



Annex B: Agendas for major actors in building science and technology capacity

Introduction

To build worldwide science and technology (S&T) capacities, all major institutions should work together to:

1. Foster a global mobilization to create a better future for humanity;
2. Convene a kick-off conference to launch, review, refine, and initiate the implementation of the set of proposals presented in this report;
3. Convene regional and national conferences to review, refine, and initiate the implementation of the set of proposals presented in this report.

But each type of institutional actor will have different roles and responsibilities in this effort. The Study Panel has identified a set of twelve major ‘actors’ necessary to implement the needed reforms and new programs for increasing worldwide scientific capacity:

- S&T-proficient and S&T-developing countries;
- S&T-lagging countries;
- S&T-advanced countries;
- United Nations agencies and regional intergovernmental organizations;
- Educational, training, and research institutions;
- National academies of sciences, engineering, and medicine;
- National, regional, and international S&T organizations;
- International development-assistance organizations;
- Foundations;
- Local, national, and international private sectors (for-profit entities);
- Nongovernmental organizations;
- The media.

The recommendations of the previous chapters are re – organized here to reflect needed actions by each of these twelve sectors.

Agenda for S&T-proficient and S&T-developing countries

This category includes countries defined as: (1) S&T-proficient – with scientific and technological strength in several research areas and a growing S&T capacity in all aspects, including personnel, infrastructure, investment, institutions, and regulatory framework; and (2) S&T-developing – with scientific and technological strength in one or more research areas, but generally lacking important aspects of S&T capacity in personnel, infrastructure, investment, institutions, and regulatory framework.



1. Identify national science and technology goals and priorities

- The government of each S&T-proficient and S&T-developing country should develop a national S&T strategy that specifies priorities for research and development that address national needs in areas such as agriculture, health, industrial development, and the environment. This should involve high government officials at the federal level, including state and even municipal levels where appropriate, the national research councils, and technological and innovation agencies.
- Such strategies for science and technology should be developed by the national government in full consultation with the country's science, engineering, and medical academies, and other scientific organizations.
- National funding commitments for science and technology should rise to at least 1 percent – preferably 1.5 percent – of Gross Domestic Product, and should be disbursed using a merit-based approach.
- The option of national 'sectoral' funding for research and development – a portion of a nation's tax levies on for-profit corporations redirected into a special fund for financing the conduct of research in selected science and technology areas of economic interest to the nation – should be seriously considered by the public, private, and academic sectors of developing nations that aspire to significant S&T capacity. The management of each fund should be tripartite, with the participation of the academic community, government, and industry. A portion of each fund's resources should be used to support basic and applied sciences, and another portion should support infrastructural needs.

2. Assess strengths and weaknesses of current S&T capacity for achieving goals

- The effectiveness of national S&T institutions, including the following, should be reviewed:
 - *Autonomous centers of excellence* – research programs, within a university, a research institute, or operating independently, typically in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output;
 - *Strong universities* – tertiary educational institutions for educating and training new generations of S&T talent, performing research and development in areas of societal need, and providing an independent source of information on topics of importance to the nation;
 - *Virtual networks of excellence* – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output;



- *Independent national or regional academies of sciences, engineering, and medicine* – merit-based autonomous institutions, in which peers elect new members in recognition of their distinguished and continuing professional achievements, elect their own officials, perform programs of independent work, and inform the general public and national decisionmakers on science and technology aspects of public policies.
- Existing S&T institutions should be assessed through expert review and evaluation. Techniques for such procedures should include, as appropriate, peer review teams, relevance-review panels, or benchmarking studies. Given the relatively modest scientific capacity of most developing nations, their merit reviews should ideally include appropriate experts from other nations. Such involvement of the global research community, possibly through a program of international cooperation among academies of science, engineering, and medicine, can make the merit review processes in developing nations more effective not just for particular programs but in general.

3. Establish a government-university-industry partnership for strengthening S&T capacity

- Governments, industries, universities, and research institutes should experiment with partnerships and consortia for addressing research areas of potential local benefit.
- Government in particular – both national and local – must play a central role in creating public-private research partnerships. National and local governments should ensure that individuals and organizations continue to have strong incentives and opportunities to capitalize on research. To this end, one of the new ideas to be considered is the implementation of a group of ‘sectoral’ funds involving the primary economic activities in each country, as described in Section 6.1 and Box 37.

4. Create centers of excellence that address research issues of national need

- Centers of excellence – research programs, within a university, a research institute, or operating independently, typically located in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – should be created, or seriously planned for the near future, in practically every S&T-proficient country. Such centers can serve as the main nodes for individuals or groups charged with enhancing S&T knowledge of national and even regional importance.
- These centers of excellence should have institutional autonomy, sustainable financial support, knowledgeable and capable leadership, international input, focused research agendas that include interdisciplinary



themes, applied research as well as basic research, technology transfer, peer review as a systemic element, merit-based hiring and promotion policies, and mechanisms for nurturing new generations of S&T talent. New scientific and technological research projects should be decided on the basis of input from expert review, with each project and program evaluated for both technical merit and its potential benefits to society.

- International funding sources for such centers of excellence – including international development banks, donor governments, philanthropic foundations, and for-profit corporations – should be identified and sought.
- Virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – should be created nationally, regionally, and globally. Emergent centers of excellence should be involved in the virtual networks of excellence.
- International institutions such as Third World Academy of Sciences (TWAS), InterAcademy Panel (IAP), and International Council for Science (ICSU) should be consulted to help in the formation and strengthening of nascent national and regional institutions. The participation of these international bodies will help new organizations to establish the requisite high standards and effective mechanisms of operation.
- Where bilateral scientific and technological agreements with S&T-advanced countries are established, provision should be made for the participation of qualified S&T personnel from neighboring S&T-lagging countries.

5. Upgrade ongoing research programs that address issues of national need

- Where relevant research institutions already exist, they should be re-inforced or, if necessary, reformed. When reform is indicated, changes should be systemwide and carried out in ways that make the best use of scarce resources (including the local talent). Where there is much talent but the system is bureaucratized, it is crucial that reform includes the following:
 - Focus on themes, not institutions (i.e., abolish institutional entitlement);
 - Build up a small but select number of centers of excellence;
 - Build up a few nodes (around individuals) of top expertise;
 - Open up the research system to competitive grants;
 - Protect public-goods research;
 - Address essential long-term issues.



- All existing research programs and centers of excellence can similarly benefit from periodic expert review and evaluation. Techniques for such procedures should include, as appropriate, peer review teams, relevance-review panels, or benchmarking studies. Given the relatively modest scientific capacity of most developing nations, their merit reviews should ideally include appropriate experts from other nations. Such involvement of the global research community, possibly through a program of international cooperation among academies of science, engineering, and medicine, can make the merit review processes in developing nations more effective not just for particular programs but in general.

6. Establish mechanisms for S&T advice to government

- Establish trusted indigenous mechanisms for obtaining advice on scientific and technological questions related to public policies and programs. Informed and reliable counsel could come from specially appointed committees of experts, standing multidisciplinary advisory bodies, or independent institutions such as merit-based academies of science, engineering and medicine.
- Develop the means to assess and manage the benefits and risks associated with the development, production, or use of new technologies, such as those deriving from biotechnology. Government should therefore ensure that indigenous S&T capacities are in place not only to enable effective adoption of a new technology but also to help implement public-health, human-safety, and environmental guidelines or regulations associated with potential side-effects of the new technology. The possibility of long-term effects should be kept in mind when setting up such systems, which should remain fully adaptable to rapid advances in scientific and engineering knowledge.
- Coordinate technology assessments with other nations to permit the sharing of experience and the standardization of some types of risk assessment.

7. Provide information on S&T resources and issues to the public

- Encourage innovation in disseminating the results of publicly funded research and in turning them into new products and services that address local needs. Such efforts could include:
 - Consultative services, provided by national or regional research institutions, in areas such as agriculture, water and land management, housing, and health;
 - Cooperative partnerships between local citizens and research institutions for sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - ‘Information kiosks,’ either publicly funded or for-profit, to help distribute useful information obtained from the Internet.



8. Upgrade educational programs and institutions

- Each nation should establish an S&T-education policy that not only addresses its own particular national needs but instills an awareness of global responsibilities (e.g., environmental). Consequent national projects should particularly aim to modernize such education at the elementary- and secondary-school levels (ages 5-18); and they should emphasize inquiry-directed learning of principles and skills while highlighting the values of science.
- Each government should focus resources on providing high-quality training for science/technology teachers. This will involve special efforts at all tertiary-education institutions, including research universities.

9. For S&T-proficient countries, share responsibilities for regional and international S&T training and research programs

- The S&T-proficient countries should cooperate with S&T-lagging countries in sponsoring world-class research and education through regional networks, which should have the following characteristics:
 - Research nodes of the networks should be recognized centers of excellence in developing nations with a strong research base; this connection would help catalyze the strengthening of S&T capacities among their less-developed partners.
 - The networks should stimulate interdisciplinary research and establish links with the member countries' private sectors.
- Centers of excellence in S&T-proficient countries should provide scholarships and research facilities, including the use of their own laboratories, to help achieve international cooperation with and among other developing nations. Where bilateral or multinational research and training programs are established with S&T-advanced nations, such programs should facilitate the participation of qualified S&T personnel from neighboring S&T-developing and S&T-lagging countries. These programs should also take into account the often-critical need for travel money.
- Regional S&T cooperation with other developing nations that leads to doctoral degrees, together with postdoctoral programs, should be promoted in national or regional centers of excellence, especially those that are in S&T-proficient countries among the developing ones. Fellowships for graduate students (master's and doctoral degrees) should be preferentially awarded to nationals from S&T-developing and S&T-lagging countries. These fellowships should include re-entry grants that allow the returning fellows to obtain some basic materials and instrumentation that will permit them to carry out research in the home laboratory and that will facilitate maintaining collaborative contacts with the research centers where they received training.



- The training of new scientists and engineers should be aided by networks that have already been established by practicing professionals in diverse specialties. These networks should be given enduring support by academic, governmental, intergovernmental, and private organizations.
- National governments and international organizations should provide the financial support and design the institutional framework to establish ‘sandwich programs’ that provide for a portion of educational training abroad.
- A number of programs and fellowships to support S&T capacity-building activities have previously been established by some countries and by organizations such as UNESCO, Third World Academy of Sciences (TWAS), International Centre for Theoretical Physics (ICTP), and International Council of Science (ICSU). A database of all such activities should be created and posted on a Website available to all scientists and engineers, even those working in the remotest regions of the world.

10. Increase S&T career opportunities within the country

- To spur locally needed S&T activities, governments of developing nations should seriously consider providing, on a temporary basis, special working conditions for their best talents (whether formed at centers of excellence abroad or at home), including income supplements and adequate research support, with a primary focus on young scientists and engineers.
- Governments of developing nations, in collaboration with their national S&T communities, should be encouraged to build ties with their expatriate scientists and engineers, especially those who are working in industrialized nations.
- Incentives should be established to help encourage companies, especially in the developing world, to create in-house research units and hire S&T talent. Local governments could give them tax rebates or national recognition for building their human-resources capacity (say, through internship programs and contracted research). More broadly, a national strategic policy to promote research and development in a country’s industries, including the provision of ‘sectoral’ funds, should be established. For their part, governments of developing nations should provide re-entry grants to encourage young scientists trained in the industrialized world to return home.

11. Develop digital S&T information sources

- Libraries should maintain electronic gateways for the sharing of digital information among researchers, teachers, and learners.
- Major hubs in the developing world should be organized for sharing digital information with research institutions in the industrialized world.



This will facilitate access to some materials (in video format, for example) that require wide bandwidth not necessarily available everywhere. It will also serve the eminently sensible goal of backing up original material.

12. Develop effective policies for intellectual property rights

- Every country should develop a clear legal framework regarding the activities of the private sector in S&T capacity building, and it should be compatible with the national S&T policy while providing incentives for real technology transfer.
- Governments of S&T-proficient as well as S&T-developing countries should focus on licensing issues, accept strong intellectual property rights for new medicines, negotiate special agreements on generics for basic pharmaceutical products, promote local industry through partnerships with foreign companies, and amend their current legislation for intellectual property rights to emphasize the genuine invention of useful technologies while putting less focus on the protection of minor or intermediate technologies and processes. Such focus often discourages further research and development.
- Governments of S&T-developing nations should consider regional and multilateral cooperation and sharing of resources for implementing intellectual property protection, so that countries with limited technical resources do not have to duplicate effort, investment, and dedication of scarce talent.

Agenda for S&T-lagging countries

This category includes countries with little scientific or technological research strengths and no discernable overall S&T capacity in personnel, infrastructure, investment, institutions, and regulatory framework.

1. Identify national science and technology goals and priorities

- The government of each S&T-lagging country should develop a national S&T strategy that specifies priorities for research and development that address national needs in areas such as agriculture, health, industrial development, and the environment. This should involve high government officials at the federal level, including state and even municipal levels where appropriate.
- Such strategies for science and technology should be developed in consultation with international experts and the help of international organizations such as the World Bank, regional development banks, United Nations agencies, InterAcademy Panel (IAP), Third World Academy of Sciences (TWAS), and International Council of Science (ICSU).
- Each country should have, at a minimum, the following types of institutions, and the national S&T strategy should include goals for developing them:



- *Autonomous centers of excellence* – research programs, within a university, a research institute, or operating independently, typically in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output;
 - *Strong universities* – tertiary educational institutions for educating and training new generations of S&T talent, performing research and development in areas of societal need, and providing an independent source of information on topics of importance to the nation;
 - *Virtual networks of excellence* – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output;
 - *Independent national or regional academies of science, engineering, and medicine* – merit-based autonomous institutions, in which peers elect new members in recognition of their distinguished and continuing professional achievements, elect their own officials, perform programs of independent work, and inform the general public and national decisionmakers on science and technology aspects of public policies.
- National funding commitments for science and technology should rise to at least 1 percent – preferably 1.5 percent – of Gross Domestic Product, and should be disbursed using a merit-based approach.

2. Mobilize international expertise for promoting national capabilities in science and technology

- Given the limited national capabilities in S&T-lagging countries, it will often make more sense to think in terms of forming national committees of eminent individuals to represent expertise in various fields (as opposed to building formal academies). Such a committee could have extensive contacts with regional and international experts and be delegated to interact with the international bodies dealing with science and technology.

3. Orient S&T capacity for achieving national goals

- Clearly, the focus of the poorest and smallest countries will be largely in the area of building up their national education systems at the primary and secondary level, with due attention to the gender dimension and to appropriate vocational training. However, emerging tertiary-level institutions should be helped early on to assume the multiple functions of the university.
- Existing S&T institutions should be regularly assessed through expert review and evaluation. Techniques for such procedures should include, as appropriate, peer review teams, relevance review panels, or benchmarking studies.



- Given the modest scientific capacity of S&T-lagging countries, their merit reviews should include appropriate experts from other nations. Such involvement of the global research community, possibly through a program of international cooperation among academies of science, engineering, and medicine, can make the merit review processes in developing nations more effective, not just for particular programs, but more broadly.

4. Participate in regional or international centers of excellence that address issues of national need

- Each S&T-lagging country should join with S&T-proficient countries to associate with those centers of excellence – research programs managed by a university, an advanced research institute, or operating independently, typically in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – whether of local, national, regional, or international status, that address the issues of critical importance to that nation.
- These should include virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output.
- The option of national ‘sectoral’ funding for research and development – corporate national tax set-asides for the conduct of research in areas of economic interest to the nation – should be seriously considered by the public, private, and academic sectors of developing nations that aspire to significant S&T capacity. The management of such funds should be tripartite, with the participation of the academic community, government, and industry. A portion of each fund’s resources should be used to support basic and applied sciences, and another portion should support infrastructural needs.
- International institutions such as Third World Academy of Sciences (TWAS), InterAcademy Panel (IAP), and International Council of Science (ICSU) should be consulted to help in the formation and strengthening of nascent national and regional institutions. The participation of these international bodies will help the new national organizations establish the requisite high standards and effective mechanisms of operation, including periodic international reviews of the research institutions and programs.

5. Establish mechanisms for S&T advice to government

- S&T-lagging countries should establish trusted indigenous mechanisms for obtaining advice on scientific and technological questions related to public policies and programs. Informed and reliable counsel could also come from specially appointed committees of outside experts.



- In cooperation with other nations, S&T-lagging countries should achieve the means to assess and manage the benefits and risks associated with the development, production, or use of new technologies, such as those deriving from biotechnology. Government should ensure that indigenous S&T capacities are in place not only to enable effective adoption of a new technology but also to help implement public-health, human-safety, and environmental guidelines or regulations associated with potential side-effects of the new technology. Coordination of technology assessments with other nations will permit the sharing of experience and the standardization of some types of risk assessment.

6. Provide information on S&T resources and issues to the public

- S&T-lagging countries should encourage innovation in disseminating the results of research and in turning them into new products and services that address local needs. Such efforts could include:
 - Consultative services, provided by expert consultants, in areas such as agriculture, water and land management, housing, and health;
 - Cooperative partnerships between local citizens and research institutions for sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - Information kiosks, either publicly funded or for-profit, to help distribute useful information obtained from the Internet, with translation into the local language.
- Libraries should develop or maintain wide-bandwidth electronic gateways for accessing and sharing electronic S&T-information resources among researchers, teachers, students, and the general public.

7. Upgrade educational programs and institutions

- Each nation should establish an S&T-education policy that addresses its own particular national needs. National projects should aim to modernize such education at the elementary- and secondary-school levels (ages 5-18); and they should emphasize inquiry-directed learning of principles and skills while highlighting the values of science.
- Each government should focus resources on providing high-quality training and support for science/technology teachers. This will involve special efforts at all tertiary-education institutions, including research universities.

8. Join regional and international S&T training and research programs

- National governments should work with more scientifically advanced nations and with international organizations to design and obtain financial support for 'sandwich programs' that provide for a portion of S&T training abroad.



- Regional cooperation in science and technology should include training that leads to doctoral degrees and postdoctoral work experience. Regional centers of excellence should provide scholarships and research facilities, including the use of their own laboratories, for educational training in science and technology.
- The training of new scientists and engineers should be aided by networks that have already been established by practicing professionals in diverse specialties. These networks should be given enduring support by academic, governmental, intergovernmental, and private organizations in more advanced nations.

9. Increase S&T career opportunities within the country

- To spur locally needed S&T activities, governments of developing nations should seriously consider providing, on a temporary basis, special working conditions for their best talents (whether formed at centers of excellence abroad or at home), including income supplements and adequate research support.
- Governments of developing nations, in collaboration with their national S&T communities, should be encouraged to build ties with their expatriate scientists and engineers, especially those who are working in industrialized nations. These scientists and engineers should be encouraged to participate in national scientific advisory panels and to facilitate the creation of new scientific institutions and programs.

Agenda for S&T-advanced countries

This category includes countries with scientific and technological strength in most research areas and a substantial S&T enterprise in personnel, infrastructure, investment, institutions, and regulatory framework.

1. Support research and development efforts in developing nations that address local and global needs

- S&T-advanced countries should provide financial support and collaboration for creating centers of excellence in developing nations – whether of local, national, regional, or international status. In particular, bilateral scientific and technological agreements between S&T-advanced and S&T-proficient countries should provide for participation by scientists and engineers from neighboring S&T-developing and S&T-lagging countries.
- International financial support and participation are required for creation of virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output.



- Research in developing nations should be supported through the following programs:
 - Research grants for poor-country diseases,
 - Support for global health initiatives,
 - Tax incentives to major companies for working in these countries and for supporting automatic licensing and other initiatives.
- S&T-advanced countries should participate in a conference of international community of donors to review the concept of a global fund for science and, if they agree to it, help form a steering group to develop the funding mechanisms necessary for implementation. They should also play leadership roles in related projects that come to pass.

2. Share information and experiences in benefit/risk assessments of new technologies

- Share experience and information with scientifically developing nations about the benefits and risks of new technologies and the standardization of risk assessments. Each nation involved in the development, production, or use of new technologies, such as those deriving from biotechnology, should have the means for assessing and managing their benefits and risks. Governments should therefore ensure that expert scientific advice is available from regional or international sources not only to assure effective adoption of new technologies but to facilitate implementation of public health, human safety, and environmental guidelines or regulations associated with their potential side-effects.

3. Support the education and training of S&T professionals in developing nations

- International support for technology professionals and doctoral programs in the developing nations' best universities should be increased by offering long-term fellowships with adequate stipends to deserving young people from the industrialized nations who wish to do their training or at least spend some time in centers of excellence there. As an integral part of this experience, visiting professors from industrialized nations should help raise the level of courses and participate in exams and thesis defenses.
- Special fellowships or grants should be supported – by governments or private institutions – that are designed to provide adequate research support and income supplements to outstanding young scientists from the industrialized nations who work in developing nations for a period of time. Such special treatment may require local institutional flexibility, but it would be amply justified by the fundamental benefit of stimulating and retaining the local talent.



Agenda for United Nations agencies and regional intergovernmental organizations

1. Help developing nations to identify national S&T goals and priorities

- United Nations agencies and regional intergovernmental organizations should help developing nations to create national S&T strategies through financial support and expert consultation. The objective should be the setting of national priorities for research and development that address national needs in areas such as agriculture, health, industrial development, and the environment.

2. Support research and development efforts in developing nations that address local and global needs

- International financial support and collaboration is required for creating centers of excellence in developing nations – whether of local, national, regional, or international status.
- International financial support and participation is required for creation of new virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – at national, regional, and global levels.
- United Nations agencies and regional intergovernmental organizations should support and help finance the creation of two global funds – an institutional fund and a program fund – that would provide international financial support to research programs of merit in developing nations.
- United Nations agencies and regional intergovernmental organizations should participate in a conference of international community of donors to review the concept of a global fund for science and, if they agree to it, help form a steering group to develop the funding mechanisms necessary for implementation. They should also play leadership roles in related projects that come to pass.
- Each nation involved in the development, production, or use of new technologies, such as those deriving from biotechnology, should have the means for assessing and managing their benefits and risks. Government should therefore ensure that expert scientific advice is available from regional or international sources not only to assure effective adoption of new technologies but to facilitate implementation of public health, human safety, and environmental guidelines or regulations associated with their potential side-effects.



3. Help developing nations to upgrade their educational institutions and programs

- These agencies and organizations should help each developing nation to establish a country – specific science – education policy that not only caters to national needs but instills an awareness of global responsibilities. Consequent national projects should particularly aim to modernize science education at the elementary- and secondary-school levels (ages 5-18); and they should emphasize inquiry-directed learning of scientific principles and skills while highlighting the values of science. Whether students go on to scientific careers or not, all should leave school with a good general understanding of science and its role in society.
- These agencies and organizations should help each government to focus resources on providing high-quality training for science and technology teachers. This will involve special efforts at all tertiary-education institutions, including research universities.
- These agencies and organizations should support government awards of special fellowships or grants, designed to provide adequate research and income supplements, to outstanding young scientists who work in developing nations for a period of time. Such special treatment may require local institutional flexibility, but it would be amply justified by the fundamental benefit of stimulating and retaining the local talent.

4. Help developing nations to provide information on S&T resources and issues to the public

- Funding should be provided for innovation in disseminating the results of new knowledge and technologies and in turning them into new products and services that address local needs. Such efforts could include:
 - Consultative services, provided by national or regional research institutions, in areas such as agriculture, water and land management, housing, and health;
 - Cooperative partnerships between local citizens and research institutions for sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - ‘Information kiosks,’ either publicly funded or for-profit, to help distribute useful information obtained from the Internet.

5. Facilitate regional and international S&T research and training programs

- International organizations should offer financial support and help design the institutional framework to establish ‘sandwich programs’ that provide for a portion of S&T training abroad.



- Regional cooperation in S&T training that leads to doctoral degrees, together with postdoctoral programs, should be promoted in national or regional centers of excellence, especially those that are in S&T-proficient countries among the developing ones. In particular, such centers of excellence should provide scholarships and research facilities, including the use of their own laboratories, to help achieve international cooperation with and among developing nations. They should also take into account the often-critical need for travel money.
- The training of new scientists and engineers should be aided by networks that have already been established by practicing professionals in diverse specialties. These networks should be given enduring support by academic, governmental, intergovernmental, and private organizations.
- A number of programs and fellowships to support S&T capacity-building activities have previously been established by some countries and by organizations such as UNESCO, Third World Academy of Sciences (TWAS), International Centre for Theoretical Physics (ICTP), and International Council of Science (ICSU). A database of all such activities should be created and posted on a Website available to all scientists and engineers, even those working in the remotest regions of the world.

6. Support the development of digital S&T information sources

- These agencies and organizations should provide funding and expert support for libraries to maintain electronic gateways for the sharing of digital information among researchers, teachers, and learners.
- Major hubs in the developing world should be organized for sharing digital information with research institutions in the industrialized world. This will facilitate access to some materials (in video format, for example) that require wide bandwidth not necessarily available everywhere. It will also serve the eminently sensible goal of backing up original material.

Agenda for educational, training, and research institutions

1. Participate in national efforts to identify national S&T goals and priorities

- Educational, training, and research institutions in developing nations should be active participants in efforts of national and local governments to plan the development of national capabilities in science and technology.



2. Assess strengths and weaknesses of universities and research institutions for achieving national S&T goals

- Educational, training, and research institutions should undergo external reviews of their personnel, curricular, and research programs. Given the relatively modest scientific capacity of most developing nations, their merit reviews should ideally include appropriate experts from other nations. Such involvement of the global research community, possibly through a program of international cooperation among academies of science, engineering, and medicine, can make the merit review processes in developing nations more effective, not just for particular programs, but in general.

3. Establish a partnership with government and industry for strengthening S&T capacity

- Governments, industries, universities, and research institutes should experiment with partnerships and consortia for addressing research areas of potential local benefit.
- Public-private partnerships should be created with industry. Increasingly, universities are establishing spin-off companies that have the right to patent and license the results of their advanced research, even though much of it originated in academic settings. This phenomenon potentially distorts the traditional function of the university, but if properly managed through partnerships that tap the strengths of each participant while safeguarding their basic interests, the risk can be minimized. Meanwhile, such partnerships offer important advantages for promoting cutting-edge research and directing its outcomes to the public good.

4. Create centers of excellence that address issues of national need

- Centers of excellence – whether of local, national, regional, or international status – should be created, or seriously planned for the near future, in practically every university in order for S&T capacity to grow. Such centers can serve as the main nodes for individuals or groups charged with enhancing S&T knowledge of national and even regional importance.
- The centers should have institutional autonomy, sustainable financial support, knowledgeable and capable leadership, international input, focused research agendas that include interdisciplinary themes, applied research as well as basic research, technology transfer, peer review as a systemic element, merit-based hiring and promotion policies, and mechanisms for nurturing new generations of S&T talent.
- Universities and research institutes should affiliate with those centers of excellence – whether of local, national, regional, or international status – that address the issues of critical importance to that nation. These should include virtual networks of excellence (VNE)-innovative



groups that are located far apart but closely linked via the Internet and anchored in recognized research centers, created nationally, regionally, and globally. Such networks can serve as the main nodes for those individuals or groups in the nation charged with enhancing S&T knowledge of national and regional importance.

5. Upgrade ongoing research programs that address issues of national need

- All existing research programs and centers of excellence can benefit from periodic expert review and evaluation. Techniques for such procedures should include, as appropriate, peer review teams, relevance-review panels, or benchmarking studies.
- Where such institutions already exist, they should be reinforced or, if necessary, reformed. When reform is indicated, changes should be systemwide and carried out in ways that make the best use of scarce resources (including the local talent). Where there is much talent but the system is bureaucratized, it is crucial that reform includes the following:
 - Focus on themes, not institutions (i.e., abolish institutional entitlement);
 - Build up a small but select number of centers of excellence;
 - Build up a few nodes (around groups) of top expertise with institutional support;
 - Open up the research system to competitive grants;
 - Protect public-goods research;
 - Address essential long-term national or strategic issues.
- New scientific and technological research projects should be decided on the basis of input from expert review, with each project and program evaluated for both technical merit and its potential benefits to society.

6. Upgrade educational programs and institutions

- Higher education in developing nations should be strengthened with public funds (supplemented with private funds if available) to offer greater opportunities for tertiary education and S&T-training to young people, ranging from ‘community colleges’ (as they are called in the U.S.) to top-class research-based universities.
- Universities should have increased autonomy while systematically seeking to strengthen their ties with regional and international institutions and networks; such links can significantly increase the effectiveness of the universities’ S&T efforts.
- Research universities should make strong commitments to excellence and the promotion of the values of science in their activities, incorporating unbiased merit review into all of their decisions on people, programs, and resources; and they should also increase their interaction with society at large.



- Systems of higher education in developing nations should be reformed, giving special attention to university governance, balancing autonomy with national purpose, and moving toward institutional pluralism in the education and training system.
- All universities in developing nations should strengthen their undergraduate and graduate-degree programs in science and technology and offer fellowships to the best students.
- Universities in the industrialized nations should support S&T professionals and doctoral programs in the developing nations' best universities by offering long-term fellowships with adequate stipends to deserving young people who wish to do their training in centers of excellence there. Visiting professors from foreign countries should help raise the quality level of courses and research, and participate in exams and thesis defenses.
- All educational, training, and research institutions should focus resources on providing high-quality training for science and technology teachers.

7. Sponsor and participate in regional and international S&T training programs

- Universities in developing nations should explore regional cooperation in S&T training that leads to doctoral degrees, together with postdoctoral programs, should be promoted in national or regional centers of excellence, especially those that are in S&T-proficient countries among the developing ones. In particular, such centers of excellence should provide scholarships and research facilities, including the use of their own laboratories, to help achieve international cooperation with and among developing nations. These programs should take into account the often-critical need for travel money.
- S&T-advanced nations should create programs that establish short-term adjunct-faculty/research positions at some of their universities and laboratories for scientists and engineers from developing nations.

8. Provide information on S&T resources and issues to the public

- Educational, training, and research institutions should encourage innovation in disseminating the results of research and in turning them into new products and services that address national or local needs. Such efforts should include consultative services, provided by national, state or city research institutions, in areas such as agriculture, water and land management, housing, and health.
- Universities in developing nations should develop and maintain libraries with wide-bandwidth, electronic gateways for accessing and sharing electronic S&T information resources among researchers, teachers, students, and the general public.



Agenda for national academies of sciences, engineering, and medicine

This category includes merit-based autonomous institutions, in which peers elect new members in recognition of their distinguished and continuing professional achievements, elect their own officials, perform programs of independent work, and inform the general public and national decision-makers on science and technology aspects of public policies.

1. Participate in national efforts to identify national S&T goals and priorities

- Academies should help the national government to develop a national science and technology strategy that specifies priorities for research and development that address national needs in areas such as agriculture, health, industrial development, and the environment.
- It is essential that the academies actively participate in national and international debates to make the voices of science and technology heard on a broad range of issues.
- The national academies should become more actively involved in bringing together the private and public sectors; and they should work across sectoral and national boundaries to help promote collaboration between the industrialized and developing nations, as well as among the developing nations. Scientists and engineers can play especially productive roles here in articulating creative proposals for different countries and sectors.

2. Help the government to assess strengths and weaknesses of national capacities for achieving national S&T goals

- Academies should help in the performance of reviews by national research organizations of their personnel, curricular, and research programs. Given the relatively modest scientific capacity of most developing nations, their merit reviews should ideally include appropriate experts from other nations. Such involvement of the global research community, possibly through a program of international cooperation among academies of sciences, engineering, and medicine, can make the merit review processes in developing nations more effective, and not just for particular programs but in general.

3. Provide S&T advice to government

- Academies should develop robust and dependable mechanisms to provide advice to governments on scientific and technological questions related to public policies and programs.



4. Encourage new centers of excellence that address issues of national need

- Academies should help facilitate the future planning for and creation of centers of excellence – whether of local, national, regional, or international status. Such centers can serve as the main nodes for individuals or groups charged with enhancing S&T knowledge of national and even regional importance.
- Academies should encourage centers of excellence to have institutional autonomy, sustainable financial support, knowledgeable and capable leadership, international input, focused research agendas that include interdisciplinary themes, applied research as well as basic research, technology transfer, peer review as a systemic element, merit-based hiring and promotion policies, and mechanisms for nurturing new generations of S&T talent.

5. Promote the upgrading of ongoing research programs that address issues of national need

- Academies should participate in the evaluation of all existing research programs and centers of excellence. Techniques for such procedures should include, as appropriate, peer review teams, relevance -review panels, or benchmarking studies.
- New scientific and technological research projects should be decided on the basis of input from expert review, with each project and program evaluated for both technical merit and its potential benefits to society.

6. Promote the upgrading of educational programs and institutions

- Science and engineering academies and other S&T organizations should also be involved in teacher training and the production of materials needed for students' S&T education. Scientists should be encouraged to visit schools at all levels to support teachers and give well-designed presentations to promote science to the young. The InterAcademy Panel (IAP) and many national academies are already engaged in promoting programs that connect scientists to teachers, school systems, and curricular change, and the results of their experiences should be widely shared and disseminated.

7. Provide information on S&T issues of importance to the public

- Academies should disseminate the results of research relevant to national needs and the implications of new scientific and technological knowledge for effective public policies.



Agenda for national, regional, and international S&T organizations

Included in this category are S&T unions and professional societies, as well as the InterAcademy Panel (IAP), Third World Academy of Sciences (TWAS), Council of Academies of Engineering and Technological Sciences (CAETS), InterAcademy Medical Panel (IAMP), and International Council for Science (ICSU) with its affiliated National Members, International Scientific Unions, and Scientific Associates.

1. Facilitate the effectiveness of research programs in developing nations

- These organizations should promote the creation of centers of excellence – whether of local, national, regional, or international status – in each developing nation. For the S&T capacity of these countries to grow, the centers should have institutional autonomy; sustainable financial support; knowledgeable and capable leadership; international input (including collaboration with international institutions); a focused research agenda that includes interdisciplinary themes, applied research as well as basic research; and technology transfer; peer review as a systemic element; merit-based hiring and promotion policies; and mechanisms for nurturing new generations of scientific talent.
- These international scientific institutions should be encouraged to help in the formation and strengthening of nascent national and regional entities. The participation of these international bodies in reviewing plans of research or operation of the nascent entities will help them establish the requisite standards and effective mechanisms of operation.
- Encourage the creation of virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – at national, regional, and global levels.
- Virtual institutes-research programs undertaken by research personnel located in different geographical locations, communicating and collaborating primarily via new technologies such as the Internet and the World Wide Web – should be created. And they should be coordinated by researchers of exceptional scientific profile who are responsible for their scientific efforts and administration, and they should be housed at host institutions that provide adequate resources, both human and material. In the case of multi-institutional teams, other entities should also guarantee effective support for the project's participants in their purview.
- These international scientific institutions should participate in partnerships and consortia for addressing research areas of potential local



benefit. They should ensure that public-private research relationships do not impair the core mission and values of public research institutions.

- These international scientific institutions should work across sectoral and national boundaries to help promote collaboration between research programs in the industrialized and developing nations, as well as among the developing nations. Scientists can play an especially productive role in articulating the imaginative proposals needed in different sectors.

2. Participate in providing scientific advice to developing-nation governments on scientific questions related to public policies and programs

- These international scientific institutions should provide informed and reliable counsel to national governments on issues involving science and technology.
- These international scientific institutions should actively participate in governmental efforts to assess and manage benefits and risks of new technologies and actively advise governments in assuring not only effective adoption of a new technology but facilitating implementation of public-health, human-safety, and environmental guidelines or regulations associated with its potential side-effects.
- These international scientific institutions should encourage coordination of national advisory mechanisms between nations, as in the sharing of experience and the standardization of some types of risk assessment.
- These international scientific institutions should encourage innovation and experimentation in disseminating the results of publicly funded research and in turning them into new products and services that address local needs.
- The scientific community should pay serious attention to the news media and participate more fully in public debates and discussions. In such interactions, scientists should make an effort to explain scientific issues in nontechnical language.

3. Help developing nations to upgrade their educational institutions and programs

- International scientific organizations should encourage the scientific community to participate as resources for providing high-quality training for science teachers. This will involve special efforts at all tertiary-education institutions, including research universities.
- International scientific organizations Support programs for technology professionals and doctoral programs in the developing nations' best universities by offering long-term fellowships, with adequate stipends, to deserving young people who wish to do their training or at least spend some time in centers of excellence there. As an integral part of this expe-



rience, visiting professors from industrialized nations should help raise the level of courses and participate in exams and thesis defenses.

- International scientific organizations should strengthen undergraduate-degree programs in science and technology, and enrollment in these programs should be stimulated through fellowships awarded to the best students.
- International scientific organizations should encourage science academies and other scientific organizations to collaborate on activities such as teacher training and the production of materials needed for students' science education.
- International scientific organizations should participate in doctoral-fellowship programs for foreign students, and then maintain the relationships, through scientific cooperation, after the students return home. One such mechanism for cooperation would be the availability of some of the scientifically proficient country's laboratories for collaborative research with scientists from other nations in the region.
- International scientific organizations should provide information about sponsored fellowships and programs that support S&T capacity-building activities, as people seeking such opportunities may not be aware of them. Therefore a database of all such programs should be created and posted on a Website so that it is available even to scientists working in the remotest parts of the world.

Agenda for international development-assistance organizations

Included in the category are organizations such as the World Bank, regional development banks, and United Nations Development Programme

1. Help developing nations to identify national S&T goals and priorities

- Through financial support and expert consultation, development-assistance organizations should help developing nations to create national S&T strategies. The objective should be the setting of national priorities for research and development efforts that address national needs in areas such as agriculture, health, industrial development, and the environment.

2. Support research and development efforts in developing nations that address local and global needs

- International financial support and collaboration is required for creating centers of excellence-research programs, within a university, a research institute, or operating independently, typically located in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – whether of local, national, regional, or international status.



- International financial support and participation is required for creation of new virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – nationally, regionally, and globally.
- Health research in developing nations should be supported through research grants for poor-country diseases and support for global health initiatives.
- Development-assistance organizations should support and help finance the creation of two global funds – an institutional fund and a program fund – that would provide international funding to research programs of merit in developing nations.
- Development-assistance organizations should participate in a conference of the international community of donors to review the concept of global funds for science and, if they agree to it, help form a steering group to develop the funding mechanisms necessary for implementation. They should also play leadership roles in related projects that come to pass.

3. Help developing nations to upgrade their educational institutions and programs

- Development-assistance organizations should help each developing nation to establish a country – specific science – education policy that not only caters to national needs but instills an awareness of global responsibilities (e.g., environmental). Consequent national projects should particularly aim to modernize science education at the elementary- and secondary-school levels (ages 5-18); and they should emphasize inquiry-directed learning of scientific principles and skills while highlighting the values of science. Whether students go on to scientific careers or not, all should leave school with a good general understanding of science and its role in society.
- Development-assistance organizations should help each government to focus resources on providing high-quality training for science teachers. This will involve special efforts at all tertiary-education institutions, including research universities.
- Development-assistance organizations should support government awards of special fellowships or grants, designed to provide adequate research support and income supplements, to outstanding young scientists who work in developing nations for a period of time. Such special treatment may require local institutional flexibility, but it would be amply justified by the fundamental benefit of stimulating and retaining the local talent.



4. Help provide information on S&T resources and issues to the public

- Funding should be provided for innovation in disseminating the results of new knowledge and technologies and in turning them into new products and services that address local needs. Such efforts could include:
 - Consultative services, provided by national or regional research institutions, in areas such as agriculture, water and land management, housing, and health;
 - Cooperative partnerships between local citizens and research institutions for sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - ‘Information kiosks,’ either publicly funded or for-profit, to help distribute useful information obtained from the Internet.

5. Help promote public-private partnerships

- Development-assistance organizations should promote imaginative partnerships between the public and private sectors that bring the benefits of scientific discoveries and technological innovations to all of the world’s people. Such partnerships can invigorate education, conduct research of mutual interest, and capitalize on the results of the research for the benefit of society.
- Development-assistance organizations should provide assistance to help stimulate long-term public and private sector investments in effective local ‘knowledge – based infrastructure’ – the entire system of national private entrepreneurship, human resources, investment, and exploration of the advancing frontiers of S&T knowledge.

6. Facilitate regional and international S&T training programs

- International organizations should offer financial support and help design the institutional framework to establish ‘sandwich programs’ that provide for a portion of S&T training abroad.
- Regional cooperation in science and technology training that leads to doctoral degrees, together with postdoctoral programs, should be promoted in national or regional centers of excellence, especially those that are in S&T-proficient countries among the developing ones. In particular, such centers of excellence should provide scholarships and research facilities, including the use of their own laboratories, to help achieve international cooperation with and among developing nations. They should also take into account the often-critical need for travel money.
- The training of new scientists and engineers should be aided by networks that have already been established by practicing professionals in diverse specialties. These networks should be given enduring support by academic, governmental, intergovernmental, and private organizations.



- A number of programs and fellowships to support S&T capacity-building activities have previously been established by some countries and by organizations such as UNESCO, Third World Academy of Sciences (TWAS), International Centre for Theoretical Physics (ICTP), and International Council of Science (ICSU). A database of all such activities should be created and posted on a Website available to all scientists and engineers, even those working in the remotest regions of the world.

7. Support the development of digital S&T information sources

- International development-assistance organizations should provide funding and expert support for libraries to maintain electronic gateways for the sharing of digital information among researchers, teachers, and learners.
- Major hubs in the developing world should be organized for sharing digital information with research institutions in the industrialized world. This will facilitate access to some materials (in video format, for example) that require wide bandwidth not necessarily available everywhere. It will also serve the eminently sensible goal of backing up original material.

Agenda for foundations

1. Support research and development efforts in developing nations that address local and global needs

- International financial support and collaboration are required for creating centers of excellence – research programs, within a university, a research institute, or operating independently, typically located in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – whether of local, national, regional, or international status.
- Foundations should financially support the creation of new virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – nationally, regionally, and globally.
- Research in developing nations should be supported through research grants for poor-country diseases and support for global health initiatives.
- Foundations should support and help finance the creation of two global funds – an institutional fund and a program fund – that would provide international funding to research programs of merit in developing nations.
- Foundations should participate in a conference of the international community of donors to review and refine the concept of global funds for



science and, if they agree to it, help form a steering group to develop the funding mechanisms necessary for implementation. They should also play leadership roles in related projects that come to pass.

2. Help developing nations to upgrade their educational institutions and programs

- Foundations should help each developing nation to establish a country – specific science – education policy that not only caters to national needs but instills an awareness of global responsibilities (e.g., environmental). Consequent national projects should particularly aim to modernize science education at the elementary- and secondary-school levels (ages 5-18); and they should emphasize inquiry-directed learning of scientific principles and skills while highlighting the values of science. Whether students go on to scientific careers or not, all should leave school with a good general understanding of science and its role in society.
- Foundations should help each government to focus resources on providing high-quality training for science and technology teachers. This will involve special efforts at all tertiary-education institutions, including research universities.
- Foundations should support government awards of special fellowships or grants, designed to provide adequate research support and income supplements, to outstanding young scientists who work in developing nations for a period of time. Such special treatment may require local institutional flexibility, but it would be amply justified by the fundamental benefit of stimulating and retaining the local talent. For their part, governments of developing nations should provide re-entry grants to encourage young scientists trained in the industrialized world to return home.

3. Help developing nations to provide information on S&T resources and issues to the public

- Funding should be provided for innovation in disseminating the results of new knowledge and technologies and in turning them into new products and services that address local needs. Such efforts could include:
 - Consultative services, provided by national or regional research institutions, in areas such as agriculture, water and land management, housing, and health;
 - Cooperative partnerships between local citizens and research institutions for sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - ‘Information kiosks,’ either publicly funded or for-profit, to help distribute useful information obtained from the Internet.



4. Facilitate regional and international S&T training programs

- Foundations should offer financial support and help design the institutional framework to establish ‘sandwich programs’ that provide for a portion of S&T training abroad.
- Foundations should support innovative regional cooperation in S&T training that leads to doctoral degrees, together with postdoctoral programs. The training should be promoted in national or regional centers of excellence, especially those that are in S&T-proficient countries among the developing ones. In particular, such centers of excellence should provide scholarships and research facilities, including the use of their own laboratories, to help achieve international cooperation with and among developing nations. They should also take into account the often-critical need for travel money.
- The training of new scientists and engineers should be aided by networks that have already been established by practicing professionals in diverse specialties. These networks should be given enduring support by academic, governmental, intergovernmental, and private organizations.

5. Support the development of digital S&T information sources

- Foundations should provide funding and expert support for libraries to maintain electronic gateways for the sharing of digital information among researchers, teachers, and learners.
- Foundations should provide funds for establishing major hubs in the developing world for sharing digital information with research institutions in the industrialized world. This will facilitate access to some materials (in video format, for example) that require wide bandwidth not necessarily available everywhere. It will also serve the eminently sensible goal of backing up original material.

6. Play an important role in implementing the actions proposed in this report, either individually or in partnerships with national governments; private sector; and international, regional, and local agencies

- Foundations should promote imaginative partnerships between the public and private sectors that bring the benefits of scientific discoveries and technological innovations to all of the world’s people. Such partnerships can invigorate education, conduct research of mutual interest, and capitalize on the results of the research for the benefit of society.
- Foundations should provide assistance to help stimulate long-term public and private sector investments in effective local ‘knowledge – based infrastructure’ – the entire system of national private entrepreneurship, human resources, investment, and exploration of the advancing frontiers of S&T knowledge.



Agenda for local, national, and international private sectors (for-profit entities)

1. Participate in national efforts to identify S&T goals and priorities

- The private sector in developing nations should be an active participant in governmental efforts to plan the development of national capabilities in science and technology.

2. Support research and development efforts in developing nations that address local and global needs

- The international private sector should participate in incentive programs for creating in-house corporate research units and hiring scientific talent. Such incentives should essentially be spurs that encourage, not replace, the private sector's own profit-motivated desire to take these steps. For example, tax rebates and national recognition for industries involved in building their human-resources capacity – say, through internship programs and contractual research – could pay sizeable dividends to the private and public sectors alike.
- The international private sector should help finance and participate in centers of excellence – research programs, within a university, a research institute, or operating independently, typically located in one geographical location, and deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – whether of local, national, regional, or international status.
- The international private sector should financially support the creation of new virtual networks of excellence (VNE) – research programs jointly sponsored and conducted by research institutes in different geographical locations, with research personnel communicating and collaborating primarily via new technologies such as the internet and the World Wide Web, deemed by merit review to be of the highest international quality in personnel, infrastructure, and research output – nationally, regionally, and globally.
- The multinational private sector should actively encourage extensions of the grace period under the Trade – Related Aspects of Intellectual Property Rights (TRIPS) to 2016 for most developing nations.
- S&T capacity building in the developing nations would be helped by corporate segmentation of the global marketplace, distinguishing between technologically advanced and poorer, technologically deprived nations. These image – improving but also commercially rewarding actions could increase the countries' ability to develop their own S&T programs, keep the local prices of products from rising beyond the reach of most of the population, and permit the development of locally produced versions.



Using the pharmaceutical industry as an example, the following recommendations apply to the multinational private sector based in S&T-advanced countries:

- Patent fees should be waived on the few existing patented tropical-disease drugs, and in some cases make them available for free.
- Automatic licensing should be allowed for S&T-proficient as well as S&T-developing nations to produce generic drugs (as long as they honor a ban on exportation of the generics to the markets of the high-income countries).
- Real partnerships should be created with developing nations' private sectors.
- Extensions of the grace period under TRIPS to 2016 should be encouraged for most developing nations.
- Special partnerships should be created for the advanced developing nations that include customized licensing, and experimentation with a few drugs at differential pricing.
- Appropriate incentive policies in industrialized nations should be supported to promote technology transfer – for instance, tax breaks for companies that license technology to developing nations.
- The private sector should support the option of national sectoral funding for research and development that significantly enhances science and technology capacity.

3. Participate in government-university-industry partnerships for strengthening S&T capacity

- Corporations should join with governments, universities, and research institutes to experiment with partnerships and consortia for addressing research areas of potential local benefit.

4. Help developing nations to upgrade their educational institutions and programs

- The private sector should support and sponsor programs for providing high-quality training for S&T teachers.
- The private sector should support government awards of special fellowships or grants, designed to provide adequate research support and income supplements, to outstanding young scientists who work in developing nations for a period of time. Such special treatment may require local institutional flexibility, but it would be amply justified by the fundamental benefit of stimulating and retaining the local talent. For their part, governments of developing nations should provide re-entry grants to encourage young scientists trained in the industrialized world to return home.



5. Help provide information on S&T resources and issues to the public

- The private sector should support and provide necessary information to the government advisory and assessment programs on health and safety issues regarding products and services. Each nation involved in the development, production, or use of new technologies, such as those deriving from biotechnology, should have the means for assessing and managing their benefits and risks. Governments should therefore ensure that expert scientific advice is available from regional or international sources not only to assure effective adoption of new technologies but to facilitate implementation of public health, human safety, and environmental guidelines or regulations associated with their potential side-effects.

Agenda for nongovernmental organizations

1. Encourage innovation in disseminating the results of research and in turning them into new products and services that address local needs

- Nongovernmental organizations should support and undertake innovative programs to provide information to the public, including:
 - Cooperative partnerships among local citizens and research institutions in sharing up-to-date information of local relevance;
 - Empowerment of social entrepreneurs for supplying products and services significantly below market prices to people in need;
 - ‘Information kiosks,’ either publicly funded or for-profit, to provide useful information obtained from the Internet.

2. Provide information to the public about S&T issues relevant to developing nations

- Nongovernmental organizations should provide information to the media and decisionmakers that identifies and protects the public-goods domain and allows for the public funding of public-goods research. The nongovernmental organizations should therefore help:
 - Ensure that public priorities are addressed by public-private partnerships,
 - Ensure that the benefits of publicly funded research are available to all,
 - Promote open access to scientific databases.

Agenda for the media

1. Assume major responsibility for educating the nation’s public on S&T-related issues

- High-quality coverage of these issues requires the S&T community to pay more attention to the media and participate more fully in public discussions and debates. In such interactions, practitioners should endeavor to explain technical issues in non-technical language.



- Regarding scientific or technical matters on which public-policy choices are to be made, the media should seek out the best S&T sources for their articles and programs. In a similar spirit, reporters and editors should not artificially generate controversy by seeking out minority positions that appear to highlight the adversarial aspects of S&T-related questions, particularly when the professional community has actually achieved broad consensus.

2. Use the new electronic media to provide the public with information related to issues of science and technology

- A wide array of communications technologies – print, television, radio, cellular telephone, World Wide Web, the Internet, among others – should be utilized in disseminating to the public the results and public policy implications of publicly or privately funded research that addresses national or local needs.