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DEVELOPMENT AND INTERNATIONAL ECONOMIC COOPERATION:
SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

Ways and means of strengthening endogenous capacity-building in science and technology in developing countries

Report of the Secretary-General

SUMMARY

In pursuance of General Assembly resolution 46/165, the present report reviews the discussions carried through and the action taken by the Commission on Science and Technology for Development and the Economic and Social Council on the contribution of technology to industrialization and regional economic integration; by the Assembly and the Commission on Sustainable Development on the follow-up to the United Nations Conference on Environment and Development; and by the Governing Council of the United Nations Development Programme on the questions of national capacity-building and environment and development. Such review points to a new policy emphasis regarding the importance of the sustainability of development and the continuing need for national capacity-building in science and technology. This report points out that since the United Nations Conference on Science and Technology for Development, held in Vienna in 1979, the issue of capacity-building in science and technology has continued to be an important part of economic growth policies undertaken by all countries, but it expresses caution in so far as the gap in science and technology capabilities that exists between North and South widened in the period 1970-1990.

The present report updates the conceptualization of the process of endogenous capacity-building in science and technology for development in view of the guidance given by the legislative organs of the United Nations and taking into account trends towards regional and global economic integration. A series of substantive elements of endogenous science and technology capacity - oriented towards the enterprise level - are identified.

Finally, possible actions for capacity-building in science and technology are brought to the attention of the General Assembly with respect to the coordination of financing, technology assessment and forecasting capabilities, and operational activities of the United Nations.

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I. INTRODUCTION

1. The General Assembly, in its resolution 46/165 of 19 December 1991 entitled "Science and technology for development", requested the Secretary-General, taking into account the outcome of the United Nations Conference on Environment and Development and on the basis of the discussion by the Intergovernmental Committee on Science and Technology for Development of the substantive theme of its twelfth session, to submit to the Assembly at its forty-eighth session a comprehensive, analytical report on ways and means of strengthening endogenous capacity-building in science and technology in the developing countries.

2. The present report is submitted in pursuance of that resolution.

A. Substantive theme

3. The Intergovernmental Committee on Science and Technology for Development, at its eleventh session held in New York from 22 April to 3 May 1991, had decided 1/ that the aforementioned substantive theme would be the contribution of technologies, including new and emerging ones, for the industrialization of developing countries and for the strengthening of regional and global integration processes, including proposals on ways and means of transferring such technologies and for their incorporation in the productive section of those countries.

4. The successor to the Intergovernmental Committee, namely, the Commission on Science and Technology for Development, dealt with the substantive theme at its first session, 2/ held in New York from 12 to 23 April 1993.

5. The Commission had before it a report of the Secretary-General (E/CN.16/1993/2) on the contribution of technology to industrialization and regional and global integration. A background paper, providing an overview of the relationship between globalization and the development process, regional case-studies of scientific and technological cooperation and several case-studies of national technological systems, was also available to the Commission.

6. The report of the Secretary-General mentioned in the preceding paragraph examined policy options for strengthening national entrepreneurship and endogenous science and technology capability at the national, regional and subregional levels, and indicated that there was wide scope for cooperation at various levels aimed at maximizing resources and promoting intercorporate regional agreements for technological innovation in order to improve the overall international competitiveness of developing countries.

7. The Commission noted that trends towards globalization had given rise to new modalities of international specialization, to which developing countries and economies in transition had to respond. Increasingly, such static comparative advantage factors as natural resources and unskilled labour endowments were ceasing to be the most important determinants of international competitiveness. The experience of many countries that had achieved high rates of economic growth demonstrated the critical role of factors associated with

technology-based competition, namely, technical skills, technological infrastructure and social organization.

8. It was stressed that the process of building the scientific and technological base of the economies of developing countries had to be accelerated and its focus deepened. Countries would then be able to engage effectively in the ongoing global restructuring process. The priority status required for long-term investments in education and human resources in general, as had been noted in the above-mentioned report of the Secretary-General, was emphasized.

9. Speakers concurred with the views contained in that report regarding the need for a consistent institutional and regulatory framework at the national level for the effective operation of innovation systems, as well as the difficulties of successfully incorporating technological innovations into economic development. With respect to achieving such goals, the transfer of technology had to be regarded as forming but one of the components of successful technological upgrading. In that respect, the Commission discussed the question of the management of incremental technical change and the problems associated with the lack of that capability.

10. The European experience with regional technological integration - the programme developed by the European Research Cooperation Agency (EUREKA), for example - was mentioned as a possible source of inspiration for developing countries. However, it was observed that developing countries were facing exceptional difficulties in reaching compatible levels of technological development, without which effective and widespread regional science and technology cooperation could not occur.

11. In addition, the Commission noted the problems faced by the least developed countries in connection with the brain drain to the more industrialized ones. Similar but special problems were also being faced by countries in transition to market economies. On the one hand, countries in transition had a high level of scientific and technological development in various fields; on the other hand, their systems had to adjust to a new market-oriented context and to environmental concerns.

12. It was stressed that the holistic nature of the current technological wave should be recognized, in particular the linkages between science, technology and sustainable development. Sustainable development depended on the efficient use of advanced technology. Scarce scientific and technological resources must be properly allocated to serve domestic needs without losing sight of the possible detrimental environmental impact of the technologies used. Therefore, the quest for ecologically sound technologies created a new burden for developing countries. Efforts of the United Nations system should aim at facilitating the access of developing countries to those technologies.

13. On the basis of the report of the Commission on its first session (E/1993/31), the Economic and Social Council adopted resolution 1993/69 of 30 July 1993 in which it decided to form an ad hoc panel of experts from the members of the Commission, aided by the relevant organs, organizations and bodies of the United Nations system, to study in depth the various issues related to the substantive theme and the report of the Secretary-General

(E/CN.16/1993/2) so as to formulate recommendations for consideration by the Commission at its second session under an agenda item entitled "Action arising from the first session", concentrating on the following issues:

(a) Policies and mechanisms for promoting linkages among national, subregional, regional and global science and technology systems and between those science and technology systems and the industrial sector of developing countries;

(b) Developing internal linkages within the United Nations system for effective coordination of the work dealing with the promotion of sustainable industrial development;

(c) Past, present and future trends in science and technology, including the transfer of technology, and their implications for the sustainable industrial development of developing countries;

(d) Strategies for using science and technology in promoting exports in selected sectors.

14. In the same resolution, the Council also requested that the report of the Secretary-General on the coordination of United Nations activities in science and technology to be submitted to the Council at its substantive session of 1994 include an updating of the section of the report of the Secretary-General (E/CN.16/1993/2) that had concerned the problems and policy measures related to promoting effective linkages between research and development and the productive sector, with particular attention to the new developments and approach being effected in support of Agenda 21 3/ and with an indication of any major new opportunities open for international cooperation in that matter.

B. Outcome of the United Nations Conference on Environment and Development

15. In respect of the subject of the present report, namely, the strengthening of the endogenous capacities of developing countries in science and technology, the outcome and follow-up of the United Nations Conference on Environment and Development, as expected, provided important elements of policy guidance, especially by emphasizing the importance of the sustainability of development.

16. The General Assembly, in its resolution 47/190 of 22 December 1992 entitled "Report of the United Nations Conference on Environment and Development", endorsed, in particular, *inter alia*, the Rio Declaration on Environment and Development, 4/ and Agenda 21. The latter is a global programme that gives new vitality to system-wide efforts in science and technology for development. In the same resolution, the Assembly called on all concerned to implement all commitments, agreements and recommendations reached at the United Nations Conference on Environment and Development, especially by ensuring provision of the means of implementation under section IV of Agenda 21, stressing in particular the importance of financial resources and mechanisms, the transfer of environmentally sound technology, cooperation and capacity-building, and international institutional arrangements, in order to achieve sustainable development in all countries.

17. The Commission on Sustainable Development held its first session in New York from 14 to 25 June 1993. In the report of the Commission on its first session, the Commission brought to the attention of the Economic and Social Council matters relating to the progress achieved in facilitating and promoting the transfer of environmentally sound technology cooperation and capacity-building. 5/

18. In particular, the Commission urged bilateral and multilateral donors, as well as national Governments, to undertake efforts to increase their financial support at the international, regional and subregional levels for activities that were designed to promote and facilitate the transfer of environmentally sound technologies, in particular to developing countries and to the building of the endogenous capacities of developing countries to develop and manage such technologies, including state-of-the-art technologies and those already in place.

19. It also stressed the importance of strengthening national capacities to assess, develop, manage and apply new technologies, and, in that context, the need to strengthen existing institutions, train personnel at all levels and educate the end-users of new technologies.

C. United Nations Development Programme

20. In June 1993, the Governing Council of the United Nations Development Programme (UNDP) considered the report of the Administrator (DP/1993/23) on national capacity-building and that (DP/1993/11) on the follow-up to the United Nations Conference on Environment and Development: UNDP strategy in support of sustainable development, including the Capacity 21 programme. In the action taken on both reports, the Governing Council endorsed policies that will provide new guidance and resources for system-wide activities in support of national and regional capacity-building programmes. Such action is particularly relevant for activities relating to endogenous capacity-building in science and technology.

21. The report on national capacity-building, which reflected the current concern on the part of the development community to identify more coherent strategies and instruments for capacity-building, called for capacity-building policy to be seen in its broadest possible sense, in terms of all the resources available, including those resulting from new patterns of international trade, technology transfer and aid flows. The report also put forth the capacity to define and manage a long-term vision of development, including perspective studies, 6/ as constituting one of the major areas in which UNDP can support national capacity-building strategies.

22. Regarding the report on UNDP strategy in support of sustainable development, the Governing Council, which had approved in February 1993 the decision of the Administrator to launch Capacity 21, requested him to proceed with the implementation of this programme in support of Agenda 21 on the basis of the proposals of the report. Among the capacities to be developed by Capacity 21 is included the capacity to draw on local information sources and to develop and adapt appropriate technology for promoting sustainable development.

23. A number of general trends can be derived from the outcome of the above deliberations by United Nations organs on the issues of (a) the contribution of science and technology to industrialization and regional and global economic integration, (b) sustainable development and environment, and (c) national capacity-building for development.

24. Such trends may be identified as follows:

(a) The process of global and regional integration will call for new forms of science and technology cooperation, including, for example, cooperation among industrial enterprises and research centres from two or more developing countries in order to upgrade technology and product quality;

(b) The attainment of sustainable development goals will require additional efforts in scientific and technological capacity-building for environmentally sound technology transfer and generation;

(c) International technical cooperation (especially multilateral), which traditionally has had the objective of building national capacities for development, will be placing renewed emphasis on this objective. Consequently, the process of endogenous capacity-building in science and technology will, increasingly, become a pivotal part of national capacity-building for development and will require the coordinated participation of the United Nations system 7/ together with the rest of the international donor community.

II. BACKGROUND

25. The paramount goal of the 1979 Vienna Programme of Action on Science and Technology for Development, 8/ was the strengthening of the developing countries' own endogenous scientific and technological capabilities as a basis for their social and economic development. The validity of that goal and other, related goals of the Vienna Programme of Action was reaffirmed by the General Assembly in its resolution 44/14 A of 26 October 1989.

Box 1. The unity of science and technology policy

For policy purposes, science and technology is generally treated as a unified topic in view of the extensive interrelations and close interactions between scientific and technological activities. This is one of the principal reasons why in most countries it has proved efficient to address science and technology in an overall manner at the macro level. In most developing countries, national development policy generally requires a long-term vision of science and technology and an explicit capacity-building strategy.

From this perspective, science is taken to cover disciplines extending beyond the natural sciences (such as mathematics, physics, chemistry and biology) and thus includes the social sciences (for example, economics, psychology, sociology and policy sciences). Technology - which is based increasingly on science - is also seen as covering a broad area of disciplines starting with engineering (civil, mechanical, electrical and chemical) and extending, for example, to medical, agricultural, educational, information and management technologies. The so-called new technologies include micro-electronics and informatics, biotechnology, new materials and fine chemistry.

The interrelations and interactions between science and technology can be illustrated in education, by the interdisciplinary structure and operation of universities and institutes of technology; in industry, by the increasing number of partnerships between government-sponsored scientific research and corporate-specific technology innovation, as well as by the widespread, mission-oriented collaboration between scientists, engineers and planners/forecasters/managers within research and development teams.

26. Since the 1970s, the issue of capacity-building in science and technology has continued to play an important part in economic growth policies undertaken by all countries. In terms of national management, this may be reflected in the fact that today most countries have succeeded in formulating an explicit national policy in science and technology and have at least one high-level body (a ministry, for example) dealing with this area. Often there are many other institutions, both public and private, at a comparable level, including specialized science and technology committees of the legislature.

27. As regards international cooperation in science and technology for development, the United Nations system has played a leading role highlighted by the United Nations Conference on Science and Technology for Development, which adopted the Vienna Programme of Action on Science and Technology for Development. Within the system, the United Nations has had a coordinating role in such areas as technology assessment and forecasting, 9/ science and technology for the development of the least developed countries, and international cooperation for the overall strengthening of national capacities in science and technology.

28. The United Nations has long worked together with interested bilateral donors such as Canada, Denmark, Germany, Japan, the Netherlands, Norway, Sweden and the United States of America in the field of development cooperation policies in science and technology. Thinking in this area has evolved towards a substantial convergence and complementarity between the United Nations system and bilateral donors.

Box 2. Conference on the Development and Strengthening of Research Capacity in Developing Countries

The Conference on the Development and Strengthening of Research Capacity in Developing Countries, convened by the Netherlands Advisory Council for Scientific Research in Development Problems, was held at the Ministry of Foreign Affairs, The Hague, on 2 and 3 September 1993.

The Conference was attended by representatives of the Organisation for Economic Cooperation and Development and donor agencies from Belgium, Canada, Germany, the Netherlands, Sweden and the United Kingdom of Great Britain and Northern Ireland.

One of the main working papers of the Conference was entitled "Research and development: policy document of the Government of the Netherlands". a/ The paper was based on the principle that research can play an important part in improving the quality of policy relating to development and development cooperation when it is targeted towards sustainable development and economic self-reliance, with special emphasis on the alleviation of poverty, sustainable environmental management and gender issues.

The paper also gave consideration to the make-up of the global research system, which is notable for its high degree of asymmetry, b/ with the bulk of research being carried out in the North. It stressed that there was a consensus in the international community of donors on the need to strengthen research capability in the South and thus that, where possible, research activities should take place in the developing countries themselves.

The paper further emphasizes such points in a passage quoted from an earlier policy document of the Government of the Netherlands:

> "Scientific research potential and scientific knowledge are very largely concentrated in the rich North and associated with interests in the North. At a time when the importance of scientific knowledge for economic, technological and social development is growing, developing countries should have their own research capacities. As a counterbalance to a northern scientific community with world-wide pretensions, the South needs to be asking its own questions and developing and using its own scientific know-how". c/

The Conference agreed that there should be no division between the North and the South and called for a true global research system. It identified steps to be undertaken at the international, national, institutional and research levels. Weaknesses in research policy and the organization and management of research must be overcome. For this purpose, countries should build the capacity to define policy, determine research priorities and express demand clearly to donors. The research system should engage policy makers in a dialogue. Developed countries should respond to clearly expressed demand and not impose their own priorities.

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a/ Ministry of Foreign Affairs, The Hague, 1992.

b/ For a quantitative illustration of this asymmetry, see paras. 29-31 of the present report.

c/ "A world of difference: a new framework for development cooperation in the 1990s" (Ministry of Foreign Affairs, The Hague, 1991), p. 310.

A. Science and technology capacities in the world for the period 1970-1990

29. During the years 1970-1990 (with the United Nations Conference on Science and Technology for Development having taken place close to the mid-point of that period), the scientific and technological gap separating developing from developed countries (measured in terms of their respective total numbers of research and development personnel and total research and development expenditure) continued to widen both quantitatively and qualitatively. It should be mentioned that a country's scientific and technological output, as measured by the number of publications or patents, tends to be directly proportional to the absolute value of expenditure on research and development.

30. During the period in question, developing countries managed to nearly double their share of world research and development personnel (which increased from 7.9 to 14.5 per cent), and this certainly reflects the expansion of scientific and technological education in those countries especially at the university level (see figs. I and II). However, in spite of this growth, the gap in absolute numbers continued to grow, as shown in figures III and IV.

31. Developed countries continue to dominate world research and development activities: They commanded 85.5 per cent of all the research and development scientists and engineers and 96 per cent of global research and development expenditure in 1990, while developing countries, which represent roughly three quarters of mankind, accounted for less than 4 per cent of the world's research and development workforce and for only 0.5 per cent of total research and development financial resources. Moreover, this gap with respect to potential science and technology capabilities has increased over time, and has been depicted in figures III-VI.

Figures I and II

Figures III and IV

Figures V and VI

32. In addition, it must be taken into account that most science and technology systems in developing countries will be facing a difficult task in trying to catch up with the level of science and technology capacity of the developed world, owing to the fact that scientific and technological progress tend to be mutually reinforcing and mutually accelerating. As a result, the extent of technological advance in the developed countries in the first decade of the twenty-first century is likely to exceed all of the advance accumulated in the current century. In simple terms, scientific research will continue to exploit the latest technology in order to achieve results more efficiently and ultimately at a faster pace (with science thus becoming "industrialized"). In turn, technological advance (including new products and processes) will be more and more grounded in and facilitated by new concepts and theories and specific breakthroughs in science.

33. Therefore, owing to this continuous increase in the pace of scientific and technological progress, which is already concentrated in developed countries, developing countries could participate in the race only when they had reached a threshold level of scientific and technological capacity. Then, the acceleration of technical progress and the effects of the diffusion of knowledge would begin to work in their favour (as was the case in Japan in the nineteenth century and in the Republic of Korea recently). It is clear, however, that the longer a country (or group of countries cooperating in capacity-building) must wait to reach a critical level of capacity in science and technology, the more uphill the road to competitiveness will become.

34. Economic history demonstrates that capacity-building in science and technology is a crucial element in the process of development; and considerable awareness of this fact currently exists in most developing countries. However, given that investments in science and technology do not produce results in a short time, but rather over the longer term, the poorest countries, including small ones and the least developed, face a dilemma. Those countries, overwhelmed with pressing problems such as critical poverty, illiteracy, high infant mortality and malnutrition, are being forced to abandon long-term scientific and technological capacity-building plans. Very little hope will exist for them if massive flows of external cooperation are not forthcoming, and the role to be played by the international donor community will be critical in the building of capabilities in science and technology.

III. STRENGTHENING THE PROCESS OF ENDOGENOUS CAPACITY-BUILDING IN SCIENCE AND TECHNOLOGY IN DEVELOPING COUNTRIES

35. The process of endogenous capacity-building in science and technology is long term and all-encompassing. Sometimes it is practically equated with the process of economic and social development itself. However, in such a vast field, it is crucial to identify substantive priorities for each national situation. On this basis, plans could be drawn up to bring the national science and technology system to a critical size and level of quality so that it might begin to perform efficiently.

A. Changing concepts

36. The process of capacity-building in science and technology is invariably connected with institution-building and human resources development and thus lends itself to involvement with external cooperation, in which the international donor community and the United Nations system in particular have participated for many years. However, the results have been disappointing, probably because specific action has not been sustained over time and because the building of endogenous capacities in science and technology has not been oriented enough towards specific problems of national development.

37. Endogenous scientific and technological capacities carry with them the ability to absorb and efficiently employ new technologies, adapt those technologies to local conditions and improve upon them, and ultimately create new knowledge. Underlying this concept is a changing perspective on the role of science and technology in the development process and the nature of scientific and technological change. Much of this derives from the new interpretations of the relationship between technical change and economic growth that are based on new theories and models of economic development, as well as from the increasing importance of technology to the competitiveness of nations and firms within the context of the globalization of markets.

1. Technology issues

38. In particular, three observations should be made with respect to technology. First, technology is becoming increasingly international in scale. Though many developing countries are attempting to mobilize their own endogenous technological resources, the importance to domestic industrial competitiveness of technologies developed elsewhere cannot be underestimated. The capacity to absorb foreign technology is as important at the national level as it is at the firm level. In most of the countries representing success stories with respect to industrialization in recent decades - Japan, the Republic of Korea and Taiwan Province of China - private firms have relied heavily on the acquisition of externally developed technologies.

39. Second, incremental improvements in technology quality can be more decisive over time than radical breakthroughs; and while the incorporation of new technology is important, conventional technologies and their adaptation play a key role in economic development. Micro-electronics and biotechnology are high-profile areas of new technology development, but the potential contribution of innovations in areas such as conventional chemical processing technology, agricultural machinery and pest control can often have a greater effect on economic development.

40. Third, certain changes can be pointed out with respect to technology today, including the emergence of several poles of technological development. In effect, technology is being developed in a number of countries, not only the most industrialized. The phenomenon is commonly referred to as technological multipolarity. In this respect it should be noted that not only have such countries as Japan, the United States and members of the European Economic Community become important sources of new technological advances, but countries such as the Republic of Korea, India and Brazil have entered the picture as

well. Furthermore, the importance of technological resources, primarily in terms of skilled human resources, has become more evident in such sectors as software engineering and biotechnology. When this is added to the newly recognized value of traditional bodies of knowledge (such as that related to medicinal plants), it can be seen that the array of possibilities for technology sourcing has become much larger than it was even two decades ago.

41. Technology is changing rapidly in all industrial sectors, and high technology is penetrating many formerly low-tech, labour-intensive industries. The innovative combinations of high and conventional (or low) technology that are appearing are being subsumed under the generic term technology blending. Technology pervades all aspects of economic and industrial activity; it is no longer limited to equipment, but includes the entire range of knowledge associated with all the phases and functions of competitive business activity (for example, marketing, administration, product design) that determine the overall productivity and competitiveness of a given enterprise. Technology is pervasive not only in the productive sphere, but in the social and cultural spheres as well.

42. Technology is no longer a determinate and static component of manufacturing; as with human resources, it is a variable in the production process that can be changed, improved and modified through innovative management.

43. The environment and its protection at all levels, from the local to the global, have become a pressing issue recently, and technological processes need to be assessed with respect to their environmental implications. Also, environmental problems are creating new technological demands that need to be addressed. In many cases, there exist areas of opportunity for developing countries.

2. National policy

44. Based on the experiences of the past and the changing context of technology today, several principles that are essential to the development of endogenous capacities in science and technology are hereby identified:

(a) There exists the need for a demand-driven approach to science and technology. This involves strengthening and developing capacities to monitor and recognize demands for science and technology in all domains, both public and private;

(b) There exists the need to integrate science and technology activities with broader development goals and programmes. Science and technology cannot be treated in isolation from other social and economic processes, but rather must be regarded as an integral part of those processes. This is even truer in terms of the recent emphasis on sustainable development because the achievement of sustainability is fundamentally predicated on the proper use of science and technology;

(c) The building of endogenous science and technology capabilities should be based on existing resources and institutions. In this sense, capacity-building is not a totally new concept but rather a new way of looking at existing resources and assessing how they can be better utilized and their integration better orchestrated. In many countries, the building blocks of science and technology capacity do exist, but they may not have been arranged properly or given sufficient emphasis to accomplish the goals of sustainable development. For example, in most of Latin America, strong and high-level research councils and related institutions have been established that provide a base upon which a broader capability can be built. Similarly, patent offices, national universities, institutes of standards, polytechnics, regional development agencies and private consulting firms all provide various elements from which a broad national capability can be developed. What is important here is the harmonization of the work of these organizations so that their different activities are all aligned and oriented towards a common purpose. This calls for innovative approaches to interorganizational coordination and management. Science and technology has both a "hard" and a "soft" dimension, including not only equipment and hardware but also, for example, the "software" of management and organizational techniques;

(d) Capacity-building must be based on a deep appreciation of the competitive pressures of the modern global economy and the continuing search for increased efficiency and productivity. Specifically, this new global context demands greater attention to the application of technology to the resources and strengths of a country in order to capture greater value added and to build a competitive advantage based on the quality and value of a given product or service. Such an approach is in sharp contrast to the past emphasis on exploiting natural resources and cheap labour without considering how value could be added to these elements through the judicious development and utilization of technology. The challenge for developing countries is to identify where that competitive advantage can best be built and to channel technological economic resources in the direction of their goal.

B. Components of endogenous capacity in science and technology

45. For operational purposes, it is useful to envisage the objectives of the process of endogenous capacity-building in terms of the key functional capabilities that the national science and technology system provide.

46. Those capabilities reside in national science and technology systems, which contain a variety of public and private institutions (such as industrial enterprises, agricultural business and health-care services, universities, research centres, national policy-making organs, advisory bodies of the legislature, and science and technology information services).

1. Technology intelligence

47. This includes:

(a) Technology sourcing and assessment;

(b) Monitoring and forecasting;

(c) Research and development in needed areas;

(d) Technology adaptation;

(e) Technology management and policy analysis;

(f) Technology acquisition and transfer.

48. Technology intelligence refers to the capacity to have a full-blown grasp of technology on a global scale. This in effect involves knowing what is happening in technology on a continuing basis at a global level, and having the wherewithal to gain access to the needed technologies wherever they are to be found and to transfer them properly and efficiently to the user, and the capacity to make informed choices about the directions in which technological efforts must be channelled.

Box 3. International Association of Technology Assessment and Forecasting Institutions (IATAFI)

This non-governmental organization was incorporated in Bergen, Norway, in July 1993, with the support of Norwegian institutions. Its goal is to foster cooperation among technology assessment and forecasting institutions world wide for the purpose of supporting sound decision-making with respect to the achieving of sustainable development in response to global change. In particular, IATAFI seeks to constitute a global network of information exchange among its members using state-of-the-art telecommunications technology.

The Association was created under the auspices of the United Nations following recommendations of the Workshop on Technology Assessment for Developing Countries, convened jointly by the United Nations and the Office of Technology Assessment of the United States Congress and held in Washington, D.C., from 4 to 7 November 1991, and the Expert Group Meeting on Technology Assessment, Monitoring and Forecasting, held at United Nations Educational, Scientific and Cultural Organization (UNESCO) headquarters in Paris from 25 to 28 January 1993.

The Organizing Committee of IATAFI includes the following institutions: Bergen High Technology Centre (Norway); Argonne National Laboratory (United States of America); Analytical Centre of the Russian Academy of Sciences; Centre for Hemispherical Cooperation in Research and Education in Engineering and Applied Sciences at the University of Puerto Rico; Centre for Prospective Studies and Assessment of the Ministry of Research and Technology (France); Centre for Technology Strategy at the Open University (United Kingdom of Great Britain and Northern Ireland); Institute for Advanced Studies at the University of São Paulo (Brazil); Interdisciplinary Centre for Technology Analysis and Forecasting at Tel Aviv University (Israel); Islamic Foundation for Science and Technology for Development (Saudi Arabia); National Research Centre for Science and Technology for Development (China); Office of Technology Assessment of the German Parliament; Office of Technology Assessment of the United States Congress; Pan African Union for Science and Technology (the Congo); Fraunhofer Institute for Systems and Innovations Research (Germany); State Committee for Scientific Research (Poland); Technology Information, Forecasting and Assessment Council (India); and Innovation Research Centre, Budapest University of Economic Sciences (Hungary).

The Association will hold its first general assembly in May 1994 in Bergen, Norway, with the participation of over 100 institutions world wide. Its membership is expected to reach several hundred by 1995.

In view of the universal relevance of technology assessment and forecasting, IATAFI will establish consultative relationships with most organs of the United Nations system. It will also cooperate with other non-governmental organizations involved in fields related to technology assessment and forecasting such as the International Council of Scientific Unions, the World Association of Industrial and Technological Research Organizations, the World Engineering Partnership for Sustainable Development, the International Association for Impact Assessment, the World Futures Studies Federation and the Third World Academy of Sciences.

IATAFI could become an important partner of the United Nations system in the implementation of activities in the area of capacity-building in technology assessment and forecasting, and could work closely with the Capacity 21 programme and the Global Environment Facility for this purpose.

2. Demand and market information

49. This derives from the ability to:

(a) Monitor market trends and patterns, and opportunities in domestic and international arenas;

(b) Assess the possibilities of entering such markets and the means for achieving this, namely, market-entry capacities;

(c) Assess objectively social demands for science and technology-based activities (for example, in health and education).

50. Understanding where demand is headed, and how to capture the opportunities existing in the market-place, is an essential element of capacity-building. Whether demand is social or commercial is less important than whether it is being accurately assessed and identified and whether the capacity to serve the relevant needs exists. It is noteworthy that for most developing countries, market-related capacities are weak and a great emphasis needs to be placed on building these capabilities. The trade policy institutions of many developing countries could play a useful role in this respect, as could the marketing departments of universities, consulting firms and business research organizations.

3. Trade development and investment promotion

51. This involves the ability to:

(a) Assess trade patterns and identify opportunities and threats (resulting, for example, from new technologies);

(b) Negotiate the acquisition of technologies and intellectual property rights;

(c) Negotiate trade relationships;

(d) Facilitate profitable and high-potential trading activities;

(e) Use trade as a mechanism to improve access to technology;

(f) Assess a country's attractiveness as a location for foreign investment and promote it as such, with a view to gaining access to technology as well.

52. Efforts to develop and use technology should be undertaken within a broader context of trade development and investment promotion. Traditional approaches to those efforts have tended to focus almost entirely on attracting foreign investment and promoting exports. However, mobilizing domestic investment in useful directions and helping local organizations in their efforts to procure goods and services and technologies from other countries are equally important objectives.

53. The capabilities in these areas therefore need to be broadened and more closely linked with technology-related activities and organizations. Such a linkage is not generally found in most developing countries.

4. Flexible financing systems

54. Capacity-building requires that science and technology activities with a high potential for success and a high social value have access, in different stages of project implementation, to the right type of financial resources. Thus, capacity-building requires a well-structured financing system that includes risk, venture, debt and equity types of financing and that is flexible and responsive and can address the special types of needs of technology-based projects. In particular, the approach to financing of technology-based projects should be based on an understanding of the complexities involved in financing such activities, and of the different types of financing that are needed at different stages of the process; and the issue of the random nature of technological change, and the need to accept certain levels of risk as inherent in the financing of innovative projects, must be addressed head-on. The financing system must therefore be capable of assessing the likelihood of success of a project based on an analysis of its technical and economic characteristics, the human resources involved and the realities of implementation.

55. The financial systems of most developing countries are generally not well suited to the needs of technology-based projects. They should be staffed by people who are comfortable with technology and technical information and have a good grasp of the risk-type nature of those projects. The systems themselves need to be less bureaucratic and more responsive to the changing financial needs associated with such projects. In the United States, the successful experience of the Small Business Innovation Research Grants Programmes of the Federal Government (National Science Foundation) and the experiences of the risk and venture capital industries could offer some insights of value. Some countries, such as Mexico, are undertaking initiatives to address the financial needs of technology projects through the establishment of specialized technology funds or similar mechanisms. In India, the Industrial Credit Investment Corporation has established a venture fund for these purposes.

5. Human resources development

56. It is especially important to increase the capacity to generate continuously at all levels the skills that are needed to improve the quality of technology development and utilization in a given country. Those skills reside not solely in the areas of science and technology, but also in others, such as those of technology management, negotiation and marketing. Because of heavy investments in the past, many developing countries have reasonably strong educational systems. However, there is a need to orient the focus of those systems towards the production of human capital that meets more closely the needs of a changing technology-driven environment. This applies at all levels of education and training and the mobilization of human resources.

57. Thus, at the wage-labour level, emphasis needs to be placed on creating higher-value skill sets through on-site and regular training programmes. At the school level, greater attention to technology and its role in development, and its linkages with other social processes, and a greater degree of practical hands-on orientation could be suggested. At the university level, more attention should be paid not only to science and engineering (especially the advanced fields) but also to the soft aspects of science and technology policy analysis and management. In many developing countries such as Mexico, Nigeria, India and Brazil, the importance of this approach to human resources is appreciated and specific measures are being taken to enhance the activities connected with such an approach.

6. Business support capabilities

58. Mechanisms are needed that provide the range of support services required by new and existing technology-based enterprises. Within many countries, technology parks, technology incubators and business support centres are being experimented with. There is a need to design these mechanisms so that they provide the types of specific support that are uniquely required by enterprises in a specific country.

7. Linkage development

59. Linkage with the wide variety of organizations and individuals that are important sources of technology and market information, financing and other inputs is critical to the long-term sustainability of economic activity. Though informal and partial networks exist in most countries, there is a need to integrate them and make better use of the resources available through those networks, including linkages at both the national and the international level. For example, Colombia has requested United Nations assistance in establishing a national information network linked with global science and technology networks, with emphasis on the teleprocessing of data and on telematics applications.

8. Policy analysis and research

60. A strong capacity in carrying out policy-relevant research based on the priorities of a country and the technological implications of those priorities is vital to capacity-building. Policy-making capabilities could exist in universities, firms and government agencies, but they should be strengthened so as to be able to address the new policy challenges presented by the global economy and the imperatives of sustainable development.

61. This element is particularly important because technology has become increasingly fast-changing, and therefore requires rapid policy responses over time. Policy analysis and research should be seen as constituting a dynamic capacity to enable a country to make rapid and accurate responses to changing conditions. Even with respect to social and public domain-related issues, the mobilization of science and technology resources must be based on an appreciation of the global context and an assessment of the most efficient and effective means of addressing such issues, as well as on an accurate appraisal

of their real nature. Technology can often promote innovative approaches to solving long-standing social problems.

IV. INTERREGIONAL TECHNICAL COOPERATION PROJECT ON ENDOGENOUS CAPACITY IN SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

62. This project, 10/ which includes pilot projects in Cape Verde, Jamaica, Pakistan, Togo, Uganda and Viet Nam, is being executed jointly by the Department for Development Support and Management Services of the United Nations Secretariat and the Office for Project Services of UNDP, with financing, in the amount of $2.2 million, from the Government of Germany through the United Nations Fund for Science and Technology for Development.

A. Goals and objectives of the project

63. The overall goal of the project is (a) to enhance human and institutional capacity in developing countries to make and executive autonomous and informed decisions with respect to the development, acquisition, deployment and diffusion of technologies and (b) to integrate science and technology into the national development process, and to introduce a cohesive approach to achieving this objective.

64. Specifically, the project aims to initiate and produce:

(a) An institutionalized decision-making mechanism that is country- and demand-driven, cross-sectoral, sustainable and coordinated, and that makes the best possible use of locally available scientific and technological expertise;

(b) A portfolio of initiatives to address the legal, institutional and policy framework within which science and technology is to be applied, *inter alia*, through specific programmes/projects, policy adjustments and instruments;

(c) Mobilization of domestic and external resources for science and technology programmes and projects leading to a coalition of resources for a unified approach;

(d) Better coordination at the country level with and within external aid agencies and United Nation system organizations.

B. Description of the project

65. The purpose of the project is to introduce a novel approach to enhancing developing countries' endogenous capacity in science and technology, that is, their ability to make an informed judgement regarding the acquisition, deployment and generation of technologies for the welfare of society.

66. The objectives are to improve human and institutional capacity, to achieve an environment conducive to arriving at informed, sound and reasonable decisions regarding the development of science and technology, and to institute a system

of decision-making that will ensure that decisions with regard to science and technology policies and programmes are closely related to national development priorities.

67. The operational target of the project is to encourage the broad participation of stakeholders in the decision-making process and to develop an operational concept of endogenous capacity-building based on a country-driven approach, through the process of consensus-building in stakeholders' policy dialogues. Consequently, policies are formulated at the national level and an operational approach is adopted in cooperation with international partners.

68. One significant output is the development of a portfolio of initiatives that may be a combination of policy adjustments, institutional restructuring, and reorientation of programmes or projects with respect, for example, to utilization of renewable energy (solar, wind), quality control, metrology, demographic development, human health, urban transport, agriculture production, and forecasting of natural catastrophes. There may be hardware initiatives such as infrastructure improvement, or software initiatives such as training with respect to specific categories of human resources.

69. The project is also assisting the participating countries in mobilizing resources for its implementation through a pooling of development efforts from internal and external funding agencies and donors. Therefore, a coalition of resources for the implementation of the portfolio is also part of the specific output that is being delivered by the project.

70. The substantive project input consists mainly of two activity items. The first item is a conceptual input from the United Nations comprising a series of diagnostic studies and several rounds of dialogues. The diagnostic studies are intended to identify critical issues and problems and to present an objective picture of the country's science and technology capacity in relation to its national development objectives.

71. The second type of substantive project input relates to policy dialogues. The policy dialogue is the most vital part of the project in so far as it constitutes the platform from which initiatives are to emerge. The quality of the output and the substantive effect of the project depend heavily on how the policy dialogues are conducted and on their results.

72. On the conceptual side, the role of the United Nations is to serve as an initiator, organizer and catalyst in the process of project implementation and to provide guidance where necessary.

C. Rationale for project execution

73. It is assumed that the essence of endogenous capacity is the human and institutional capacity to make sound and informed decisions, narrow the scientific and technological gap, reduce dependency and participate in international science and technology efforts related to development. A country may not have the infrastructure needed to undertake a research project, may not possess technical know-how of a specific type, or may lack the capability to perform a specific technological task. Yet in most cases, as long as a country

has access to sources of information and the capacity to develop a strategy to either acquire or generate what it needs, that capacity can be turned into a vital input in its national development.

74. The idea accounting for the critical importance of consensus-building has three components. First, consensus-building among stakeholders is the basis of national development. Only when the needs and priorities of a society are fully reflected in policies and programmes can the well-being of that society as a whole be advanced. Consensus-building is also an essential element in the mobilization of human and financial resources. Second, consensus is regarded as having a certain intrinsic value in itself, in so far as it represents a respect for individual human values in development. Third, consensus-building constitutes a process of communication among the different players and beneficiaries in development, and in this sense, it is a learning process. Players and beneficiaries learn about each other's needs and potentials, and this results in a synthesis of different perspectives leading to a unified strategy.

75. It is believed that through a number of diagnostic studies and through intensive interactions among the stakeholders, some common understanding previously lacking will emerge with regard to the role of science and technology in the development process. Based on this understanding, consensus will arise on new initiatives, and those initiatives will remedy situations where science and technology have not been fully utilized for development. It is also assumed that initiatives based on consensus will have the widest support from the society as a whole, and should consequently be effective.

76. The rationale for policy dialogues among the stakeholders is that solutions to national development issues cannot come from outside the society for which they are intended, but only from within. Past experience has shown that ideas and strategies not generated by the development community itself, no matter how well thought out and designed, fail to take root in the society concerned and to produce, therefore, a lasting effect on development.

D. The process of project implementation

77. Diagnostic studies are related to the legal and institutional policy framework within which science and technology are applied, as well as to specific aspects of science and technology development. They are similar to and have much in common with technology missions, as introduced by the Organisation for Economic Cooperation and Development (OECD). OECD speaks as follows of such missions:

"They may have either a sectoral or a generic focus, but they should always take account of the needs and possibility for synergy between and among sectors and technologies. They should be chosen and designed with a view to enhancing the productivity and competitiveness of the economy in the broadest sense, and responding to the needs of the people in the areas of health, education and basic technologies, in a way which can be sustained and developed over time." 11/

78. Inter-agency missions serve as a mechanism for involving external donors and agencies in the process of decision-making and preparation of science and technology-related programmes and projects without undercutting the autonomy of that process, which is a country-driven one. The involvement of external donors and agencies becomes particularly important in the stage of implementation of the portfolio of policy initiatives and projects through a coalition of resources.

79. Whereas most aid projects are implemented by donor countries or external executing agencies, this project is to be executed by the participating countries themselves. It is to be country-driven from start to finish. In addition, instead of there being created a single national focal point which could at times acquire the character of a particular constituency, a national steering committee consisting of cross-sectional representatives is being organized in each country to provide guidance and to monitor project implementation. In the spirit of developing endogenous capacity, maximum possible use is being made of local consultants, local organizations and local mechanisms, within the overall local social, economic, cultural and political setting.

E. Progress in project execution

80. During 1991, the project established the necessary infrastructure. In each participating country, a National Steering Committee, usually headed by a high-level government official and composed of a core group of representatives from a variety of development constituencies, was established. A national Project Coordinator was also recruited to coordinate country-level activities. Work was done to create awareness among different stakeholders and to set up the necessary administrative procedures. At United Nations Headquarters, a Project Steering Committee consisting of representatives of the United Nations, the United Nations Fund for Science and Technology for Development and UNDP was constituted to provide overall guidance to the project. Missions were sent to the participating countries to recruit local consultants, to prepare both terms of reference for the first set of diagnostic studies and the First National Policy Dialogues, and to monitor progress and assist, whenever requested. With that preparatory work completed, the project entered into the substantive phase in 1992.

81. During 1992, the first set of national studies was completed, all undertaken by national consultants in the six countries. The First National Policy Dialogues were also completed.

82. The first round of Dialogues was well received in the participating countries and generated interest among the different constituencies

participating in science and technology decision-making. The project’s national policy dialogue approach has already been adopted as a useful means of mobilizing an entire society for efforts to solve economic and social development problems (such as those affecting women, and poverty) in the country concerned.

83. During the first half of 1993, in Jamaica and Viet Nam, which had already conducted their Second National Policy Dialogues, the National Steering Committees were studying and identifying three-to-four high-priority areas consideration of which was to be further developed in detailed analytical studies.

84. The Third National Policy Dialogue will be held in Jamaica in late October 1993 and in Viet Nam in late November 1993. Those Dialogues will elaborate on the pre-feasibility studies that can be submitted to domestic financial institutions and the external donor community for financing, and will be followed by round-table meetings of donors towards the end of 1993 or the beginning of 1994.

85. In all six countries, the project has attracted people ranging from high-level government officials to grass-roots practitioners, from economic policy makers to scientists and engineers from research and development laboratories. This process of integrating stakeholders both vertically and horizontally in the science and technology decision-making process has created a favourable attitude in the countries involved towards science and technology as tools for economic and social development.

86. In Viet Nam, the Chairman of the National Steering Committee had been the Chairman of the State Committee for Science and Technology; and following the First National Policy Dialogue, he was appointed Minister for Science, Technology and Environment. In Jamaica, the Science and Technology Adviser to the Prime Minister is chairing the National Steering Committee. In Pakistan, the Permanent Secretary to the Ministry of Science and Technology is the Chairman of the National Steering Committee. In Cape Verde, the Director-General of Planning in the Ministry of Planning and Finance is also chairing the National Steering Committee. In Togo, the Chairman of the National Steering Committee is the Minister of Education, while in Uganda the Project Coordinator is the Commissioner for Technology, Ministry of Industry and Technology. Other high-level government or legislative decision makers have also participated in the series of Dialogues.

V. POSSIBLE ACTIONS FOR STRENGTHENING THE PROCESS OF ENDOGENOUS CAPACITY-BUILDING

87. On the basis of the preceding discussion, the following elements for action on capacity-building by the United Nations are brought to the attention of the General Assembly.

A. Coordination of sources of financing

88. In its resolution 46/165 of 19 December 1991, the General Assembly requested the Intergovernmental Committee on Science and Technology for Development at its twelfth session, or possible successor arrangements, to submit to the Assembly at its forty-eighth session concrete proposals for organizing a more effective coalition of resources to meet the scientific and technological needs of developing countries. In pursuance of the request made in that resolution, the Economic and Social Council, on the basis of the report of the Commission on Science and Technology for Development on its first session (E/1993/31), adopted resolution 1993/73 of 30 July 1993 entitled "Financing science and technology for development".

89. In that resolution, the Economic and Social Council requested the Secretary-General to convene a consultative meeting in 1993, and decided that the participants in the meeting should include representatives from multilateral development financial institutions, including UNDP, the World Bank and the regional development banks, together with private and international foundations and bilateral donors interested in science and technology for development.

90. In the same resolution, the Economic and Social Council also decided that the meeting should compare and exchange views on portfolios of programmes and projects in science and technology in support of endogenous capacity-building at the national, regional and global levels, and consider ways and means of securing continuing interaction and complementarity of the institutions involved in the financing of science and technology.

91. The Department for Development Support and Management Services of the United Nations Secretariat and UNDP, together with other organs and bodies of the United Nations system, have a comparative advantage in providing the basis (through, for example, a flexible mechanism) for coordinating the action of international science and technology financing sources in support of capacity-building at the national, subregional, interregional and global levels.

92. The General Assembly may wish to provide further guidance to the Secretary-General regarding such a coordinating mechanism, which would need to be established in order to fully comply with the requests contained in Assembly resolution 46/165 and in Economic and Social Council resolution 1993/73.

B. Technology assessment and forecasting

93. A crucial element of endogenous capacity in science and technology for sustainable development is the ability to assess the consequences of technology for the economy and for society at large, including the ability to forecast new technological trends, particularly in the short and the medium term. Technology assessment and forecasting capacity is at the root of strategic planning of the science and technology capacity-building process. Such capacity is needed by decision makers at the national policy level as well as by the managers of private and public enterprises and other entities (for example, hospitals, universities and agricultural businesses) that apply science and technology to sustainable development.

94. The International Association of Technology Assessment and Forecasting Institutions (IATAFI) and its recently established world-wide network could be an important partner of the United Nations in its efforts to build technology assessment and forecasting capacities in developing countries. It would therefore be useful for the General Assembly to encourage United Nations initiatives in technology assessment and forecasting, including cooperation with IATAFI in programme implementation.

C. Operational activities of the United Nations

95. Endogenous capacity-building, including institutional and human resources development in science and technology, are central to United Nations technical cooperation. Activities on endogenous capacity-building in science and technology, and others for which the Department for Development Support and Management Services of the United Nations Secretariat and other organizations and agencies of the United Nations system currently assume responsibility, should be expanded and reinforced as a response to the fact that priority has been given to science and technology in the United Nations programmes for the biennium 1994-1995 as well as in the current medium-term plan.

Notes

1/ See Official Records of the General Assembly, Forty-sixth Session, Supplement No. 37 (A/46/37), chap. II, resolution 1 (XI) B.

2/ See the report of the Commission on Science and Technology for Development on its first session, 12 to 23 April 1993 (E/1993/31), chap. II.

3/ Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992, vol. I, Resolutions Adopted by the Conference (United Nations publication, Sales No. E.93.I.8), resolution 1, annex II.

4/ Ibid., annex I.

5/ See document E/1993/25/Add.1, chap. I, sect. E.

6/ The area of technology assessment and forecasting is generally at the centre of such studies.

7/ In this respect, see the report of the Director-General for Development and International Economic Cooperation (A/CN.11/1991/5) on new developments and trends in the programmes and activities of the United Nations system in science and technology for development and the note by the Secretary-General (A/47/419/Add.1) on the comprehensive policy review of operational activities of the United Nations system (their contribution to the enhancement of the national capacities of developing countries in the field of science and technology).

8/ Report of the United Nations Conference on Science and Technology for Development, Vienna, 20-31 August 1979 (United Nations publication, Sales No. E.79.I.21 and Corr.1 and 2), chap. VII.

9/ The mandate in this respect was given by the General Assembly in its resolution 44/14 E of 26 October 1989 entitled "Assessment of technology".

10/ See project document INT/89/TO2/A/71/31.

11/ Organisation for Economic Cooperation and Development, Managing Technological Change in Less-advanced Countries (Paris, OECD, 1991), p. 13.
