to this process will have implications for the enterprise sector in the developed and developing world alike. Increasingly it will be important to find solutions through cooperative partnerships and networks. Thus, the business community is pooling resources through various forms of inter-firm cooperation such as strategic alliances and technology partnerships with the respective partners depending on each other's complementary skills. This includes forms of cooperation involving a blend of capital, technological know-how and marketing skills. Policies facilitating inter-firm cooperation are recognized as a tool to enable firms, particularly small and medium-sized enterprises, to meet the challenges of the new competitive environment, in terms of technology, marketing and managerial know-how, for example.

The new global environment also has repercussions for academic institutions. The major response of the R&D community appears to be networking. Networks provide an opportunity for resource-sharing and collaboration. For example, today, networks exist of agricultural research laboratories (such as the Consultative Group on International Agricultural Research), within scientific disciplines (such as the International Biosciences Network) or among universities which share a common goal (such as the European Copernicus programme of universities working for sustainable development). [9] At the same time, academic institutions and enterprises are increasingly seeking cooperation with each other. The nature of cooperation between enterprises and R&D institutions with the objective of increasing the commercialization of R&D results is manifold, but often a common goal is the utilization of locally available R&D results.

There is an increasing need to create an enabling environment and legal framework conducive to networking and partnership, and, through specific policies, to create incentives and raise awareness of the benefits to be derived from these forms of cooperation. The international community has played an important role in supporting networking of R&D institutions among and between developed and developing countries. Further efforts will be required to enhance inter-firm cooperation, in both North-South and South-South contexts, by promoting policies and programmes supporting partnerships and facilitating the access of firms, particularly small and medium-sized enterprises, to financial resources and technical services.[10] To this end, programmes will need to rely on existing institutions of civil society that serve as intermediaries, such as business associations (including those operating at the local level), R&D institutions and the enterprises themselves that could be associated in a new system of alliances.

D. Role of the State in S&T development

In the past, national science and technology institutions in many countries have played an important role in promoting awareness of the importance of S&T. With the increasing knowledge-intensity of production and its generalization across sectors, there will be a need to rethink the process of S&T policy formulation and its coordination at both the local and national level. Future efforts at spearheading technological development will require the strengthening of technology services for capturing and registering patents and trademarks, standard-setting and establishing systems of quality control. In addition, there will be a need to promote the creation of training centres aimed at developing technology management and skills. Strategic alliances between researchers, educators, government technology-support staff, technology developers and technology users will also need further encouragement. The requirements of S&T should be fully taken into account when setting development objectives at the national and local levels with respect to the needs of different development actors. Governments could play an important role in creating a culture of strategic planning.

[9] The experiences of research networks in a selected sector - biosciences - will be presented to the Commission in a special study carried out by the secretariat with the support from the Government of Austria.

[10] See report of the UNCTAD Expert Meeting on the impact of government policy and government/private action in stimulating inter-firm partnerships regarding technology, production and marketing with particular emphasis on North-South and South-South linkages in promoting technology transfer (know-how, management expertise) and trade for SME development (TD/B/COM.3/12-TD/B/COM.3/EM.4/3).

III. Some issues for further consideration

The issues raised in the previous section, together with the related questions suggested below, could constitute a framework for the formulation of a common vision for the future consideration of science and technology for development. Such a formulation would have to take into account the new technological and economic environment that has emerged in the second half of the twentieth century. The emergence of new technologies and the rapid pace of their diffusion has created new opportunities but also challenges for developing countries and transition economies in their efforts to cope with a process of continuous change. It has also induced changes in the roles of the main development actors, with more and more responsibility being assigned to the private sector, non-governmental organizations and other stakeholders. All this creates a much more complex development scenario for the future. It is in this context that the meeting might consider some of the following broader issues:

- The future contribution of S&T to development in areas such as industrial upgrading, agricultural production and services, and in general to sustainable development. What capacities - in terms of education, research, innovation, ability to access and manage information, knowledge networks and partnerships - will be needed, in particular by developing countries, to meet the challenges of the coming century? What new approaches must be taken to build these capacities?

- Global entitlement to knowledge, in terms of education and development aspirations, inter-generational equity (which has emerged in the discussion on sustainable development), the need to identify applications of specific new technologies in the development process (information and communication technologies, biotechnology, new materials, etc.), and the role of networking and partnering for capacity-building.