I am honored to have this opportunity to present to you the first issues paper of the CSTD Secretariat – Science, technology and engineering for innovation and capacity-building in education and research.
There is wide consensus that technological innovation is a driver and critical source of sustainable economic growth in the new millennium.

Applying technological advances in tandem with entrepreneurial approaches to the provision of goods and services can help transform scientific and technological advances into more productive economic activities.
Role of Innovation in Development

- Innovation contributed to economic success of recently industrialized countries.
- Countries need capacity not only to conduct R&D but also to do engineering and quality management.

Innovation has played a critical role in the economic success of today’s advanced and recently industrialized countries.

Developing countries must understand not only how to procure capital, but also how to build the capacity to innovate.

Building the capacity to innovate with new technologies is not a simple task. Technological effort is necessary even to use imported technologies, because new technologies cannot be passively absorbed and used at best practice levels without conscious effort to access, master, adapt and improve on imported technologies.

Countries need not only the formal Research and Development (R&D) but also the informal production engineering and quality management skills to innovate.
Though technological progress can drive overall improvements in living standards, it is also clear that many countries and peoples have been excluded from the benefits of technological innovation.

How and why have scientific advancements failed the developing world and what is required to put science, technology, and innovation at the service of development?

A great place to start is in improving our understanding of technology and how it can contribute to economic growth. Innovation takes place in a social and institutional environment, and the concept of "systems of innovation" is an interesting framework to help us think about the knowledge system in which innovation occurs.
Innovation System

- Shows the institutional environment in which innovation takes place.
- Many conditions in the "innovation system" must be right for an enterprise to innovate.

A "national innovation system" is a system of interconnected institutions to create, store and transfer the knowledge, skills and artifacts which define new technologies.

The Figure in this slide illustrates the concept of the innovation system, sketching all the actors and activities in the economy which are necessary for innovation to take place and to lead to economic development.

In the innovation systems model, the ability of an enterprise to innovate depends not only on its access to knowledge or technology, but also on many other institutional factors including access to finance, human resources, infrastructure, inter-firm linkages, general business services, demand conditions, and investment climate.

Therefore, innovation is not concentrated within any single institution, but operates within and among the interactions of the various actors in the innovation system.
One way to assess the strengths and weaknesses of an innovation system is to measure some of the inputs and outputs of the innovation system.

Some of the inputs are related to the finance of innovation, such as R&D expenditures and venture capital, as well as the human resources for scientific and technological innovation, like R&D personnel and tertiary enrolment in S&T fields.

Some of the outputs are related to the creation of knowledge, for example, S&T publications and patents, as well as the access to and transfer of technical knowledge through licensing.

Though these inputs and outputs are not comprehensive in helping us understand the strength of an innovation system, they can help provide useful analysis for policy makers in developing innovation strategies for development.
This chart shows the vast differences in the performance of the LDCs compared with the developed and other developing countries.

Overall, the developing world lags the OECD countries in virtually all innovation indicators and particularly the inputs and outputs to the innovation system that we highlighted in the previous slide.

But effective policies for capacity-building can perhaps decrease the gaps between the OECD countries and the developing world.
Policy Options for building innovation capacity

- STI policies can be developed to strengthen the inputs and outputs of the innovation system.
- Policies should not focus only on technology transfer or R&D alone, but also on technological learning and commercial innovation.
- The key is striking the right balance between creating new knowledge and absorbing existing knowledge.
- Policies should also address the overall business environment.

STI policies can be developed to strengthen the inputs and outputs of the innovation system that are considerably weak in developing countries.

STI policies should not be limited to technology transfer or pure scientific research. Rather, they should focus on proactive technological learning by domestic firms, as well as commercial innovation. The key is to find the right balance between the creation of new knowledge and building the capacity to absorb and adopt existing knowledge.

Policies can also help stimulate the supply and demand for technology, lubricate the links between supply and demand, and address the overall business environment.

Now we will look at specific policy options on the national, regional, and international levels.
Governments can develop a national S&T strategy in full consultation with the country’s science, engineering, and medical academies, and other scientific organizations.

Based on a country’s capacity to innovate and use technology, its national S&T capacity-building strategy can build upon its existing capacity. For rich countries, they may be able to push the knowledge frontier further. For developing countries, their priority may be to learn how to master, adapt and improve technologies that already exist in more technologically advanced countries.

For example, Malaysia is often viewed as a country that evolved from dependence on tin and rubber to export-oriented manufacturing, dominated by electronics assembly. But the commodity that took the country to the technological frontier is palm oil. Palm oil firms are an integral part of value chains in which Malaysian companies play a significant role, making palm oil a major pillar of Malaysia’s industrialization.

I will now explain several specific policies that can be promoted on the national level.
Financing innovation

• Governments can commit funds for R&D research in public as well as private institutions.

• Financial institutions and angel investors can support entrepreneurs in new technology ventures.

The national government can promote R&D through the provision of "sectoral" funds for conducting research in selected S&T areas of economic interest to the nation.

Governments can encourage firm-level innovation through the provision of grants, loans or venture capital for the establishment of in-house research units and/or the hiring of S&T talent. For example, the Korean government directly supported private sector R&D through various instruments, including tax-exempt funds, R&D tax credits, and “research related human capital.” As a result of Korea’s support over the course of two decades, private sector funding has skyrocketed from 20% (with 80% public funding) to more than 80%.

Financial institutions can support entrepreneurs in new technology ventures. In Venezuela, brokerage houses are connecting entrepreneurs with investors where the angel investing community and the stock exchange have failed to sufficiently finance the local private sector. And in Brazil, the first formal angel investing group, Gávea Angels, brings together investors with the goal of expanding seed capital for the Rio de Janeiro metropolitan region.
Assessing, Strengthening, and Creating STI Institutions

- Improving governance of universities and research institutes
- Linking research to social and economic needs

STI institutions can be assessed, strengthened and reformed for excellence and relevance.

Improved governance of universities and research institutes can be facilitated through competitive grants and targeted funding for research linked to social and economic needs.

One example is the government of Ghana establishing the University for Development Studies in 1992 to bring academic work to support community development in northern Ghana.

In Uganda, Makerere University has developed new teaching approaches that allow students to solve public health problems in their communities as part of their training.
Government agencies, multinational companies and local firms can make use of the local educated labor force, absorbing those who have not gone abroad and eventually attracting back a portion of those who have.

To spur locally-needed S&T activities, developing country governments can consider temporary special working conditions for their best talent, whether formed at centers of excellence abroad or at home.

Taiwan, for example, set the trend for inviting expatriate scientists and engineers home to participate in key R&D projects for national development.
Effective Governance of Innovation

- Developing capacity to draft and implement innovation policy.
- Policy and ministerial coordination is key.
- Instruments for scientific advice at the highest levels can be provided through a variety of mechanisms.

The key to developing the government's capacity in relation to STI issues is to develop such capacity through policy practice.

Since innovation policies often require efforts from many Ministries and government agencies at the national and sub-national levels, policy co-ordination is essential to avoid duplication and ensure coherent policies at different levels.

One way to effectively guide STI policy issues is through the creation and promotion of mechanisms for scientific advice. Informed and reliable counsel can be obtained from specially appointed committees of experts, advisory bodies, or independent academies of science, engineering and medicine.
Government at various levels can play a central role in creating public-private research for addressing research areas of potential local benefit. Effort is needed to move human resources and technology from universities and research institutes to local firms.

Ghana’s Intermediate Technology Transfer Unit (ITTU), established by the Faculty of Engineering at the University of Science and Technology, Kumasi under the Technology Consultancy Centre (TCC), is a good example of how appropriate technologies are transferred and diffused to businesses in Kumasi’s industrial areas.
Educating an S&T-literate labor force

- S&T Education should be promoted at all levels.
- S&T literacy should be promoted for all, in spite of ethnic, gender, and cultural diversity.

Studies show that science education should be strengthened at the earliest level in educational systems and should extend to S&T studies at the tertiary level.

Science and technology can be mainstreamed within the national education system and S&T literacy and culture can be imparted in ways that capture the interest and imagination of young learners. S&T literacy and educational initiatives can also ensure ethnic, gender, and cultural diversity.

An example of a successful initiative promoting science in the primary and secondary level curricula is the Science Education Reform of the U.S. National Science Resources Center. It was created to improve the learning and teaching of the sciences for students 5 -18 across the country’s school districts. By 2004, 369 U.S. school districts were implementing this new vision for science teaching and learning, serving approximately 25 percent of the nation’s schoolchildren. This model has since been emulated in Sweden, Mexico, and Canada.

Capacity-building can take place not only in schools but also in the private sector. On the industry level, for example, firms in Malaysia heavily invested in training. In Penang, foreign multinationals and local firms established the Penang Skills Development Center. In 1992, the government introduced its Human Resource Development Fund along with related legislation to pressure manufacturing firms with 50 or more employees to increase training.
Engaging the Media on Science and Technology

- Media should educate public on S&T.
- Media sources on S&T should be accurate and balanced.

The nation's media can assume responsibility for educating the public on S&T-related issues. The media should seek out the best S&T sources for their articles and programs, especially on issues relating to public policy.
Moving to the regional level, developing countries can sponsor world-class research and education through regional networks. The national research nodes of the networks could become recognized centers of excellence, helping to strengthen S&T capacities among less-developed partners.

For example, the East African Regional Program and Research Network for Biotechnology, Biosafety, and Biotechnology Policy Development has been building capacity in biotechnology in Ethiopia, Kenya, Tanzania and Uganda and promoting appropriate research and related policies. Similarly, the Southeast Asian Regional Training Centre in Biotechnology in Thailand was established in 1994 by collaborating research institutes in the Asian region and international organizations engaged in capacity building.

In addition to capacity-building activities, regional economic communities can also establish regional infrastructure to support S&T activities.
The international community can consider STI capacity-building as a particular form of knowledge aid, as mentioned in UNCTAD’s 2007 Least Developed Countries Report. Aid for STI can support the development of productive capacities, development of governmental capacities to design and implement STI policies, and infrastructure for S&T.

International agencies and organizations can provide funding and expert support for libraries to maintain electronic gateways for the sharing of digital information among researchers, teachers and learners. United Nations agencies and regional intergovernmental organizations can partner with the developing world to identify national S&T priorities through financial support and expert consultation, like UNCTAD’s Science, Technology and Innovation Policy Reviews.

Finally, countries can cooperate with others in North-South and South-South networks sponsoring world-class research and education. UNCTAD’s Network Centres of Excellence, for example, identifies and mobilizes outstanding scientific and technological institutions in the developing world as regional hubs of learning and training for developing country scientists and engineers.
There are many opportunities for building the capacity to do science, technology, and engineering for education and research. This meeting will help us explore particular strategies that can be implemented at the national, regional, and International levels.

Thanks for your time.