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COUNTRY REPORTS:
EXCHANGE OF NATIONAL EXPERIENCES IN BRIDGING THE TECHNOLOGY GAP BETWEEN AND WITHIN NATIONS

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CHINA
Innovation capacity-building

Since the adoption of its reform policy more than 20 years ago, China has witnessed significant development in science and technology. The Government attaches great importance to innovation capacity, which is key to bridging the gap between China and developed countries.

In recent years, China increased investment on science and technology (S&T) for the construction of key R&D bases and implementation of major projects. Industries have been encouraged to establish and improve their R&D facilities and build up capacity in R&D activities. After accession to the WTO, China has shifted its public expenditures priority from supporting science and technology itself to supporting its capacity-building. In addition, China has adopted a new strategy "Talent, Patent and Standard" to create an enabling environment for technology development.

1. Budget increase

The cumulative amount of state expenditure on S&T has more than doubled between 1998 to 2002 compared to the previous five years, and reached more than 300 billion RMB. The total national R&D expenditure has increased on average by 15.8 per cent annually from 1993-2003, and reached to US$18.6 billion in 2003, and rose from 14th place to 6th place in the world ranking. The major part of the increased budget has been used for capacity-building in recent years.

2. Science and technology programmes

The National Key Technologies R&D Programme is China's first national S&T programme. It was launched in 1982 with the aim of strengthening innovation capability in high technology, and particularly in strategic high technology fields. Since then, China has systematically formulated a series of S&T programmes.

The National Key Technologies R&D Programme aims to contribute to economic development by promoting industrial and technological upgrading and structural reform and by providing solutions to major technology issues close to public interests. National Programme on Key Basic Research Projects aims at enhancing China's original innovative capability. Some other programmes focus on S&T capacity-building for national key labs and technology research centers, and national R&D infrastructure construction. Programmes such as the "Spark Programme" and the "Torch Programme" aim to improve the commercialization of research.

As a result, 100,000 researchers received financial support, 32,000 R&D papers were published and more than 3,000 patent applications were submitted in 2002. Meanwhile closer collaboration between research institutes have brought about major S&T breakthroughs.

3. Science and technology training

In recent years, R&D teams in China have improved quantitatively, qualitatively and structurally. The total number of R&D staff increased by 10.9 per cent from 1999 to 2000 and employed 922,000 people, but the number of R&D staff as a ratio of the overall population is still behind that of developed countries. To reduce the gap, China has given priority to the education and training of R&D personnel within the context of its S&T capacity-building efforts.

4. Science and technology extension services

To combine existing facilities with national demands on S&T and economic development in China, S&T extension services backed by enterprise incubators, productivity promotion centers and consulting organizations are gradually expanding. There are currently more than 460 kinds of enterprise incubators in the country. About 15,000 enterprises are under incubation and close to 4,000 enterprises have been incubated. In China, there are more than 850 productivity promotion centres, which provide services to more than 60,000 enterprises, and there are more than 13,000 S&T consulting organizations in the country.

5. Public awareness on science and technology

At present, investment on public awareness by all levels of government has been increasing each year. By the end of 2002, 425 S&T exhibition halls have been built in China. Every year, between 7,000-8,000 science education publications are produced: this plays an important role in promoting public awareness of science.

GERMANY

Bridging the technology gap within nations: The experience with the new Länder in Germany

1. The German situation after reunification

With the reunification of Germany in 1990, the former GDR became the sole transitional region within the EU. The transition is occurring on three different levels, namely: (i) structural adjustment as the economy evolves from a centrally planned to a market economy; (ii) emergence of new development trajectories and growth regimes; and (iii) phasing out of public funds.

2. Strengths and weaknesses of the innovation system in the new Länder

The central problems of the innovation system in the new *Länder* are as follows: The economy is dominated by small enterprises and lacks large, international, R&D-intensive firms; there are relatively fewer firms with high productivity and international competitiveness; the industry is concentrated on sectors with relatively low technology/innovation level (e.g. food, glass, furniture); Thus, the density of R&D personnel in the new Länder industry is low[1] (3.8 per cent) compared to that of the rest of Germany (4.3 per cent). Equity capital is unsatisfactorily low for most firms, as is the transfer rate of R&D efforts into marketable products and services. Firms in the new Länder achieve only 40 per cent of innovation productivity – measured in patents per R&D activity – compared with the rest of German enterprises. While there is a relatively large base of highly qualified R&D personnel, the new Länder is faced with high migration rate and an ageing society.

3. New instruments: Regionalized innovation policy and network support

The Federal Government has formulated a strategy since the late 1990s, with a view to "building up a strong East German economy, which holds its own in the market and offers sufficient employment and income chances." Research, Technology and Innovation policy has undergone a number of reviews and changes. The current policy places special emphasis on stimulating regional development focuses, networks between enterprises and research institutions, as well as competences and management capabilities. It adopts a "bottom-up approach", which builds on and mobilizes the regional initiatives and their "endogenous potentials".

Of particular importance is a new initiative "Enterprise Region" (Unternehmen Region) with its four sub-programmes. The InnoRegio Programme provided Euros 65 million in 2003 to subsidize cooperative networks with a regional focus. The total funding for the period 1999-2006 is estimated at Euros 255 million. The programme targets large companies, SMEs, research institutes, universities, public authorities and individuals, provided that the projects include a region-specific focus. Two-fifths of

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1 As of 2001.

firms have submitted patents in the last two years and almost all have introduced new products. The programme has also helped create 50 new firms since 2000.

4. Achievements and lessons learned

As a result of these policy measures, R&D expenditures in the new Länder have almost doubled from 1996 to 2003, to speed up GDP growth to 8 per cent in 2003 (and 14 per cent in manufacturing). Firms with higher expenditures on R&D grew faster and achieved better export performance.

Despite these improvements, there is still a marked gap in the economic indicators, e.g. GDP per capita or unemployment, between the new Länder and the rest of Germany. Even 15 years after reunification, the transformation process is still ongoing. Two important policy lessons can be drawn from this experience: 1. Regions have different paths of development and growth; designing innovation policy therefore needs to take into account regional characteristics; and 2. Bridging the technology gap is a learning process over an extended period of time.

ITALY

The Trieste System for International Scientific Cooperation

1. International Centre for Genetic Engineering and Biotechnology

The International Centre for Genetic Engineering and Biotechnology (ICGEB) was created as an intergovernmental organization to provide a centre of excellence for research and training in genetic engineering and biotechnology to address issues prevalent in developing countries and transition economies.

The ICGEB is a single entity made up of two components with a network of 37 affiliated centres. One of the components is located in Trieste, Italy, and the other in New Delhi, India. In addition to the two components and the network of affiliates, the system's partners include 71 signatory States and 52 member States.

2. Activities and accomplishments

The ICGEB's activities include: advanced research projects in the Trieste and New Delhi Laboratories; long-term post-doctoral fellowships; short-term fellowships; Ph.D programme; organization of meetings, courses and workshops; collaborative research programmes; cooperation with the industrial sector; scientific services to member countries; and technology transfers.

During 1988-2004, the ICGEB undertook an impressive range of activities: it completed and disseminated more than 1200 publications in peer-reviewed international publications; awarded 487 long-term fellowships and provided short-term training to more than 5000 people. ICGEB also awarded 255 research grants with a value of more than $13,360,000, filed 30 patents, and signed 65 technology transfer agreements.

The ICGEB is collaborating with the United Nations on research on the safe and sustainable use of genetic engineering and biotechnology; biodiversity protection; biosafety and risk assessment, and implementation of Article X of the Convention on Biological Disarmament.

JAMAICA

Bridging the technological divide between and within countries – The Jamaican Approach

1. Nature of the gap

Living on a small island with fragile ecosystems, Jamaicans are on the frontline of environmental destabilization, and are acutely aware that earth's renewable and non-renewable resources are being depleted at ever-increasing rates. The island imports 90 per cent of its energy needs, and nowhere is this more evident than in the prevailing oil and energy sector. In addition, the island is confronted with shrinking forests, deteriorating grasslands, falling water tables, collapsing fisheries, soil erosion, greenhouse gas emissions and global warming. Some of these problems have led to inefficient agriculture for some small tropical islands.

2. Strategies to close the gap

The Government recognizes the technology gap as a paucity of knowledge generation, transfer and application, for meeting the needs and solving the island's problems. To close the gap, the island aims to increase production and productivity, especially in agriculture and agro-industry, to satisfy the needs of all Jamaicans without sacrificing the environment. To this end, the Government recognizes the need to improve local skills and create a wider understanding of science, while conducting relevant R&D to enable the creation and transfer of technologies to address local needs. R&D is undertaken not only to spark innovation to increase production and productivity, but also to ensure more effective education, infrastructure improvement, marketing and management.

Learning and capacity-building are at the center of this approach. Jamaica is proactively raising its skills and capacity to solve its own problems, including social science competence to improve organizing, networking, marketing, managing and learning abilities. To this end, Jamaica has begun developing scenarios and modeling to acquire a more complete understanding of its physical and social environments by compiling statistics and systematically monitoring new S&T developments, as well as changing patterns of local needs. Scientists are trained and encouraged to operate in centers of excellence, thereby facilitating application of emerging technologies such as bio-engineering to improve agriculture, nanotechnology to increase industrial variety and efficiency; and geological mapping to improve water supplies and mitigate losses from natural disasters such as earthquakes and flooding.

3. Actions taken to close the gap

a) Creation of a National Commission on Science and Technology

Jamaica has taken significant steps since the 1960s to use knowledge to make better use of the island's natural resources. Since this time, S&T institutions were established and there are now over 40 of them. Nevertheless, their impact on the

island's socioeconomic development have not been as great as expected.

A decision was therefore taken in the early 1990s to create the National Commission on Science and Technology (NCST) to better manage, coordinate, monitor and integrate the activities of these institutions. This is a broad-based cross-sectoral assembly of leaders from the private and public sectors, academia and other national bodies, such as unions and professional associations and chaired by the Prime Minister. The primary mandate of this body is to provide a forum for collaborative priority-setting among business, government and S&T institutions.

The Commission has drafted a new S&T law and policy along with action plans. A national strategy has also been designed to reverse the decline in S&T capability, caused by an unbalanced national emphasis on business and management education and training. Additionally, the Commission has launched a programme to ensure that domestic technological needs and aspirations are better known and expressed. The NCST is positioning itself to become the main repository of S&T learning, anticipation and advice on the island.

b) Additional activities

- *New legal arrangements*

The Scientific Research Council (SRC) was formed in 1960. It has been decided to amend the SRC law to make it an R&D and Transfer of Technology Centre.

- *Indicators*

To be able to make sound S&T decisions, the NCST has begun to collect information on input, output and demand indicators. It also elaborated a national strategic plan with targets to be met and ways to measure success in the dissemination and utilization of S&T competence for balanced development.

- *Young Scientists Forum*

Young scientists on the island have taken up other jobs or have been leaving to settle in foreign countries. Moreover, there has been a fall in science and engineering enrollments at the universities. To counter this, a Young Scientist Forum has been established. Efforts have also been made to identify gifted students and encourage them to take up research and engineering careers. S&T parks are established at the universities to allow science graduate students to commercialize their research.

- *Work with the Jamaican diaspora*

As part of the international cooperation and partnership, Jamaica has decided to work closely with Jamaican professionals abroad to transfer knowledge and encourage investments in S&T-led operations and businesses. At the same time, partnerships with other developing countries have intensified.

- *Education and training*

To ensure a sustainable flow of S&T professionals, S&T education at the primary and secondary school levels is to be promoted. To this end, the media is being used accordingly.

- *Financing of R&D and S&T activities*

A major gap in the island's S&T system is the absence of sizeable risk and venture capital funds for S&T and innovative activities. The NCST presently administrates a small Technology Investment Fund for such projects, but the demand has been so overwhelming that serious consideration is being given to remodeling and expanding this facility.

- *A National think tank*

The Prime Minister's Adviser's Office is working with the local arm of the Caribbean Academy of Sciences and experts at the island's universities and professional societies to assemble a group to act as a think tank and provide advice on technology applications and selections.

SLOVAKIA

Bridging the Technology Gap between and within Nations: Policies and Strategies of the Slovak Republic

The Slovak economy has undergone profound changes in the past fifteen years; these changes include its transformation into a market economy, full integration into the European Union and the implementation of deep structural reforms. The Slovak economy now faces new opportunities and challenges in its development efforts. The Government has adopted a new development strategy, the primary objective of which is to reduce the gap in living standards between Slovakia and the most prosperous EU countries as quickly as possible. The strategy is therefore based on two main pillars: 1) successful completion of structural reforms and maintaining their results; and 2) systematic focus on the fulfilment of the development part of the Lisbon Strategy of EU. The strategy, which will be in effect until 2010, focuses on: (i) information society; (ii) science, R&D and innovations; (iii) education and employment; and (iv) the business environment.

1. Information society

The strategy attaches great importance to strengthening institutional capacity in this area. It adopts measures to strengthen the competencies of Government employees in the use of information technologies, and to transform the Ministry of Transport, Post and Telecommunications. The priority areas are:

Information literacy

The strategy aims at universal information literacy among its citizens. Associated objectives include: ensuring IT literacy among teachers at all school levels, as well as among employees in public administration; catching up with the European standard in equipping schools with information and communication technologies (ICT); supporting computer literacy through life-long learning programmes, in cooperation with the private sector; and improving general awareness of the benefits of an information society and IT literacy.

Effective e-government and modern online public services

The strategy outlines the role of the Government in providing a range of electronic services which serve as important catalysts in the process of introducing ICTs. The principal objectives are to connect the basic information systems of public administration in an effective, reliable and secure way; to make Government services available online at a central public portal for citizens and especially for firms; to improve the functioning of all public registers and databases; to undertake joint public procurement, on the basis of an audit of the expenditure on ICTs and public administration services; and to introduce secure electronic identification cards.

Internet access

The strategy aims at building a high-quality and affordable information and communication infrastructure, with broadband Internet access. It outlines appropriate legislative and regulatory measures which promote a more competitive environment in the telecommunications sector. The main objectives of the strategy is to: continue the liberalization of the telecommunications market, especially by improving the regulation process in this market; promote access to broadband Internet and its wider use in under-developed regions; promote the development of public Internet access; to make all school multimedia classrooms open to the public; and promote schemes, based on partnership with the private sector in order to provide computers with broadband internet access to the wider public.

2. Science, R&D and Innovation

Educating and supporting highly qualified scientists

The main objective is to motivate gifted people to take up a career as a professional scientist by creating worthwhile opportunities for quality scientific work. Some of the other objectives include: improving the interaction between scientific research and university education; removing institutional obstacles that prevent leading scientists from career advancement in domestic research and academic institutions; dividing the public financing of science between financing for institutions and financing based on the principle of competition; increasing public financial supports (including scholarships) for PhD students and introducing financial support for PhD graduates; creating financing instruments aimed at improving the international mobility of Slovak scientists, as well as the mobility of scientists between academic and business sectors.

Research of international quality, adequately interconnected with the business sector

The strategy aims at raising the standard of publicly-funded domestic research and making research more relevant to economic development. Some of the other objectives of the strategy include the implementation of efficient cooperation and shared responsibility between the Ministry of Education and the Ministry of Economy, and other relevant ministries, for the development of public instruments and institutions supporting applied research and development; the introduction of mechanisms to independently assess the quality of projects and make it mandatory to publish the results of all publicly-funded research projects; the introduction of instruments for special public support for those scientific teams and institutions that are successfully cooperating and obtaining funds from the private sector and abroad; to provide for extra funding for research in two to three priority areas and in the network of centres of excellence; the removal of institutional obstacles which reduce the mobility of quality scientists between the academic and business sectors, and to create instruments to help obtain funding for projects from international R&D, community schemes and EU initiatives in R&D.

Effective public support of business activities in the areas of R&D and innovations

Primary objectives include motivating increased private sector financing of research, development and innovations, mainly by introducing an effective public co-financing of such activities; unifying and improving existing public instruments supporting new and innovative firms, particularly SMEs; creating a significant public instrument which will improve access to venture capital for innovative firms in the early stages of their operation, and incorporating basic business knowledge and skills into the standard curricula of technical universities.

3. Modernizing education

The primary aim is to reform primary and secondary education. The objectives are to: reform schools, placing greater emphasis on the ability of students to obtain, evaluate and use information, rather than its memorization; strengthen and improve education in the area of foreign languages, IT, and basic business knowledge and skills in secondary schools; enhance the quality of teachers, particularly by making the profession more attractive for high-quality teachers and by improving the conditions for their training and the continuous development of their skills; encourage students to regard learning as a life-long process; and support programmes for the integration of children from marginalized groups into the standard school environment; and provide financial support to children from poor families through scholarships and similar tools.

At the university level, the objectives are to: improve access to education by loans and social scholarships; improve the quality of teaching, particularly by making the profession more attractive for quality teachers and by improving the conditions for their professional development; support the acquisition of a greater range of skills by university students (e.g. communication, analytical, teamwork skills), as well as the practical skills gained in previous education (languages, IT literacy, business); and support the mobility of students and teachers.

The strategy also outlines the role of the Government in encouraging life-long learning for its citizens, including supporting the creation and use of international standards; creating a functional model for financing further education, and supporting existing regional networks of institutions which provide individually tailored advisory services and life-long education.

ROMANIA

Bridging the technology gap between and within nations

1. Technological innovation in enterprises: assessment of current situation

Romania's most critical need in view of the EU accession is to bridge the technology gap. Enterprises with the highest productivities are mostly engaged in assembly activities and in subcontracting regimes. The main source of competitiveness in enterprises is from low-cost production, rather than the innovation of products and technologies. To a large extent, enterprises acquire new technologies through imports and FDI. Seventeen per cent of Romanian enterprises are innovative.

The overall structure of innovation expenditures at the enterprise level is approximately as follows: equipment acquisition, 53.4 per cent; R&D activity, 24.5 per cent; licences and patents acquisition, 6.6 per cent; and other expenditure, 15.5 per cent.

2. Measures to promote technological innovation in enterprises

a) R&D and innovation policies

One of the most fundamental R&D and innovation policies is to encourage the development of research-industry partnerships. To this end, Romania implemented the National Plan for R&D and Innovation (1999) and the Research of Excellence (2005) programmes. These programmes fund collaborative R&D projects and have helped to form ten technology clusters/ platforms in such fields as hydrogen and fuel cells, water management, maritime transport, sustainable chemistry, plants genomics and biotechnology. Other policies that have been implemented include the enhancing the market for R&D results via data banks, Internet online processing and intellectual property rights regime; and the development of innovative SMEs with the support of investment funds for technology transfer and development, as well as joint action plans of related ministries and institutions.

Another crucial policy is the development of infrastructure for technology transfer and innovation. Efforts such as technology transfer and innovation package include the following: GO 57/2002 for Scientific Research and Technological Development; GO 14/2002 for S&T Parks: creation and accreditation procedures for entities in the TT&I infrastructures; and INFRATECH- The new Technology Transfer Programme of MER (GD 128/ 2004). At the regional level, the efforts include the creation 14 S&T parks, incubators, S&T information and assistance centres and services (19 technology transfer centres are under development), and stimulation of "spin-off" processes. Romania regards international S&T collaboration as an essential part of its policies and actively participates in such collaborations.

b) Industrial development framework

Within the industrial development framework, some of the programmes coordinated by the Ministry of Economy and Commerce include programmes to increase the competitiveness of industrial products (GO 120/2002); R&D plan (2005) for sectoral development; and a national strategy which includes sector-specific policy packages and action plans to promote exports.

The programmes coordinated by the National Agency for SMEs and Cooperation include: the National Guarantee Fund for SMEs (loan guarantee); financing instruments for the development of innovative SMEs; the development of business assistance services; UNDP programme for BICs development; and the UNCTAD Empretec Programme for entrepreneurs. The Ministry for Environment Protection and Water Management also runs a programme for monitoring the introduction of BATs in order to ensure the application of IPPC directives.

c) **National Export Strategy**

Romania's national export strategy has three objectives: (i) bridging the technology gap; (ii) bridging the competitiveness gap; and (iii) achieving high value-added exports. Bridging the technology gap initiative involves more rapid deployment of advanced technologies in all economic sectors, and the implementation of sustainable technological development patterns at sectoral level through large-scale deployment of high performance information technologies in all economic sectors and via direct support to enterprises for technology-related capital investments.

The strategies for bridging the competitiveness gap includes promoting a culture of innovation, supporting enterprises for their good managerial practices for technological development and innovation activities, and forming structured network of regional providers (of infrastructures and services) that are specialized in, for example, technology transfer and innovation services, as well as compliance and evaluation of conformity with European and international technical regulations and practices.

To promote high value-added exports, the Government provides fiscal incentives and aid instruments to promote R&D and innovation activities in enterprises, especially in hi-tech industries by encouraging enterprises to develop in-house research capacity (personnel, departments, laboratories), and to participate in publicly-financed R&D and innovation programmes.