

science policy studies



United Nations
Educational, Scientific and
Cultural Organization

**Future Directions
for National Reviews
of Science, Technology,
and Innovation in
Developing Countries**

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Future Directions for National Reviews of Science, Technology, and Innovation in Developing Countries

Workshop Report,
23-24 April 2003, Paris, France

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Foreword

How states organize themselves to strengthen or improve their capacity to produce knowledge and conduct research is often a bit of a hit-and-miss exercise. Different methodologies are likely to be used because nations have unique cultures, histories, geographies, economies, and societies. But all can learn from practice, comparative cases, and theory. Attention has been focussed lately on the notion of national innovation systems. Academics have made an industry of this technique of assessing the complementarities among research and innovation in a given country or region.

Such techniques are fine for the developed world. But what of developing countries? How can they learn? How can they innovate and shape skills? How can they effectively develop mechanisms, policies, and tools to encourage science and technology (S&T) and manage their impacts on their respective societies? How can they ensure they are participating in the global pool of knowledge production? How do they take advantage of knowledge to improve their standard of living, eradicate poverty, and strengthen capacity for decision-making? These were some of the questions addressed in a workshop co-organized by IDRC's Research on Knowledge Systems Program and UNESCO's Division of Science Analysis and Policies. The 60 participants discussed the impacts of S&T reviews, the design and implementation of ongoing national assessment, and future directions for these exercises.

The summary of this IDRC–UNESCO Workshop on *Future Directions for National Reviews on Science, Technology and Innovation in Developing Countries*, along with all of the resources papers presented at the workshop is available on the websites of both organizations (www.idrc.ca/roks and www.unesco.org).

It is our hope that by joined forces we can help to enhance the methodology and tools of analysis available for national science-policy reviews. This workshop was a first step in this direction and we hope that its conclusions and recommendations will have considerable impact on the design, preparation, and implementation of future national reviews. Continuous dialogue and critique will help advance the body of knowledge. To provide comments on the workshop discussions or to obtain more information please contact us by email.

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Introduction

The cosponsors of this workshop, UNESCO and IDRC, have long been involved in science policy. Since the early 1960s, UNESCO has supported several international science policy reviews. This has included the organization of regional conferences of Ministers responsible for Science and Technology Policy (MINESPOL for the European and North American region; CASTLAC for the Latin American and Caribbean region; CASTAFRICA for the African region; and CASTARAB for the Arab region). The last of these regional conferences, CASTAFRICA II, was held in 1987 in Arusha, Tanzania.

Between 1965 and 1991, UNESCO published a series of science-policy documents. Most of these documents, which are still in demand, were on science policy and the organization of scientific research in such countries as Japan, USA, Korea, France, and Germany. In the early 1990s, science-policy studies were phased out as a separate entity within UNESCO. Therefore, for over a decade, requests from member states for support in areas of science and technology policy were responded to in a less focussed way.

IDRC has supported science-policy research since the 1970s, and has always had a concern for the management of science and technology within its programs. IDRC has provided guidance, expertise, and other forms of support for countries wanting to explore how to improve and strengthen their knowledge capacities. Over the past decade, IDRC has supported a series of national reviews of science, technology, and innovation policy in South Africa, China, Chile, Vietnam, and Jordan, and is considering others in Africa.

These IDRC-supported national reviews shared three important attributes. First they were strongly “user-driven,” with the host-country client contributing time and resources, sharing in the financing of the overall effort, and being committed to using the findings of the review. Second, the reviews were “action-oriented.” They were not simply catalogues of institutions and programs, but guidelines for reform. Third, they offered opportunities for networking and sharing of “good practices” across national boundaries because the review teams were multi-national and there were ongoing interactions between the reviewers and local experts and authorities.

In 2002–2003, a Division of Science Analysis and Policies was established in UNESCO. This signalled the re-entry of UNESCO into the international science-policy community.

The division's main thrust is international partnerships, and it expects to play a leading role, particularly within the United Nations System. Since rejoining the science-policy community, UNESCO has collaborated on assessments in Albania, Bahrain, and Lebanon, and is exploring others.

Other organizations represented at the workshop had many experiences to share. These included: the World Bank, with its S&T Vision and work on China and Korea; the US Agency for International Development (USAID) with a recent report on S&T capacity for development, which examined four cases in India and Russia; the Sweden International Development Agency (SIDA) with its programming on universities and research in developing economies; the United Nations Conference on Trade and Development (UNCTAD) with previous assessment of Jamaica, Colombia, and Ethiopia; the OECD with reviews of China, Korea and Mexico; and the Institut de recherche pour le développement (IRD) with its reviews in Africa, including a recent exercise in Morocco.

The Workshop

The context for the workshop was established in the opening addresses by Mr Walter Erdelen, Assistant Director-General for Natural Sciences, UNESCO, and Mr Brent Herbert-Copley, Director, Social and Economic Equity, IDRC.¹

Two guidelines for the implementation of the Johannesburg Plan of Implementation (JPOI) of the World Summit on Sustainable Development (WSSD) were brought to the attention of the participants: (1) UN activities should advance the integration of the three components (economic, environmental, and social) of sustainable development; and (2) synergies should be based on the comparative advantages of each organization. The integration of these three components of sustainable development require the building, at the national level, of capacities for the elaboration of science and technology policies and strategies. For this to occur, science and technology must be placed at the heart of policies to promote sustainable development.

The participants were reminded that there has been little effort to compare and contrast the lessons of the various reviews by different agencies. IDRC and UNESCO would like to promote the sharing of lessons learned among agencies involved in similar reviews in other countries. This workshop was an important first step in this process.

Consequently, the workshop organizers hoped to achieve two broad objectives: (1) to develop a shared understanding of the lessons of the national reviews conducted to date — what has been their impact? What are key success factors? What have been

¹ The texts of these speeches are included in the Annexes to this summary report.

the limitations of the review process as practised to date? and [2] to advance collective thinking about the way forward — How might agencies approach national reviews in the future? and What might this entail in terms of collaboration among agencies involved in this field?

The participants were challenged to envision alternative approaches to the review process — approaches that would help to strengthen indigenous Southern capacity to critically analyze science, technology, and innovation policies and programs, and also foster networks of learning and partnership across developing and industrialized countries.

To provide focus to the workshop discussions, a number of papers² were commissioned for presentation during the workshop. These contributions were made by individuals with considerable field experience in carrying out national reviews and included:

- *A Critique of National S&T and Innovation Review* by Roger Voyer, Consultant for IDRC;
- *Competence Building and Policy Impact through the Innovation Process* by Lynn Mytelka and Banji Oyelaran-Oyeyinka, both of United Nations University (UNU) Institute for New Technologies (INTECH);
- *Mapping Global Research Networks and National Systems* by Caroline Wagner, Research Fellow, RAND Europe and University of Amsterdam; and
- *Reflections on the Process of Reviewing National Policies for Science Technology and Innovation* by Mullin Consulting Ltd., Kanata, Ontario, Canada.

In addition, representatives of countries that had carried out reviews, were in the midst of reviews, or were contemplating reviews also shared their experiences.³ Representatives from donor agencies, research organizations, development agencies, and scientific organizations and networks completed the list of participants. (Annex A provides a list of participants as well as a breakdown of the types of organizations represented at the workshop.)

Agenda

The workshop was launched with the presentation *Review of National Reviews* by Roger Voyer. This was followed by two panel discussions. The first examined how three countries (South Africa, Vietnam, and Jamaica) have responded to reviews of their national science and technology systems conducted by IDRC and UNCTAD. The second session included presentations by countries that were either about to consider a review exercise (Senegal and Mozambique) or were in the midst of a review exercise (Peru and Lebanon). The first day concluded with a presentation by Dr. S. T. K. Naim,

² These resource papers are included in the Annexes to this summary report.

³ The formal presentations made by all participants are included in the Annexes to this summary report.

Chairperson, Pakistan Council for Science and Technology, *Review of the National Innovation System and Policy Initiatives*, which gave an example of a developing country that has carried out the review of its national science and technology and innovation system using mainly locally available expertise.

The second day started with a presentation of a summary of the issues emanating from the discussions of the first day. This was followed by three presentations that provided a perspective from donor agencies involved in knowledge systems work and national reviews of science and technology and innovation. Presentations were made by: the World Bank, SIDA, and UNCTAD. To help articulate a new direction for future Science, Technology, and Innovation (STI) reviews for developing countries, Dr. Lynn Mytelka and Prof. Banji Oyejinka made a joint presentation entitled *Competence Building and Policy Impact Through the Innovation Review Process*. The day continued with two other papers. Caroline Wagner in *Mapping Global Research Networks and National Systems* provided an overview of recent work on science and research collaboration among networks of developing and developed countries. Ernesto Fernandez Polcuch talked about the progress made to date in developing a global database of science and technology indicators. The day concluded with a discussion of the workshop's conclusions and recommendations.

Conclusions and Recommendations

The presentations made throughout this 2-day workshop stimulated a great deal of useful discussion about how reviews of science, technology, and innovation have been conducted in developing countries, and how the lessons from these earlier studies might be applied to future reviews.

The impacts of the reviews have varied for a variety of reasons. Timing for the reviews is critical. Politics almost always plays a role. Champions and funding are required. But, institutional capacity to absorb the recommendations of these reviews is a must. As many in the workshop recognized, unless there are sound frameworks for decision-making, data-collecting, communication, and governance of innovation and knowledge infrastructure, little will come of recommendations designed to improve research capacity. This was spelled out in the Jamaican case study, which flagged the regulatory and other requirements needed to create a sound information and communication technology (ICT) infrastructure. Training is critical. Not just an educational system that is well developed, but the institutionalization of critical thinking on future directions for knowledge. South Africa is an example of a country that has put in place a variety of new training and development organizations for innovation. Ongoing assessment or evaluation is also critical, as has been the case of Vietnam where the government has attempted to update its activities in response to a review conducted with IDRC.

But responsibility is not one-sided. Donor agencies have a role to play, and learning from good practice is a healthy thing. The World Bank Institute's innovation policy dialogue tele-learning format with developing countries is one model; the IRD's review of science in 15 African countries with surveys and other data is another case; as is UNCTAD's revised Science, Technology, and Innovation Program. Enhanced coordination (or communication) among donor groups on their respective approaches to similar developing countries should be re-assessed. Such a recommendation was put forward by the World Bank participant and resonated among those in attendance. A pilot project with selected countries will be the result. As well, more effort to mount joint activities among the donor agencies and other organizations in national or regional reviews was recommended.

Countries like to benchmark themselves. It makes for a more striking picture. The paradox of national reviews is that quite often assessments by foreign teams receive

more attention from decision-makers than assessments by national experts. This reality was confirmed by several participants who felt that outside-led reviews have more impact on business leaders, governments, and other public sector decision-makers. Ultimately, however, it is important that developing countries conduct such reviews themselves, and as the cases increase, and the theory becomes practice, South–South assessments are more likely to become the norm.

Production and sharing of data and indicators is a significant gap in all assessments. OECD, Eurostat, and UNESCO can play a strong role here. Indeed, the UNESCO Institute for Statistics and UNESCO's Division of Science Analysis and Policies are developing a program for developing countries in S&T data and indicators.

To translate the recommendations of reports into concrete action, skills are required, and people are front and centre. During the workshop, several developing country representatives noted that their countries are looking at ways to more effectively link their overseas citizens to their domestic needs and strategies. Others suggested the need for some sort of strategic intelligence or foresight activity that can help point the way. The need for well-trained people to provide such knowledge, and for training to communicate the results of knowledge and research in the media and to legislatures, continues to be critical.

The specific conclusions and recommendations made by the participants are presented here under several major categories.⁴

Context or Environment

- Political context cannot be underestimated when initiating a review. The underlying purpose of the review is very important. If change is to be implemented, the intensity of satisfaction with the status quo within the country must be considered.
- Evaluations must consider the context of the country in which they are undertaken. The need to develop country-specific baseline indicators of science and technology and innovation was emphasized. Baseline data would provide a platform for tracking trends and progress on a national basis and also for carrying out cross-country comparisons. UNESCO, as an international organization, could play a leading role in helping member nations develop the required capability.
- When policy reviews have looked at specific sectors, they have often not embedded these sectors in the broader policy environment. Policy dynamics (the interface between policies and the practices of those in a sector) were lost in this process as was the opportunity to monitor policy impact. To embed a sector in the

⁴ Those wishing to obtain more in-depth input are directed to the Annexes of this report, which include both the formal presentations and summaries of the discussions that took place during the workshop.

broader system, it would be useful to undertake more ‘sector-based’ reviews that have a clear focus on interactivity among actors and on the role of policies in setting the parameters within which actors take decisions.

- Reviews are initiated in different ways: high-level discussions between donors and ministers; individual initiatives by ministers of science and technology; and influential advisors promoting the need for reviews. Whatever the stimulus, local commitment to the process is crucial.
- There is value in “shocking” the system by acquiring baseline data and comparing this data with similar data from other countries, particularly those that are perceived to be at the same level of development. This approach can help encourage the top echelon of decision-makers to become committed to implementing the review and acting on the recommendations.

Design

- In designing science, technology, and innovation reviews, there is need to identify the strengths and weaknesses of local organizations and institutions to ensure that the required competencies are developed and that the appropriate interactions take place.
- There is a need to incorporate domestic capacity building into both the design and implementation of the review process.
- With regard to the design of the scope and methodology of the review, there is a need for: a clear vision of the methodology to be adopted; the tailoring of the review to local realities; and the determination of the extent of integration of the S&T review into the macroeconomic system. To integrate macroeconomic components into future science and technology policy reviews, an integrated approach that involves science and technology, economics, and investment should be considered.
- Most country reviews have concentrated on issues at the macro level; however, sectoral reviews are also desirable because they can highlight, in a more forceful manner, a country’s weaknesses in Science, Engineering, Technology, and Innovation (SETI) capacity.
- Engineering is critical to the achievement of development through science, technology, and innovation. However, past reviews have tended to relegate engineering to the background because engineering may have been viewed as a generic activity designed to solve technological problems. To achieve greater effectiveness and impact, particularly within developing economies, future attention should be focussed on the review of SETI. The World Federation of Engineering Organisations is ready to cooperate with other bodies in carrying out reviews.
- In some of the reviews discussed during the workshop, there was no initial country review on S&T, which is expected within the framework of the OECD methodology. The design of future reviews should be based on digesting what the national experts have to say.

Implementation

- The process of review is as important, if not more important, than the content of the review, as it brings stakeholders together to discuss issues.
- The timing of the review is very important as is the need for a domestic champion if the review is to have impact.
- A number of the national reviews of science, technology, and innovation that have been carried have been conducted by teams of external consultants. Professionals within the countries themselves have been involved in a support role to facilitate the work of the reviewers. It is highly desirable that policymakers (as well as scientists) within the countries involved be trained on the tools and methodologies available for science, technology, and innovation review so that they can play a more significant role in the review process. Preliminary training should be given before the review is started and should involve several different institutions within the country.

Training

- There is a need to develop decision-making capability in the countries involved in reviews. To develop these capabilities, it will be necessary to conduct training workshops at the ministerial level for the government officials who receive and must take decisions on the basis of the reviews. Such training will enhance the adoption and implementation of the recommendations of the reviews. The training should ideally use facilities in the countries concerned.
- There is a need to build local analytical capacity outside of government for policy analysis.
- “Innovation” is a relatively new concept. First introduced in industrialized nations, it is an effort to identify policies that will accelerate the movement of ideas into the marketplace. Bearing in mind its current importance in national reviews, there is a need for training in the process of innovation.
- In most reviews, capabilities are almost invariably considered to be technological and productive skills acquired through learning by doing. However, because of the increased knowledge-intensity of production and the growing importance of innovation in sustaining competitiveness, attention should be refocused on learning to learn, learning by searching, and learning interactively. This calls for the development of a broader set of competencies (including openness, experimentation, coping with uncertainty, dealing with change, questioning established truths, building trust, and working within collaborative partnerships both across ministries as well as among firms and between firms and universities or research institutes) rather than the more usual set of capabilities found in the development and innovation literature.
- Development of this broader set of competencies is not amenable to standard training processes (such as apprenticeships) in which tacit knowledge is shared.

These skills cannot simply be acquired from outside or imitated by rote, because the ability to build such competencies requires that they be internalized by the individual or organization and subjected to continuous scrutiny, feedback, and change. All actors in an innovation system must therefore become learning organizations.

- Science is a cultural enterprise that affects all human activity. The cultural dimensions of science and engineering must be integrated into a larger educational effort. Failure to do this will limit the capacity and impact that science has on societal problems. Policies must recognize this and avoid treating science and technology as the exclusive servant of industrial development.
- Primary and secondary education in S&T are critical to the long-term application of science, technology, and innovation to development.

Other Stakeholders

- Small business leaders as well as science leaders are important in science, technology, and innovation and should therefore be actively involved in review activities.
- Private sector participation in funding of research is very low in most developing countries. There is a need to develop incentives to encourage private sector participation in research and involve the private sector in reviews. In Peru, for example, there is a growing realization of the need for seed money to be given to the private sector companies to encourage them to carry out innovation. This is to be coupled with incentives if companies carry out R&D with the help of universities or a consortium of universities.
- Micro-enterprises engage in a lot of innovation for survival. These enterprises are usually not recognized in the S&T policy, which tends to concentrate on the formal sector. Future reviews should give due attention to this sector.

Donor Involvement

- Donor cooperation, although highly desirable, may be difficult to achieve because donors have different interests, mandates, and areas of operations. It may be more effective to publicize the activities of the various donors to enable countries to approach donors whose interests are most closely allied with their own national programs. UNESCO has seed money that can be used to help countries interested in carrying out such reviews and does bring such projects to the attention of other donors. UNESCO could facilitate donor interventions by marshalling expertise, cataloging similar projects, and providing coordination.
- Donor agencies have a number of critical roles to play in building innovation systems in developing countries. These include, but are not limited to: identifying the frontiers of scientific and technological change and sharing their knowledge and

insight with developing countries; developing channels for dialogue between North and South and among actors in the South; strengthening the absorptive capacity of local actors; strengthening centres of excellence in areas of expertise required to build innovation systems; linking these centres of excellence to policy-making processes; and broadening technology transfer to include stimulating and supporting learning to learn and sharing of experiences and knowledge in ways that contribute to the creation of a self-sustaining and self-governing process of choice and change in the developing world.

- Some countries have been more successful than others in attracting foreign funding for review activities. The role and sources of foreign funding should be shared among interested parties. There is a need to consider both donor and foundation inputs because foundations have resources and can handle certain aspects of studies better than donor agencies. Foundations have greater flexibility and are less political in their operations.

Impact

- Although a number of positive impacts were noted in the case studies presented, it is important to be cautious about trying to show a one-to-one allocation of impacts to the implementation of review recommendations.
- With regard to innovation, it was noted that when innovation takes place, other changes or innovations (both upstream or downstream) are likely to be quickly necessary if success is to be achieved and sustained. Therefore, when characterizing the effectiveness of innovative systems, innovation should be viewed as a series or cluster of events, not as a single, isolated activity.
- When waiting for the recommendations from a review to be implemented, donor agencies should exercise “policy patience” because the pace of implementation of recommendations emanating from national reviews has, almost invariably, been characterized as rather “slow” in most countries.
- There is a need to identify baseline indicators to determine policy impacts. It is helpful to construct database/performance indicators to measure progressive impacts of implementation.

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Summary of Day One Presentations and Discussions

A CRITIQUE OF NATIONAL SCIENCE, TECHNOLOGY, AND INNOVATION REVIEWS

Roger Voyer

Introduction

The purpose of this report is to provide a critique of National Science and Technology (S&T) and Innovation Reviews undertaken by the International Development Research Centre (IDRC) and other selected international agencies.

IDRC has been involved in conducting National S&T and Innovation Reviews of developing countries since the early 1990s. The original focus was S&T. The innovation dimension was introduced gradually over time. Given on-going requests for such reviews, IDRC wishes to re-examine where the reviews are going. A number of questions have arisen such as:

- What is the role that IDRC should play in future such reviews?
- What has been the value-added to the host countries in undertaking these reviews?
- Is there another model or another generation of reviews that needs to be considered?
- What other forms of partnerships can be developed to maximize the effect of these reviews?

This report provides a context for addressing these concerns.

The IDRC Reviews

The Methodology

Since the early 1960s, the Organization for Economic Cooperation and Development (OECD) has conducted reviews of member countries' S&T. More recently, it has added

an innovation dimension to these reviews. The reviews have used a well-established, three-step approach:

- Preparation of a background study, providing basic information and data, by the country to be reviewed;
- A set of interviews, conducted by an international team of experts with considerable experience in policies for and the management of science, technology and innovation, with senior people in government, universities and business, designed to provide insights necessary for the preparation of a report which analyses the performance of the country and its institutions;
- A set of discussions, often including public discussions, of the study report, involving members of the study team and interested stakeholders in the country under review.

This OECD methodology has been adapted by IDRC and other international agencies to undertake reviews of developing countries. The five IDRC reviews undertaken so far are presented below.

South Africa

The report *Building A New South Africa: Science and Technology Policy*, published in 1995, is Volume 3 of a four-volume set of reports resulting from a series of missions, held between 1991 and 1995, designed to assist the country in its transition to democracy. These activities were supported by IDRC in partnership with the African National Congress (ANC), the Congress of South African Trade Unions (COSATU) and the South African National Civic Organization (SANCO).

The origins of this review were discussions held by researchers associated with the mass democratic movement following the January 1992 symposium on *The Role of Research in Transforming South Africa* cosponsored by the journal *Transformation* and IDRC. Out of this came discussions among ANC, COSATU, SANCO and IDRC on steps that might be taken to make research policy, and more broadly, S&T policy, the subject of national debate. It was decided that a useful first step would be a review of South Africa's existing S&T policy and the institutions involved.

The mandate of the review was a broad one and centred on the functioning of the research system and on the S&T policies needed to meet the needs of post-apartheid South Africa. The OECD methodology was used with some variations. Firstly, there were discussions to obtain 'buy-in' of the main stakeholders. This was followed by the preparation of background documents by various state institutions on their S&T policies and their implementation. Independent researchers also wrote papers on the functioning of the country's S&T system. This work was carried out in September and October 1992. The second phase, which was interviews in South Africa by the international mission of experts, took place from November 15 to 28, 1992. The third phase involved in meetings between mission members and stakeholders to review the findings on March 4th and 5th, 1993.

Impact of the Review — The process of the review had major impacts in the following ways:

- For the first time the democratic movement interacted with the heads of S&T establishments;
- The review received a great deal of publicity which generated a lot of discussion in the media;
- The review led to the formation of the Department of Arts, Culture, Science and Technology (DACST);
- An immediate follow-up to the review was the formation of the Science and Technology Initiative (STI) to engage stakeholders in discussing directions for S&T policies and priorities. The STI was eventually reconstituted as the National Science and Technology Forum (NSTF) for the purposes of engaging in on-going consultations of S&T issues between the DACST and the scientific community;
- Initiatives in S&T policy research were launched.

These impacts were recognized in an Afterword to the review report by David Kaplan of the University of Cape Town and a member of the team of experts.

With the continued support of IDRC, the ideas generated in this project pervaded government thinking so it is not surprising that they found their way into the government's Green and White Papers on S&T Policy. As well, new ideas generated during the follow-up activities, such as using the concept of the national system of innovation (NSI) as an organizing framework for analysis, found their way into the White Paper which was published in September 1996. In 1998-99, a system wide review of 10 institutions and 2 programs was undertaken which led to restructuring of these organizations. As well, an S&T indicators development program was set in place so as to better measure the performance of the NSI. IDRC spent approximately \$1 million on follow-up activities to the review. The ideas generated by the review and its follow-up are now firmly embedded in government thinking and planning.

China

The report *A Decade of Reform: Science & Technology Policy in China* was published in 1997. The origins of this review go back to a conversation between the Chair of the State Science and Technology Commission (SSTC), Song Jian, and the President of IDRC, Keith Bezanson, held in Beijing in 1994. To mark the 10th anniversary of S&T reforms in China and the 15th anniversary of cooperation between SSTC and IDRC, they decided to jointly commission a review of the Chinese experience of S&T reform using the OECD methodology.

The mandate was a broad review of S&T reforms focussing primarily on those reforms introduced by SSTC in 1985. As well the terms of reference included five specific areas to be reviewed; basic research, high-technology, technological renovation of state-owned enterprises, agricultural research and rural development, environmental

and social development. It is interesting to note that while the focus was on S&T, the notion of a National System of Innovation (NSI) was introduced by the international review team. The OECD has defined the NSI as ‘a network of institutions in the public and private sectors whose activities and actions initiate, import, modify and diffuse new technologies’. As well, a set of six functions, that need to be present from the effective functioning of the NSI, were introduced. They are:

Central government functions;

- policy formulation and resource allocation at the national level,
- regulatory policy making,

Shared functions;

- performance level financing of innovation related activities,
- performance of innovation related activities,
- HRD and capacity building,
- Provision of infrastructure.

The review had three phases. The first phase was the gathering of background information by the government with the assistance of an outside consultant in July 1995. The second phase was the review mission of international experts which took place between November 9th and December 1, 1995. The third phase was the final meeting held in Beijing on May 20-21, 1996. As well, following the Beijing seminar, discussions were held in Shenyang, Xi’an and Shanghai, three cities that were visited in November 1995 by the review mission. The visit to cities other than Beijing brought out some differences. For example, there seemed to be more interest in the NSI concept in the regions than at the national level.

Impact of the Review — In the Foreword to the report, Zhu Li-lan, member of the State Council Leading Group on S&T, and Executive Vice Minister, State S&T Commission, People’s Republic of China noted that even before the final report was officially published, ideas and concepts that emerged during the process had already been integrated into policy formulation.

Zhu Li-lan who was the senior Chinese official involved with the review became Minister of S&T and was therefore able to follow-up directly on the recommendations of the report. The report was presented to the Leading Group on S&T, which is chaired by the Prime Minister, and two initiatives were retained for further evaluation.

Firstly, it was decided to investigate the notion of the NSI. A set of studies was undertaken at both the national and provincial levels to structure the NSI. The NSI has now become embedded in policy considerations in China.

Secondly, it was decided to develop a strategy for international collaboration. An Advisory Committee was established which included two members of the International

Review Team. Several background studies were undertaken and an international conference sponsored by IDRC was held to help define directions for the strategy.

For a time following the original study, the Chinese wanted to establish their own IDRC for both internal and external needs. More recent thinking has led to favouring a US model, that of the New York Academy of Sciences.

Vietnam

The report *Vietnam at the Crossroads: The Role of Science and Technology* was published in 1999. The idea for this review stemmed from a conversation in January 1997 between Dr Pham Gia Khiem, Minister of Science, Technology and Environment, and Dr Keith Bezanson, then President of IDRC.

This review differed from others in that the principal objective was to contribute directly to preparing a long term S&T strategy up to 2020 and as such was more prescriptive than other reviews. The review process was specifically linked to the production of a new national policy which was to appear in 1998. (The preparation of the document on which the national policy is to be based was completed by the State Council on S&T at the end of June 2002, and subsequently submitted to the Prime Minister). The review was asked to address seven specific topics:

- Technology import to provide the technological capabilities of enterprises;
- Research and application of high-technology in economic sectors;
- S&T for agricultural and rural development;
- Basic research;
- Training, education, and use of S&T human resources;
- The research and development (R&D) institutional network; and
- A system of agencies responsible for S&T management.

The first phase of the review involving the gathering of background information was truncated because of the lack of such materials. Emphasis was placed on the second phase, that is getting the views of as many stakeholders as possible by the international review team. The Vietnamese government appointed the National Institute for Science and Technology Policy and Strategy Studies (NISTPASS) as the Vietnamese counterpart to the review. As well, the international review team provided the services of two outside consultants to give training courses related to the development of a long term S&T strategy. The second phase review by the international team took place in a three- week period, from September 14th to October 4th, 1997. The third phase, the return visit took place in February 1998.

While the focus was on S&T, the NSI concept and the accompanying set of functions were also introduced in this review.

Because of the link between the review and the development of a long-term strategy,

the international review team saw this review more as a consulting study than as a traditional OECD review or previous IDRC reviews.

Impact of the Review — The report remained within NISTPASS and did not receive wider distribution until IDRC published the report in January 1999. IDRC continued to support related activities such as a Vietnamese visit to Canada to study S&T organizations. This visit led to establishment of a S&T Granting Council (the Council still has to receive funding). However, this initiative is an indication that a new model of science is emerging based on distributed responsibilities rather than the previous ‘top-down’ approach.

IDRC sponsored a follow-up study of Viet Nam’s approach to international S&T collaboration. Elements of the report have found their way into the just completed long term S&T strategy document (e.g.-reorganizing S&T institutes to respond to local needs). There was also a follow-up mission to the report focussing on technology and industry strategy, sponsored by the United Nations, involving two members of the International Review Team.

Chile

The report *Science, Technology, and Innovation in Chile* was published in 2000. The origins of the review go back to agreement reached in August 1997, at the time of the APEC meeting in Vancouver, between the President of Chile and the Prime Minister of Canada to undertake a joint review of Chile’s S&T and Innovation (STI) policies. The project was jointly funded by IDRC and the Chilean National Council for Science and Technology (CONICYT) and managed by IDRC.

The terms of reference for the review, which were developed in March 1998 were fairly specific and related to an assessment of the policies and mechanisms of CONICYT in promoting the development and application of S&T in Chile within the policy and institutional environment in which the agency operates.

The OECD methodology was used in this review and the NSI was used explicitly as the analytical framework for the analysis. As well the set of functions for the NSI were used for analytical purposes. The international review team visited Chile between August 3rd and 15th, 1998 and returned in January 1999 for the review meeting with Chilean stakeholders.

Impact of the Review — The review highlighted the problems related to the structuring of S&T activities in Chile. The report was distributed to some 2000 people involved in S&T. One copy went to Presidential candidate Ricardo Lagos, now President, and it was used by his commission of S&T as a base for his program. The report is now a reference document on science policy within the scientific community. A follow-up study was undertaken of publicly funded S&T institutions.

Jordan

The final manuscript of the report Science, Technology and Innovation: Policies and Programs in Jordan was submitted on May 28, 2002. Publication is yet to come. The origins of the study go back to discussions between the Chairman of Jordan's Higher Council for Science and Technology (HCST), H.R.H. Prince Hassan and IDRC in 1999.

The terms of reference for the activity centred on a review of the policies, programs, priorities, institutions and policy instruments managed by the HCST and the policy and institutional environment in which it is situated.

A modified OECD methodology was used:

- a preliminary background was commissioned from an outside consultant to provide a basis upon which future IDRC financial contributions might be negotiated between HCST and IDRC. This study was carried out in October 2000;
- based on this study the international review team was established. The team prepared a series of questionnaires and interview guides which were collected during the team's visit to Jordan between June 16th and June 28th 2001;
- a report was drafted and submitted for comment to the HCST on July 19th 2001;
- a revised report was presented by the team leader to the HCST Vice –Chairman, Secretary General and heads of HCST associated centres in Amman on November 19th 2001.
- a final version of the report was submitted to the HCST on May 28th. 2002.

The NSI concept and the set of related functions were used as the framework for the analysis in this review.

Impact of the Review — The report referred to the 'missing function' of the Higher Council, that is the function of being a policy forum where ministers could deliberate on issues of technical. It is still too early to gauge the impact of this review but indications are that some restructuring will take place.

Observations

A summary on the time-lines and mandates of these five reviews can be found in Table 1.

The following observations can be made regarding the five IDRC reviews:

- There was generally a high level of satisfaction by the client country and the reviews did influence thinking and decision-making. Client satisfaction and impact/influence are two important criteria in assessing the value of the reviews;
- The origins of the reviews were of an ad hoc nature and were taken at a very high level (heads of state/senior officials). Initially, there was no expectation that there would be on-going requests for reviews;

Table 1: Summary of Timelines and Mandates for the Reviews.

Review	Origins	Mandate	Background Report	Expert Team Visit	Review Meeting	Publication
South Africa	Jan. 1992	Broad S&T policy review prepared by country reps	Sept–Oct 1992;	15–28 Nov 1992	4–5 Mar	1995
China	1994	Focus on S&T reform since 1985	July 1995; prepared by country	9 Nov to 1 Dec 1995	20–21 May 1996	1997
Vietnam	Jan 1997	To provide government with long-term S&T strategy	Truncated	14 Sept to 4 Oct 1997	Feb 1998	1999
Chile	Aug 1997	Focus on CONICYT S&T policies and its institutional context	None	3–15 Aug 1998	Jan 1999	2000
Jordan	1999	Focus on HCST S&T polices and its institutional context	Oct 2000; prepared by outside consultant	16–28 June 2001	None; draft report submitted 19 July; revised doc. presented 19 Nov 2001	Final doc. submitted 28 May 2002, publication to come

- The mandates ranged from broad reviews of S&T policies to reviews focussing on the activities of particular S&T agencies within a broader S&T policy context;
- An innovation focus found its way into the reviews early on. The NSI concept was introduced in the Chinese and Vietnamese reviews and became the explicit organizing framework in the Chilean and Jordanian reviews as reflected in the inclusion of the word ‘innovation’ in the titles of these latter two reviews. As well, a set of functions related to the effective functioning an NSI was introduced;
- While there was a shift of focus from S&T to innovation in the reviews the mix of the international review teams did not change. The teams were made up of consultants, academics and government officials but no business people were included. It was also noted in the Chilean review that there was “the lack of any widespread commentary from the private sector” (p 123);
- The time-line for the reviews was approximately three years from initial agreement to publication. The exception was the Vietnamese review which took about two years. There was a sense of urgency with the Vietnamese review because it was linked directly to the preparation of a long-term S&T strategy;
- The fieldwork by the international review teams took from two to three weeks;
- The OECD methodology was adapted to suit particular circumstances. For example

in one case an outside consultant prepared the background report and in two other cases there was little organized background information. As well, in the Jordanian review the final review meeting was limited to a presentation by the international team leader to a few heads of agencies. On the other hand, the final review meeting for the Chinese review took place in Beijing and three other cities which permitted getting a regional perspective as well as a central one;

- The South African and Chinese studies led to important follow-up activities. They were cases of “being at the right place at the right time”; i.e. South Africa was preparing its post-apartheid regime and in China the senior Chinese official who received the report became the Minister of Science and Technology;
- In some instances, members of the review team became involved in follow-up activities.

Experiences of Other Selected International Agencies

United Nations Educational, Scientific and Cultural Organization (UNESCO)

UNESCO's science policy program has a country review component. Examples of activities include:

- the Government of Albania has sought the assistance of UNESCO in the creation of an efficient system for science and technology (S&T) capable of making a leading contribution to the economic and social development of the country and also integrating Albania into the mainstream of the world economy. UNESCO fielded a mission in July 1996 for the provision of advice on four topics: the formulation of a national S&T policy; international relations in S&T; Science and Technology Statistics and the formulation of a science budget for the Government of Albania.
- UNESCO provided financial and technical assistance to the University of Namibia for the elaboration of a national S&T policy. The policy study conducted by the University's Multidisciplinary Centre culminated in the organisation of an international workshop on the Management of Science and Technology in Namibia.
- UNESCO held a workshop in April 2002 on S&T policy in Bahrain. A report based on that workshop is forthcoming.

Such activities fit into UNESCO's mandate which is to “assist Member States in drawing up strategic plans, conduct sectoral analysis and formulate policies for the development of their scientific research programmes and institutions.”

In January 2001, UNESCO published guidelines for country reviews in a document entitled A Prospectus for the conduct of S&T Policy Reviews for African States. The document outlines a simple methodology that could be used in African States to conduct a first, rapid analysis of the present state of S&T activities within their borders and to lay the groundwork for key decisions to be taken. The methodology uses a structured framework of a ‘national system of innovation’ to allow an appreciation of

the current interactions among policies, programs and organisations within the state and to permit the elaboration of practical steps which might be taken to improve the way in which S&T are being used to promote economic and social development. This methodology is the following:

- review of the existing national priorities of the client country, including those relating to S&T;
- elaboration of the concept of a national system of innovation in the specific context of the client country;
- identification of ‘stakeholders’ - both public and private- in the client country and of the structure of scientific and technological activities in the country;
- identification, in discussion with the client government, of the existing policy areas to be the subject of review (e.g. support to R&D, support to training of scientific and technological personnel, ...);
- review, in detail, of any policy documents or government statements with respect to S&T policy;
- review of processes available to produce and update statements of governmental policy for S&T;
- review of the client country's international S&T relations (both bilateral and multi-lateral, and the relationship of these activities to overall national priorities);
- elaboration of the concept of a “science” budget, and the requirements to produce a budget useful for Ministerial decision- making;
- elaboration of the need for “science indicators” and the steps needed to produce them.

The review is carried out by means of an intensive set of structured interviews with key stakeholders in the country's national system of innovation. In most countries, a review could be formulated in a way in which execution could be carried out in two full weeks by a two-person team; that team would lead an in-country seminar prior (to discuss preliminary impressions) to departure at the end of the field work; the team would provide a written, interim report prior to leaving the country at the end of field work; the team would provide a full written report within one month of the completion of the field work. (For an example of the type of output to be expected, see The Development of Albanian S&T Policy - A Report to the Ministry of Higher Education and Scientific Research of the Government of Albania, financed by UNESCO and UNDP, August 1996)

Adhering to such a schedule is dependent on the client government being able:

- to provide documentation (in either English or French) concerning existing policies and institutions relevant to the review;
- to set up an intensive set of interviews for the international consultants (typically three or four interviews per day for each consultant for at least seven of the days during which they are on mission) and
- to assign a competent local liaison officer to work with the consultants.

This methodology differs from the OECD/IDRC methodology in at least six ways:

- no background document is prepared;
- a two person review team is proposed;
- the execution is carried out in two weeks;
- the team would lead an in-country seminar on findings before leaving the country. It does not return for a final review meeting;
- the team provides an interim report prior to leaving the country;
- the team provides a full report within one month of completion of the field work.

This methodology puts a lot of pressure on the review team in very short space of time. The advantage is that the review is completed in a short period of time; delays in submitting final reports have been a criticism of OECD reviews.

Organization for Economic Cooperation and Development (OECD)

The OECD pioneered the methodology of National S&T Reviews. OECD reviews have their origins in examination procedures which became established at the time of the OEEC (Organization for European Economic Co-operation) in relation to the implementation of the Marshall Plan. With the creation of the OECD in 1960, countries wished to look at international experience and profit by the success and failure of the policies of others.

Its first review was of Sweden in 1963. Since then most member countries and some non-member countries have been reviewed, some twice. The OECD has undertaken two assessments of these reviews, one in 1986 and the other in 1995. A list of the countries reviewed up can be found in Table 2. The following are pertinent points taken from the two summary reports of the meetings where the assessments were discussed.

The 1986 Meeting

The following relevant factors were highlighted at this meeting:

- Innovation was starting to appear as area of interest. There was divergence of opinion on whether or not to include this concept in the reviews. Some wanted to focus on the early stages of the R&D process (e.g.-the research system) while others emphasized that innovation policy is not an additional policy to R&D policy. It was agreed that country requirements should guide the selection of a framework for analysis;
- It was emphasized that regional aspects within countries needed special attention;

Table 2: OECD S&T and Innovation Reviews to Date.

<i>National S&T Reviews</i>			
Sweden	1963	Iceland	1981
Greece	1964	Greece	1983
Belgium	1965	Norway	1983
France	1965	Portugal	1984
Germany	1965	Australia	1985
United Kingdom	1965	Finland	1986
Japan	1966	Netherlands	1986
United States	1968	Sweden	1986
Italy	1968	Austria	1987
Canada	1969	Switzerland	1989
Norway	1969	Italy	1989
Austria	1969	Iceland	1992
Spain	1970	Hungary	1992
Switzerland	1971	Denmark	1994
Iceland	1971	Mexico	1994
Netherlands	1972	Russia	1994
Ireland	1973	Turkey	1995
Yugoslavia	1973	Poland	1996
Australia	1974	Korea	1996

<i>National and Regional Innovation Policies Reviews</i>	
Ireland	1985
France	1986
Spain	1986
Canada's Western Provinces	1986

- It was agreed that the reviews were useful and that their basic structure should be maintained. In this context the country under review is in the best position to prepare the background report. The work of the examiners was considered to be satisfactory but, since governments select the interviewees the sample could be skewed and a broader representation should be aimed for. (The examiner teams included industry experts in some reviews as well as consultants, academics and government officials). Also the review meeting should be held shortly after the visit of the international examiner team. A follow-up mechanism to the report should be established.
- The presence of one or more members of the Secretariat was considered not only beneficial but also essential to provide information, advice and help with the various negotiations or compromises necessary for the success of a review.

The 1995 Meeting

There were two main recommendations from this meeting: to continue Country Reviews of both member and non-member countries on a voluntary basis according to an improved and streamlined process; and to initiate Thematic Reviews of specialized aspects of science and technology policies to explore these themes in more depth and allow comparison of a few countries.

The following recommendations were made for improving the review process:

- Country reviews are valuable and should continue to be conducted on a voluntary basis; reviews of non-member countries should be encouraged particularly for those of special interest to the Committee on Science and Technology Policy (CSTP);
- Country reviews should result in a single report prepared by the Secretariat (combining the background report, examiners' report and results of the review meeting); the country under review should provide input to a more limited background report; the preparation and publication of the review should be streamlined;
- Greater involvement of CSTP delegates in the review process should be encouraged by including one CSTP delegate on the review team and holding final review meetings in conjunction with CSTP meetings; and
- Countries, which have been reviewed, should provide the CSTP with a report on outcomes within a year of the review meeting.

Other pertinent points made at this meeting were:

- Good statistical information was recognized as an important starting point. Several countries advocated greater involvement of the Secretariat in the preparation of the Background and Examiners Reports, while others spoke of the benefits derived by preparing their own Background Report even though this involved a large commitment of resources. These reports should target a wider audience and not just government officials;
- The knowledge of national science and technology systems by review teams had sometimes been rather limited. The short time allocated to visits by the review team was also a subject of concern, although it was noted that a good Background Report helped to overcome the problem;
- Several countries felt that their reviews had taken too long to complete and concern was expressed about delays in publication;
- Interest was expressed in regional reviews within countries;
- Requests by member countries for reviews have been declining in recent years.

A background paper prepared by the Secretariat for this meeting made the following observation: *In the mid 1980s a number of countries applied for an innovation policy review; this reflected a new concept put forward by the Secretariat at that time which focused on a country's technical and industrial development potential & These reviews were in fact broader than those for science and technology policies proper and called into question certain aspects of industrial, educational and financial poli-*

cies, for example. The difficulty in identifying a clear demand for these reviews on account of their across-the-board nature and the lack of specific institutional 'clients' led to the invention of science, technology and innovation policy reviews. This has meant that innovation is addressed rather narrowly as an adjunct to science and technology policies, rather than in its broadest sense. On the whole, this reduced scope does not seem to have affected the results anticipated by those commissioning the reviews.

Since 1995 only two country reviews have been undertaken, those of Poland and Korea, two countries seeking membership in the OECD. No thematic reviews have been undertaken. S&T reviews appear to have a low priority among OECD members.

Another approach seems to be emerging. The 1998 economic review of France included a chapter on S&T. Tying S&T and innovation policy to economic reviews could possibly be a way of moving forward.

United Nations Conference on Trade and Development (UNCTAD)

UNCTAD country reviews were triggered by a request from the Economic and Social Council (ECOSOC) in 1995. The purpose of science, technology and innovation policy (STIP) reviews is to enable participating countries to evaluate the effectiveness of their S&T system by the economic performance of their national enterprises, namely the manner in which the S&T outputs have been converted into increased wealth by the productive sector and the extent to which this increased wealth has led to improved quality of life for the citizens of those countries.

UNCTAD undertakes STIP reviews using the OECD methodology and the NSI concept as the organizing framework for its country reviews. A review is undertaken at the request of a UN member state, expressed in a letter to the Secretary-General of UNCTAD. Once launched, the national authorities prepare a background report, the international review team prepares an evaluation report following its visit and a Round Table meeting is held in the country under review. The background report, the review team's report and a summary account of the Round table meeting are compiled and published in a single volume.

To date, UNCTAD has published three country reviews. The experience related to these reviews is as follows:

- **Colombia:** This first review was undertaken in 1995-1997 and the report was published in 1999. Many of the recommendations have been or are being implemented. The responses of both the public and private sectors to this exercise have been positive. The review engendered a large scale S&T program;
- **Jamaica:** This review was undertaken in 1997-1998 and the report was published in 1999. A number of recommendations have been adopted, particularly in the information technology sector. As a follow-up to the review, a subregional project entitled 'Becoming a global player: opportunities in the music industry for develop-

ing countries' has been initiated. Several other Caribbean countries, including Cuba and Trinidad and Tobago, have shown interest in this project. The review has led to interventions on intellectual property at WIPO;

- **Ethiopia:** This review was initiated in 1997 and the report published in 2002. This review integrated investment with innovation policy.

These reviews apparently worked well because of the 'buy-in' by the client governments and close collaboration between the governments and the UNCTAD Secretariat. The reviews led to institutional reforms. On the negative side there were at times problems with the review team (e.g., not having people with the right skills, not enough time for visits, difficulty in having the review team together at the same time for country visits). As well, the editing of the review reports by the Secretariat was felt by some to have altered the views expressed.

An important spill-over of these studies is the fact that UNCTAD officials responsible for investment were influenced by these reviews and the use of the NSI concept, such that the most recent review was titled Investment and Innovation Policy Review of Ethiopia.

There have been recent requests for reviews (e.g., Peru, Iran), but there is currently a hiatus in this kind of activity at UNCTAD largely because of funding problems. Also, there is a perception that science, technology and innovation policy is too complicated and academic. As well, staff members associated with the reviews have moved on. The program is being repositioned. It is easier to get funding for investment reviews so STIP reviews could possibly become associated with these. The Ethiopian review had an investment focus as well as an innovation focus. As well, a recent investment review of Tanzania had a chapter on S&T policy. Another option being looked at is a focused sectoral approach.

Inter-American Development Bank (IDB)

The IDB now undertakes reviews, using the OECD approach, to provide inputs into its assessments of loans to develop science, technology and innovation infrastructure. The NSI concept is used as the organizing framework in these analyses. Completed reviews include El Salvador, Guatemala and Venezuela with one of Peru is in the offing. These reviews are not published independently of the loan announcements.

The reviews fit into the IDB's policy and strategy of supporting the development of national S&T policies which is stated as follows: *The Bank should at all times support the initiation of a national science and technology policy, one of the objectives of which should be to integrate scientific and technological development with overall national development policies and plans.*

A main element of the Bank's strategy is to use a systems approach. As stated in a recent strategy document: *The Bank's analytical work has improved over time. Until*

recently it lacked a systems approach, especially with regard to linkages and to the articulation of comprehensive policies & future project analytical work would need to examine the NSI as a whole, with emphases on national, regional and international linkages, interchanges, institutional development, policy reforms, knowledge utilization, and technological needs of small and medium sized enterprises; and program documents also would need to have more clearly defined goals, benchmarks, and means of measuring success.

L'Institut de recherche pour le développement (IRD)

The IRD is a French public science and technology research institute under the joint authority of the French ministries in charge of research and overseas development. The IRD has three main missions: research, consultancy and training. It conducts scientific programs contributing to the sustainable development of the countries of the South, with an emphasis on the relationship between man and the environment.

The IRD has recently undertaken a two-year study of the status of science in 15 African countries. The project was called 'La science en Afrique à l'aube du 21ème siècle'. The final synthesis report was published December 21st, 2000. A four-part methodology was used for this study:

- A bibliometric study of scientific output (1989-1999) permitting the comparison among countries of volume, trends, domains of emphasis, strong and weak points of scientific publications;
- A questionnaire addressed to 1,500 researchers aimed at getting an understanding of the evolution of the profession and its financing;
- A study in each country of the genesis of their research systems and of related reforms, either undertaken or planned;
- Interviews with researchers and administrators in each country to better understand the dynamics of their research systems

Some 30 people were involved in the preparation of this study. The focus of analysis is the research system concept.

World Bank Institute (WBI)

The WBI undertakes assessments of countries economies and their potential for innovation. The approach differs from that used by the OECD and IDRC, but a description of the program is presented here because of the focus on science, technology and innovation, the use of the concept of an innovation system, and the fact that the studies are undertaken in co-operation with client countries.

The main goal of WBI's program on Knowledge for Development (K4D) is to create capability in client countries to take advantage of the new opportunities raised by the knowledge revolution; in effect, building the knowledge dimension into their development strategy. This is done by analyzing/taking stock of how well-positioned our clients are to take advantage of the knowledge economy. Based on this conceptual analysis, the program works with them to develop concrete strategies that can be

implemented, taking into account issues of political economy, governance and the need to build stakeholder ownership.

This program consists of courses, policy services, strategic advice, and the promotion of knowledge networks and communities of practice to help high-level decision makers and private sector and civil society representatives in interested client countries to cope with the challenge of the knowledge revolution in a dynamic and increasingly interconnected world. A critical focus is also to address the risk of the 'knowledge divide' and to focus explicitly on the use of knowledge to develop sustainable strategies that particularly address the needs of the poor.

The program has also developed the following framework to help countries articulate strategies for their transition to a knowledge-based economy:

- An economic and institutional regime to provide incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship.
- An educated and skilled population to create, share, and use knowledge well.
- A dynamic information infrastructure to facilitate the effective communication, dissemination, and processing of information.
- An efficient innovation system of firms, research centres, universities, consultants, and other organizations to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.

Recent work that use this framework include reports on China and the Knowledge Economy: Seizing the 21st Century and Korea and the Knowledge-based Economy: Making the Transition.

European Commission Sponsored Studies

In 1997, the European Commission (EC) formulated a policy for supporting efforts to engage in a policy dialogue on research, technology for development (RTD) reform to assist in its aid programs. The European Centre for Development Policy Management in Maastricht (ECDPM) was chosen by the EC to help prepare the ground for this policy dialogue on RDT reform, and to develop a replicable framework of objectives, structure and work procedures within which the various actors can meet. A methodological framework was developed around four basic elements:

- The activity, i.e., an ongoing, open learning process;
- The actors, i.e., the RTD stakeholders and their mutual power relations;
- The content, i.e., the issues that are being addressed;
- The level, i.e., intra-national, inter-regional and/or inter-national.

Since the focus was on dialogue, seminars, workshops, round tables and other face-to-face mechanisms that brought stakeholders together were important tools. These four basic elements were used to structure the Terms of Reference for reviews of Ghana, Senegal, Uganda and Vietnam. Reports on these countries were published in 2000, and an evaluation of their impact is currently underway.

Observations

The following observations can be made:

- The OECD, which pioneered the country S&T review process, has undertaken numerous reviews since 1963, but demand has weakened in recent years;
- OECD reviews added an innovation component to its S&T reviews because there was no clear client base for innovation reviews per se;
- While IDRC initiated national S&T reviews of developing countries in the early 1990s, there are now several other organizations undertaking such reviews;
- The OECD methodology is used, with some adaptations, by these organizations except for the EC, IRD and WBI;
- The NSI is the organizing framework for the reviews (the focus for the IRD study was the country's research system while that of the EC is on research and technology);
- The visits by the international experts get mixed evaluations;
- Other approaches to reviews are being explored (e.g., tying S&T and innovation reviews to economic reviews; sectoral reviews; regional reviews).

Discussion

Two panel discussions were held during the workshop to examine the use of national reviews. The first examined country responses to reviews of their S&T systems that had been conducted by IDRC and UNCTAD. Presentations on the followup to reviews in South Africa, Jamaica, and Vietnam preceded a discussion session. The second panel looked at the expectations of countries that were considering, or in the midst of, reviews. Four papers from Peru, Senegal, Lebanon, and Mozambique provided the basis for discussion.

PANEL 1: NATIONAL RESPONSES

South Africa (IDRC sponsored) – Presented by Hendric Marçais

In 1992, IDRC co-sponsored a symposium on *The Role of Research in Transforming South Africa*, which led to discussions among ANC, COSATU, SANCO, and IDRC on how to make research policy, and more broadly, S&T policy, the subject of national debate. Later that year, the Tripartite coalition (ANC, COSATU, and SANCO), which was involved with the democratic movement, sought IDRC support to carry out a review of the S&T system. The study's mandate was to examine the research system and the S&T policies that would be needed to meet the needs of post-apartheid South Africa.

The review, which followed the OECD methodology, was carried out between September 1992 and March 1993 and was well received by both the scientific community and the ANC-led democratic government that took over in 1994. Therefore, the policy review was initiated by a “government-in-waiting” and implemented by the same people.

Some of the strategic issues addressed in the review were: innovation; affirmative action; gender; and government size and S&T. The review led to: the formation of the Department of Arts, Culture, Science and Technology (DACST); the formation, first of the Science and Technology Initiative (STI) and later the National Science and Technology Forum (NSTF), to engage stakeholders in discussing directions for S&T policies and priorities; and the launching of initiatives in S&T policy research. With continued support from IDRC, new ideas, such as using the concept of a national system of innovation (NSI) as the organizing framework for analysis, found their way into the government's 1995 Green Paper on Science and Technology and the country's White Paper on Science and Technology adopted as government policy and endorsed by Parliament in late 1996.

The White Paper on S&T was well received by all stakeholders and considered both to be realistic and to reflect national priorities. Out of the White Paper emerged a system-wide review of government science, engineering, and technology institutions (SETIs) that led to the restructuring of 10 institutions and 2 programs. A program was also set in place to develop S&T indicators to measure the performance of the NSI. The post-review period also witnessed the establishment of a National Advisory Council on Innovation, the creation of an Innovation Fund, and the reorganization of the support to research in the universities under a new National Research Foundation. The largest public technological institute, CSIR, responded by establishing a process that led in the short term to the creation of two experimental “Manufacturing Advisory Centres” to provide extension services to SMEs. This program is on-going, and there are now nine centres operated by the NAMAC Trust.

Implementation of the review recommendations faced the twin problem of inadequate human resources and finance. Future reviews should note:

- Political context cannot be underestimated when initiating a review.

- The underlying purpose of a review is very important.
- Level of satisfaction with the status quo must be considered if change is to be implemented.
- The underlying strength of the country itself must be considered.
- Implementability of the recommendations must be considered. In other words, start with the end in mind.
- Evaluation must consider the specific context of the country.

Jamaica (UNCTAD-sponsored) – Presented by Arnoldo Ventura

A science, technology, and innovation policy (STIP) review was undertaken in 1997–1998 by UNCTAD using the OECD methodology and the National System of Innovation (NSI) concept as the organizing framework. The review, which focussed on agro-industry and information and communication technologies (ICT), was published in 1999 and well received. One of the main reasons for its success was the fact that the review followed, and was guided by, an intense national industrial policy process, which provided insights into sectoral analysis and was crucial in setting priorities for action.

The STIP review revealed organizational weaknesses in the S&T sectors that were investigated and provided new insights into how to stimulate growth and help transform how these sectors contributed to the national economy. The National Commission on Science and Technology (NCST), the main local architect for the review, used the report to solidify confidence among members of the S&T community, the political decision-making machinery, and the private sector, in its coordinating and advisory work. This made it easier for NCST to promote the absorption of new technologies and to pursue efforts to foster S&T development and applications.

Private – public sector partnerships and greater integration within R&D institutions were advocated. These are now occurring. New higher skilled jobs have been created, and efforts to increase production and productivity in traditional sectors, using new methods, have been more widely accepted, even among members of the informal and small-scale sectors.

Following the review, the government declared that the agro-industrial and ICT sectors were major national priorities and that their development was centred on innovation, deployment of both domestic and foreign R&D results, transfer of technology, and harnessing of information for manufacturing and service. Basically, a shift in emphasis from market access to market penetration was advocated. Steps were also taken to harness the potential of the Internet, especially as it relates to strengthening links between research and extension, in agriculture, the music industry, and a variety of small-scale industrial applications. In agriculture, this anticipated innovation is crucial to small farmers in their efforts to obtain adequately priced, quality inputs, and to identify and reach both local and foreign markets. New institutions and firms were expected to enter the market to deliver innovative products in the ICT sector.

As a follow-up to the review, a subregional project entitled *Becoming a Global Player: Opportunities in the Music Industry for Developing Countries* has been initiated. Several other Caribbean countries, including Cuba and Trinidad and Tobago, have shown interest in this project. The review has led to interventions on intellectual property at WIPO.

Several lessons were identified from this review:

- After an important innovation takes place, other innovations, upstream or downstream of the original one, quickly become necessary if success is to be achieved and sustained. In characterizing the effectiveness of innovative systems, we should therefore be talking about innovation series or clusters, and not just an innovation event in one activity or place.
- R&D and technological collaboration among enterprises, and interactions among businesses, universities, and R&D institutions to increase technological spread and performance, are crucial imperatives for achieving innovations.
- To improve the economic environment for innovation, the responsibilities and capabilities of the private sector need radical change. The building of an effective innovation system requires the deliberate and calculated inclusion of domestic knowledge and skills in private sector operations.
- Weaker sections of the formal private sector, and their informal counterparts, must link with the knowledge generating capacity of their local S&T systems while the S&T community must be willing to respond in what may seem to be less high profile or rewarding endeavours.
- Risk and venture capital, and how to allocate, monitor, and ensure their proper use are components of the innovation system that need dedicated attention at the review stage.
- The bidding process for projects in developing countries tends to shift emphasis away from S&T and timely innovation to classical economic cost-effectiveness. The process often turns up less competent innovators thereby dampening the innovation system. This calls for the development of capability to attract the best innovators for innovative-type projects and learning how to balance risk with innovative possibilities.
- Because competition, and the development it fosters, is not a one-off process, the challenge is to keep a continuous process of innovations going. This cannot be done without a functioning local innovation system.

Vietnam (IDRC-sponsored) – Presented by Tran Ngo Ca

This study was initiated in 1997 by the Minister of Science and Technology after meeting the President of IDRC. The study was designed to contribute to S&T strategy to year 2020, which was first drafted in 1996. The review was conducted by an international team of six experts. The National Institute for Science and Technology Policy and Strategy Studies (NISTPASS) was the Vietnamese counterpart. Two additional international experts provided support in the forms of training on methodology for strategy making and on STI policy.

The review was expected to address seven specific topics: technology import to provide the technological capabilities of enterprises; research and application of high-technology in economic sectors; S&T for agricultural and rural development; basic research; training, education, and use of S&T human resources; R&D institutional framework; and a system of agencies responsible for S&T management. The review team met with representatives from some 70 organizations, institutions, departments, firms, and associations and some 320 Vietnamese S&T policymakers, policy implementers, and other stakeholders.

The review contained 16 recommendations in the following areas:

- A possible fast track for improving coherence in S&T policy.
- Review of Vietnam's four high-tech research programs.
- Revision of S&T Law.
- Accelerating S&T reform to build Centre of Excellence.
- The problem of an aging scientific community.
- A Vietnam Science and Engineering Foundation (VISEF).
- Measures to facilitate acquisition and assimilation of technologies.
- Constructing S&T innovation policy.
- International collaboration in a long-term S&T strategy.
- Women's participation rate in S&T.
- Techno-management program (TMP).
- Instruments to promote economic transformation.
- Widespread use of the Internet.
- Pilot program to bring IT to communities in the Mekong Delta.
- Streamlining criteria for decisions on high-tech parks.
- Creating an observatory for S&T and innovation

The publication of the English version of the report *Vietnam at the Crossroads* generated mixed feelings arising from different interpretations of the title by the stakeholders. This led to the non-publication of the Vietnamese version of the report and the suggestion of the presenter, Tran Ngo Ca, that in carrying out national reviews in future, those involved should pay due attention to factors of history and culture of the people concerned. In spite of the mixed reactions precipitated by the title of report, several recommendations of the review were followed up and some implemented, notable among which are:

- Direct input into the preparation of the S&T Strategy 2010.
- Document as well as the 5-year Socio-Economic Plans.
- The establishment of 16 focused laboratories.
- Revision of the country's S&T Law.
- Establishment of Vietnamese Science and Engineering Foundation.
- Incorporation of some elements of technology management in the curricula of some universities.
- The application of the concept of Technology Foresight as a tool for forward-looking strategic decision-making in the economic sector (e.g., in food processing).
- Greater emphasis on SMEs in the productive sector.

Furthermore, two members of the Review Team participated in handling the STI component of the SIDA/UNDP sponsored project on the drafting of the Socio- Economic Development Strategy till year 2010 hosted by the Ministry Planning and Investment (MPI). Recommendations of the earlier Review in the areas of S&T application to agriculture, high-tech development, and support of technology innovation in SMEs were further reinforced and accepted by MPI in the preparation of the Socio-Economic Development Document for the country. The review also served as catalyst for the government efforts, with possible support of IDRC, toward the development of international cooperation in science and technology (ICST).

For future review exercises, Tran Ngo Ca advocated:

- The need to pay attention to the cultural realities of the nation being reviewed.
- What can be described as “policy patience” on the part of donor agencies, vis-a-vis the expected pace of implementation of recommendations emanating from national reviews and the realities in most countries which have, almost invariably, been characterised by rather “slow” pace.
- The need for focussed sectoral studies at micro-level to complement most national reviews which have tended to concentrate on issues at the macro-level.
- The need for active involvement of local experts in partnership with external experts in carrying out national reviews.

Discussion Summary

In initiating the discussion, Geoff Oldham made several comments and observations:

- Reviews have been initiated in different ways in the countries involved. In China, the President of IDRC and the Minister of S&T China were involved. In Vietnam, the Minister of S&T in Vietnam saw the review report for China and wanted something similar. In Jamaica, the Science Adviser to the Minister of S&T brokered the idea of a review.
- There is need to be programmatic in conducting reviews.
- On methodology he noted the following:
 - No initial country overarching review report on S&T to go by in most cases as expected within the framework of the OECD methodology.
 - Scope varied from country to country as well as the terms of reference for the review and the team composition. In respect of the latter, China demanded four members be drawn from industrialized economies. It was a balanced situation in the case of South Africa with the choice of team involving the donor, the agency carrying out the review and the country.
 - Reports were basically joint efforts although in the case of Vietnam the Minister asked for recommendations by reviewers to be provocative, if need be. [The report probably became too provocative as noted earlier].
- In respect of impacts of reviews, he noted the following:
 - In the case of China, the S&T Commission brought hundreds of people to discuss

S&T matter. The people in the provinces received the report well while in Beijing government people were more on the defensive. However the country was interested in innovations, international collaboration, long-term training strategy on collaboration, and joining OECD as observer on S&T.

- In South Africa although it was not easy to isolate the exact impact of the review, it, however, did catalyse a process which involved dialogues by the stakeholders.

Following these introductory comments, the participants discussed the issues raised in the various papers. The main points raised were:

- The review process is very important as are the factors informing the conduct of the exercise for a country.
- Information collection is very important to the process although not sufficiently highlighted in the presentations.
- There is a need to build local capacity most especially analytical capacity outside government for policy analysis. It was noted that although the South African review contained such recommendation to involve, for example, the University of Cape Town and others, it has apparently not been implemented.
- Macro-economic components — explicit and implicit — should be integrated to future S&T policy reviews. This calls for an integrated approach involving, for example, S&T, Economics and Investment.
- The educational sector, particularly the formal sector, is very important although not included in most of the reviews carried out. It is now very important.
- There are other ways such as Policy Reforms as opposed to Policy Reviews.
- There are needs for better international cooperation, better communication, and understanding of the innovation system, most especially at the micro level.
- Access, through ICT, to the knowledge/information super highway is very important.
- National Strategy vs. National System linking both the users and developers should be seen from bottom up.
- Every country should supplement Donor Review with their own indigenous policy making exercise.
- Review should be based on digesting what the national experts have to say before preparing the review report.

PANEL 2: NATIONAL EXPECTATIONS⁵

Senegal — Presented by Kadidiatou Tall Thiam

Senegal is preparing for a country review. The major points of raised during the presentation were:

- Senegal inherited most of its scientific and technological research system from the French colonial system. For a long time, the research institutes and organizations active in Senegal have included very few local researchers.
- To develop local content in research, successive governments have been attempting to develop a national policy on scientific and technological research.
- There are several research institutes, including: IFAN (French Institute for Black Africa, now called the Fundamental Institute for Black Africa); CNRA (National Centre for Agronomic Research in Bambey, now called ISRA, Senegalese Institute for Agricultural Research); ORSTOM (Office for Scientific Research in Overseas Territories, now known as IRD, the Institute for Development Research); BRGM (Bureau of Geological and Mining Research); The Pasteur Institute; ENSA (The National Higher Institution for Agriculture); ITA (Institute for Food Technology); and ITNA (Institute for Applied Nuclear Technology). In addition, there are the Cheikh Anta DIOP University (UCAD) in Dakar with several departments carrying out basic and applied research in different areas; CERER (The Study and Research Centre for New and Renewable Technologies); and CEREEQ (The Equipment Study and Research Centre).
- Over the years, various institutional frameworks have been used in an effort to develop and manage S&T. This evolution is reflected in changes in government departments: 1968 The Directorate for Scientific and Technical Affairs; 1973 General Delegation for Scientific and Technological Research (DGRST); 1979 The Secretariat of State for Scientific and Technological Research; 1983 The Ministry of Scientific and Technological Research; 1986 The Ministry was dissolved; 1995 The Ministry of Scientific and Technological Research; 2000 The Ministry of Higher Education and Scientific Research; and 2002 The Ministry of Scientific and Technological Research (MRST).
- Institutional instability has limited the ability of the country to build strong capacity in planning, programming, managing, and steering science policy.
- The S&T system exhibits systemic weaknesses because: there is a lack of coordination in activities and programs delivered by the various research institutes and centres; MRST has not been able to perform its key coordinating functions because all research bodies have been placed under the supervision other Ministerial departments; there has been no operational consultative platform to enable various stakeholders (researchers, administrative authorities, the private sector, donors, and users of research findings) to meet and discuss issues for the strate-

⁵ An oral presentation on Peru was given by Dr. Javier Verastegui. His contribution provided useful input into the discussions, but no formal paper was submitted.

gic development of S&T; there are inadequate human resources both in quantity and quality; there is a lack of risk capital to fund technological development; there is a lack of fiscal incentives to promote the use of research findings by industries; and there is a lack of dynamism by the Senegalese Agency for Technological Innovation (ASIT), which is responsible for encouraging the use of research findings.

- The annual budget for research was 11 billion FCFA with over 60% from foreign partners and only about 2% from the private sector.
- To improve funding of research the authorities set up the Foundation for Promoting Scientific and Technical research (FIRST) in 1983. FIRST includes members from both the private and public sectors, but has not performed as well as expected.
- Significant results have however been recorded in the areas of medical and pharmaceutical research, agricultural research, and agro-industrial research.
- The country is weak in ICT and several measures have been put in place to strengthen the country's capacity in this crucial sector.
- Identified goals to be vigorously pursued by the Ministry of Scientific and Technological research are: build institutional capacity in the Ministry of Scientific and Technological Research; improve the system for coordinating research (to ensure sustainability); reinforce funding for research by strengthening existing mechanisms and creating new ones; promote teaching, research, and development at the same time; promote technological innovation, while replicating and building on results (the Senegalese Agency for Technological Innovation has been set up for this purpose); review and update existing scientific and technical potential; and establish a system for evaluating the impact of scientific and technological research on people's lives.

Lebanon — *Presented by Mouin Hamze*

Lebanon is in the middle of a country review. The National Council for Scientific Research (CNRS) was created in 1962 to advance scientific research in Lebanon. CNRS plays an advisory role in developing national science policy and provides funds for science, technology, and innovation (STI) through its four research centres and various programs. CNRS research funding places emphasis on projects implemented by multidisciplinary teams and on projects that have a potential positive impact on the main productive sectors such as environment, public health, and human and economic development. In 2003, CNRS funded 141 projects in the following disciplines: public health (40%); engineering (17%); environment (15%); agriculture (15%); mathematics and physics (11%); and social sciences (2%).

In October 2002, CNRS launched an initiative to develop and adopt a New Science, Technology, and Innovation Policy for Lebanon. This was undertaken with the support and assistance of UNESCO and the Arab Education, Culture and Scientific Organisation (ALESCO) and under the guidance of an international expert. CNRS adopted a participatory approach that involved more than 60 Lebanese scientists (university professors, researchers, NGO representatives, engineers, social scientists, professionals and lead industrialists) who worked in three task forces: Medical Sciences and Public

Health; Physics and Mathematics, Industrial Technology, and Engineering Sciences; and Environmental, Agricultural, and Biological Sciences.

The three task forces met regularly and provided useful recommendations on the future direction of research based on a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis and considering basic societal needs. The task forces made a number of preliminary recommendations that were being considered in the preparation of the final science, technology, and innovation policy (STIP) report to be ready by the end of 2003. Two key recommendations have emerged from this exercise: fostering human resources development and networking; and promoting research programs for industrial competitiveness and innovative applications. When completed, the STIP will enable CNRS to articulate research priorities to propose to the universities and other research centres in the country.

Mozambique — *Presented by Adalberto Alberto*

Mozambique is currently developing a S&T policy to help achieve socioeconomic development of the country after a long period of war that devastated the entire nation. At independence in 1975, Mozambique had one university with 3000 students, but by 1978 this number had dropped to 750 due to the exit of Portuguese nationals. After the peace treaty was signed in 1992, the country started on a course of peaceful development that was centred on improvements in higher education and the application of science and technology in the different sectors of the national economy. In 1975, the country had only two research institutes: an agricultural research institute and an institute for research in animal husbandry.

The country has reorganized the systems for higher education and research. There are now 15,000 students registered in 11 different institutions (public and private) and several research organizations that cater to most of the economic sectors. Despite this appreciable progress, the S&T system can be characterised by:

- a certain degree of fragmentation;
- little connection between the S&T system and the productive sector;
- a productive sector with rather low level of technology;
- a national economy dominated by export of raw materials; and
- heavy reliance on import of intermediate products for final processing in the country.

To reorganize the higher education and technological systems in the country, the government created the Ministry of Higher Education, Sciences and Technology in 2000. The Ministry has responsibility for guiding the growth of higher education and for formulating S&T policies for the development of the different sectors of the economy. To help achieve its mission, the Ministry created the Observatory for Higher Education, Sciences and Technology to monitor and evaluate the growth of the two sectors. To encourage the evolution of appropriate national S&T policy, the Ministry initiated three baseline studies on: the educational system; the research system; and the technological levels and innovation capacity in the productive sector.

The baseline studies formed the basis for national discussion of the state of S&T by the different stakeholders. This has led to the drafting of a national S&T policy for the country that is expected to be approved very soon. An inter-ministerial group was also created to evolve appropriate indicators that can be used to periodically evaluate the implementation and impact of the higher education and S&T policies. The Observatory is responsible for collecting the information necessary to monitor the selected indicators.

Discussion Summary

Roland Waast led off the discussion by raising three points for consideration:

- Who is responsible for technology policy formulation?
- There is a need to provide a stable system for technological change.
- Strategic updates of policies are required.

Following these introductory comments, the participants discussed the issues raised in the various papers. The main points raised were:

- It was noted that Peru was funded by international bodies but not so with some other countries.
- The role of foreign sources of funding should be brought out clearly as foreign inputs could be significant in most cases.
- Micro enterprises engage in a lot of innovation for survival. These enterprises are usually not recognized in the S&T policy, which tends to concentrate on the formal sector.
- There is a need to identify baseline indicators to determine policy impacts.
- In responding to the realities of competition engendered in WTO, demand for S&T will come.
- The importance of brain drain arising from mobility of skills must be considered. To combat the problem in Peru, government tries to pay good salaries.
- In Peru, the Government set up six centres for Technical Innovation to address simple innovation activities in the areas of wood, textile, and leather. The beneficiaries are mainly micro and small enterprises.
- Private sector participation in funding of research is very low in most of the countries covered. There is a need to develop incentives to encourage private sector participation.
- In Peru, there is a growing realization of the need for seed money to be given to the private sector companies to encourage them to carry out innovation. This is to be coupled with incentives if companies carry out R&D with the help of universities or a consortium of universities.
- How broad or generic should S&T Policy be to take care of the demands of S&T for development? Do the various countries have any target they are strategically trying to achieve? There is need to examine if there are such targets to which S&T can be deployed to achieve some goals.

- While carrying out reviews, there is need to pay attention to change - the dynamics of things.
- The World Federation of Engineering Organisations is ready to cooperate with other bodies in carrying out reviews which must also recognise the important role of engineering as the deliverer of S&T for development. The realities of situations in most developing nations dictate the need to consider engineering capability along with S&T capacity. Consequently, we should be talking of Science, Engineering and Technology (SET) review.

REVIEW OF THE NATIONAL INNOVATION SYSTEM AND POLICY INITIATIVES OF PAKISTAN

Dr. S.T.K. Naim, Chairperson, Pakistan Council for Science and Technology

Pakistan has undertaken a review of her S&T and innovation system without any external assistance. This summary provides highlights of the methodology, the basic features of the emergent policy initiatives, and the impacts of policy implementation.

The methodology for the review of the S&T and innovation system contained the following elements:

- Identification of the key actors in the national innovation system (NIS).
- Defining the state of each actor in the NIS.
- Using the “shock and awe” approach to get the government to be more responsive to the implementation of new initiatives in S&T development.
- Setting up different panels of experts to carry out the review of the NIS system.
- Identifying S&T development initiatives for implementation over a plan period.

The study identified three main actors in the national innovation system (NIS):

- Private Firms and Industry (demand innovation);
- Government Policies (support innovation); and
- Universities, R&D Organizations and Firms (where innovations take place).

The pre-review state of the country’s NIS was characterized as follows:

Government Policies

- Scientists not appointed in Policy Positions
- No Industrial vision or coordinated S&T policy
- Inconsistent investment and economic policies
- Nationalization policy harmed industrialization process
- Policy instruments to create demand for R&D in the firm were not used (e.g., tariff structures, tax incentives, and venture capital)
- In the 60s-70s most Government funding focused on agriculture research, limited funding for industrial R&D.
- No support for technology development within the firm
- No technology parks or Incubation centres for creating technology entrepreneurs
- Limited Foreign Direct Investment without technology transfer.
- No control on smuggling

R&D Organizations

- R&D organizations and universities were under-funded, under-staffed and ill-equipped.
- Highly qualified manpower depleted with no replacement.
- Lack of modern libraries and information networks.
- International collaboration limited.
- Not able to gain confidence of industry.

Industry

- Industry thrived in noncompetitive environment
- Operating at low level of technology.
- Most Firms lacked in-house R&D design and engineering capabilities.
- Prevailing culture of rent seeking and quick returns on investment.
- Technology transfer mainly on turnkey basis.
- Negligible investment in training of manpower for R&D.
- No quality control on products

The following development indicators were obtained for Pakistan and compared to those of developed and developing economies (such as Iran, Saudi Arabia, and Turkey).

- Tertiary enrolment
- R&D expenditure
- Government versus private R&D expenditure
- R&D expenditure as a percentage of GNP
- R&D human resources
- Overall export performance
- Manufacturing value added

Facts and figures emanating from the above exercise demonstrated the relatively poor performance of Pakistan, even when compared to countries perceived to be at the same level of development. This served the useful purpose of shocking the government into supporting the review and implementation of recommendations arising there from.

Review Exercise

Different committees of experts were set up to review, in phases, 36 best performing R&D organizations, 228 Centres/Divisions/Units of R&D organizations, 300 S&T departments in public sector universities including scientists and their scientific research. Identified were institutions for upgrading, strengthening, merging, streamlining, and closure.

A survey was also launched to study innovations in public/private sector industries towards: the identification of successful public/private linkages and missing links; private sector investment in R&D; private sector demand for public R&D; and government incentive policy for private R&D.

New Initiatives in Science and Technology (2000–2003)

The review led to new initiatives in S&T:

- Enhanced allocations for the S&T sector;
- Human resource development;
- Upgrade of R&D infrastructure and launching of R&D programs;
- Technology development and industrialization;

- Information technology; and
- Strengthening of the policy, coordination, and management structure.

Impacts of Review

The government has demonstrated strong commitment to the implementation of the recommended programs. For example, the government's budget allocation for the S&T sector was increased from the original allocations (in Rs billion) of 1.44, 2.87, and 3.49 to 2.51, 3.35, and 5.35 in 2001, 2002, and 2003, respectively. There was also increased investment in basic education and R&D. For example, 700 PhDs were trained under four schemes, post-doctoral scholarships were awarded, and efforts were increased to attract expatriate Pakistani and foreign scientists and engineers. Several incentives for scientists were put in place and the infrastructure was strengthening.

Significant impacts were recorded in ICTs. The number of ISPs increased from 29 in 2000 to 1050 in 2002 and this was coupled with ten-fold increase in bandwidth and 100-fold reduction in bandwidth rates. To enhance the GDP, attention was focussed on diversification and adding value in agriculture, and in industry, diversification into Shipping, automobile manufacture, engineering goods, chemicals and pharmaceuticals, household appliances, transportation equipment, and telecommunication equipment was emphasized.

DAY 1: ISSUES

The main observations and comments raised by the participants in day 1 were:

- Review is one tool among many different approaches that countries need to consider in the formulation of S&T policy for development.
- The review reports presented in the sessions came up with useful recommendations.
- The process of review is as important, if not more important, than the content of the review, as it brings stakeholders together to discuss issues.
- The timing of the review is very important as is the need for a domestic champion if the review is to have impact.
- A number of positive impacts have been noted, although it is important to be cautious about trying to show a one-to-one allocation of impacts to the implementation of review recommendations.
- Review is not static. It is basically a dynamic process.
- There is a need for the incorporation of domestic capacity building into the review process.
- The S&T institutions to be involved should be identified in advance of the review.
- The review should take due cognizance of the history of institutions involved.
- It is helpful to construct database/performance indicators to measure progressive impacts of implementation.
- The framework for carrying out the review should be clearly spelt out.
- With regard to scope and methodology, there is a need for: a clear vision of the methodology to be adopted; the tailoring of the review to local realities; and the determination of the extent of integration of S&T review to the macro-economic system.
- With regard to coordination of donor agencies activities, if it is to have merit, it will entail their interacting and collaborating to harmonise the methodology, the funding and formation of the review team. Or in the alternative, is it better to have the pluralism that enables countries to choose whatever donor they wish?

Summary of Day Two

Presentations and Discussions

DONOR PERSPECTIVE ON REVIEWS

The second day of the workshop was designed to provide a donor perspective on knowledge systems and national reviews of S&T and innovation. Papers were presented by the World Bank, SIDA, and UNCTAD. Of particular interests during this sessions were:

- The extent of involvement of donor agencies in the reviews;
- Donor perceptions of the role of reviews; and
- The coordination of donor activities.

World Bank — *Presented by Erik Thulstrup*

The World Bank (WB) has taken an action-oriented approach. Lending has been concentrated in science-related sectors such as agriculture, industry, environment, energy, health, and education. The Bank has spent about \$500 million per year on higher education in S&T each year since 1993. Learning by WB from its experiences in S&T lending has been limited because evaluations of outcomes from its S&T projects have only rarely been carried out. Recently, WB has sought to define its S&T strategy more clearly through a number of background studies, meetings with bilateral donors, international organizations, and developing country specialists, and reviews written by a number of specialists from around the world. This has culminated in a Vision Paper to guide future activities of the Bank in S&T.

From this exercise, the WB made three key conclusions:

- S&T must be deployed to support the WB's key goals of poverty alleviation and economic development in developing countries.
- There was a need to examine how these themes had been dealt with in WB projects over the years.
- A country's ability to understand, interpret, select, adapt, use, transmit, diffuse, produce, and commercialize S&T knowledge is critical to its development.

Based on the experiences of the World Bank and some other donors, the new WB strategy emphasized four key S&T policy areas: education and human resources development; the private sector; the public sector; and information and communication technologies. The new WB strategy for S&T strategy has five goals:

- To increase awareness of S&T and its role in development.
- To increase attention to S&T in four key policy domains.
- To achieve greater integration of on-going S&T support.
- To increase and strengthen S&T-related analytical work.
- To foster collaboration with a range of international partners.

The WB feels an urgent need to implement its new S&T strategy in connection with its lending. But to accomplish its goals, the Bank is keenly aware of the need for conducive S&T and innovation policies to stimulate and nurture the design of S&T-based projects. No standard solution for STI policy improvement exists. Consequently, the WB looks forward to closer cooperation with donors and other agencies that have experience with S&T reviews. The WB looks forward to active participation in international S&T assessments and to increased sharing of experiences within the international S&T community (e.g. S&T expert groups in developing countries, donors interested in S&T, S&T organizations, such as the Third World Academy of Sciences, and relevant UN organizations).

World Bank Institute, Paris — *Presented by Jean-Eric Aubert*

Initially, STI policy review was carried out mainly as an academic exercise. It had little practical effects on policy direction and implementation. However, a broader framework involving education, science, technology, and ICTs was applied to the China and Korea reviews. The Institute's experience suggests that there is a need for increased training of policymakers and a division of labour among donors.

The WB approach is two-pronged: providing finance and building core capacity to have the critical mass of expertise within the country. This approach is coupled with policy dialogue with different stakeholders.

Swedish International Development Agency (SIDA) —

Presented by Thomas Kjellqvist

SIDA provides developing countries with support to improve their capacity to run their own research programs that can contribute to the solution of important developmental problems. Grants by the Agency are usually distributed as: 30% bilateral research; 30% regional research; 30% international research; and 10% Swedish development research.

Bilateral research cooperation supports the development of national research capacity. There are currently programs of research cooperation with: Bolivia, Eritrea, Ethiopia, Mozambique, Nicaragua, Sri Lanka, Tanzania, Vietnam, and Uganda. As of 2000, there were more than 200 projects that involved more than 120 Swedish institutions. In most of these countries, SIDA supports university research and training (e.g., PhD, Masters, engineers, laboratory workers, and librarians).

SIDA's involvement in national reviews has been influenced by the need to make informed decisions when starting programs of country support (e.g., Burkina Faso,

Rwanda, Uganda, Laos, Bolivia, and Honduras) or when entering into new phases of research cooperation (e.g., Nicaragua). These reviews have included both commissioning new reviews and consulting existing reviews (e.g., Ethiopia, Mozambique, Tanzania, Uganda, and Vietnam). SIDA is also interested in thematic reviews that focus on social sciences, engineering, and medicine.

SIDA has adopted different methods for carrying out its review:

- Using local expertise and authorities (Uganda, Nicaragua).
- Using regional institutes (IESALC, Bolivia).
- Using consultants (Honduras and Rwanda).
- Using researchers (Burkina Faso and Laos).
- Using self-assessment (of social sciences and medical faculties using regional teams).

SIDA's experiences point to some potential pitfalls of review exercises:

- Lack of (quantitative) longitudinal data, which makes reviews "impressionistic."
- Lack of comparative approaches.
- Lack of reference to theories.
- Tendency to create and repeat "narratives."
- Possibility of missing system-influencing side issues.
- Donor-supported reviews risk the distinct possibility of being biased.
- Hidden agendas can lead to the hiding of information.

Some steps that could be taken to improve the effectiveness of reviews include:

- Establish data banks of national reviews.
- Establish a program for longitudinal review processes (through an international agency).
- Build local analytical capacity.
- Institutionalize continuous monitoring systems.

UNCTAD — *Presented by Mongi Hamdi*

UNCTAD followed the OECD methodology in carrying out the country reviews for Jamaica and Columbia. A hybrid policy review involving S&T Policy and Investment Policy has been carried out for Ethiopia and some other countries. UNCTAD has cooperated with the United Nations University (UNU) in carrying out these reviews. So far, 11 policy reviews have been carried out for different countries.

Discussion Summary

The discussion was led by John Grayzel of USAID, who noted that USAID is most interested in capacity building. The New York Academy of Sciences has completed case studies of several countries. USAID is using the results of these cases to help shape its future programs. Of particular relevance to review exercises are:

- The need for investments to be strategic if they are to achieve impacts.
- The need to identify goals.
- The need to integrate S&T and Innovation with the socioeconomic goals.
- The need for the coordination of both donor and foundation inputs because foundations have resources and can handle certain aspects of studies better than donor agencies. Foundations have greater flexibility and are less political in their operations.

Following these introductory comments, the participants discussed the issues raised in the various papers. The main points raised were:

- On donor coordination, it is very important for countries to have data and information on donor review activities and methodologies to enable countries that want to do reviews to make informed choices.
- The issue of primary and secondary education in S&T should be looked into as it is critical.
- There is need for donor agencies to do self evaluation as well.
- Policy reviews should pay attention to the different sectors (e.g., ICTs, agriculture, and biotechnology).
- There are lessons to learn from the USAID support for Korea. USAID supported the initial establishment of KAIST, which helped tremendously in S&T capacity building in Korea.

A New Direction for National Reviews?

This session was designed to provide an outline of actions for future reviews of STI in developing countries. The emphasis was on encouraging partnerships among client countries and donor agencies. The discussion was stimulated by a paper entitled *Competence Building and Policy Impact through the Innovation Review Process*, which was presented by Lynn Mytelka and Banji Oyeyinka of the UNU Institute for New Technologies. In their presentation, they raised the following points:

- The loss of global market share and competitiveness in traditional exports, and the sharp decline in government spending on education in most developing nations, particularly in Africa, pose growing challenges. The processes of learning and innovation require close examination in these countries if they are not to remain at the margins of society and the world economy.
- The importance of the innovation system approach is based on its usefulness in uncovering the strengths and weaknesses of developing countries faced with new global competition.
- In seeking new directions for carrying out STI reviews, the authors noted three key areas: the need to make distinctions between capabilities and competencies; the need to see a distinction between institutions and organizations that add value to the innovation system approach; and the utility of embedding a sector-specific focus within reviews of the national system of innovation.

- Traditionally, technological and productive capabilities are acquired through learning by doing. However, as a result of the increased knowledge-intensity of production and the growing importance of innovation in sustaining competitiveness, attention has begun to focus on learning to learn, learning by searching, and learning interactively. This means that there is now a need for a broader set of competencies (as distinguished from the more usual set of capabilities found in the development and innovation literature). These competencies include openness, experimentation, coping with uncertainty, dealing with change, questioning established truths, building trust, and working within collaborative partnerships both across ministries as well as among firms and between firms and universities or research institutes.
- Competencies such as these are not as amenable to standard training processes based on knowledge transfer and traditional apprenticeship practices. They cannot be acquired from outside or imitated by rote because the ability to build these competencies requires that they be internalized by the individual or organization and subjected to continuous scrutiny, feedback, and change. All actors in an innovation system must thus become learning organizations.
- Competence building in developing countries is required at multiple levels — individual and organizational, as well as across all actors in the system. Building linkages within an innovation system is critical for innovation, and building competences beyond the traditional emphasis on training graduates in the fields of science, technology, and management is also needed. Therefore, the Science, Technology, Innovation Policy (STIP) review process should be conceptualised as a series of activities that combine traditional capability building with the development of new competencies.
- Innovation must be seen as an interactive process in which enterprises interact with each other and are supported by institutions and a wide range of organizations that play a key role in bringing new products, new processes, and new forms of organization into economic use. In this context, “organizations” are basically the universities, public-sector research bodies, science councils, and firms that have traditionally been the focus of science and technology reviews; whereas, “institutions” should be considered as “sets of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals and groups” that “E prescribe behavioural roles, constrain activity and shape expectations.”
- The utility of this distinction between “organizations” and “institutions” lies in the fact that simply having potentially critical actors located within a geographical space, does not necessarily predict their interaction. Actor competences, habits, and practices with respect to three of the key elements that underlie an innovation process — linkages, investment, and learning — are also important in determining the nature and extensiveness of their interactions. It is also observed that organizations do not change on their own, unless there is pressure or threat.
- Most of the earlier STIPs that looked at specific sectors did not seek to embed these sectors within the broader policy environment. Policy dynamics, that is, the interface between policies and the habits and practices of the actors in a sector, were

lost in this process and so, too, was the need to monitor in a continuous fashion, the impact of policies. To embed a sector in the broader system, it would be useful to do more “sector-based” STIP reviews but with a clear focus on interactivity among actors and the role of policies in setting the parameters within which actors take decisions. In STIP review, there is need to identify strengths and weaknesses of organizations and institutions so as to ensure that the competencies are enhanced and interactions take place.

- Donor agencies have a number of critical roles to play in building innovation systems in developing countries, including:
 - identifying the frontiers of scientific and technological change and sharing their knowledge and insights with developing countries;
 - developing dialogue between North–South and across actors in the South;
 - strengthening the absorptive capacity of local actors;
 - strengthening centres of excellence in the knowledge bases required to build relevant innovation systems;
 - linking these knowledge bases to the policymaking process; and
 - broadening technology transfer beyond technological capability building to one that stimulates and supports learning to learn, that shares experiences and knowledge, and contributes to the creation of a self-sustaining and self-governing process of choice and change in the developing world.

Following this presentation the participants noted that developing countries must develop their own institutions.

Mapping Global Research Networks and National Systems

To provide the participants with an overview of recent work on science and research collaboration among networks of developing countries, two papers were presented. The first, *Can the Global Network of Science Contribute to Development?* was presented by Caroline Wagner, Research Fellow, RAND. The second, *International Consultation on S&T Policy Priorities and Information Needs* was presented by Ernesto Fernandez Polcuch, Programme Specialist, Science and Technology Statistics, UNESCO Institute for Statistics.

The main points raised by Caroline Wagner were:

- Science is becoming a single world system. Consider the following statistics: International articles increased by 50% over 10 years and accounted for 15% of all articles in 1997; more than 50 countries can now be considered as “scientifically proficient;” and Internet searches produced more than 45,400,000 hits for “science” and more than 3,500,000 hits for “international science.”
- There has been a significant increase over the years in the number of articles that are internationally co-authored.

- A global network has emerged that is characterized by: strong growth in the Americas; strongest growth in links in advanced countries, particularly in Europe; recorded growth in links in sub-Saharan Africa; growth in links in Asia; growth in links is stronger in developing areas (e.g., South America); no growth in the Middle East (an exception); increasing growth in U.S., Europe, and Japanese linkages; and the inclusion of 128 core countries in 2000.
- The forces driving networking have varied over time from exploitation (use of resources, people, and knowledge to enhance scientific processes in advanced countries), to imitation (recreation in developing countries of the institutions and knowledge systems in scientifically advanced countries), more recently to cooperation (mega science, science for development, and sharing of resources to enhance science on both sides), and now, self-organization (linking by scientists based on rewards and the needs of knowledge creation).
- These deductions can be made about scientific networks: science is becoming a single world system; “core-periphery” may no longer be the working model of development; regional models of collaboration may replace the core countries as sources of science; and investments in collaborative capacity may be good ones for developing countries.
- The above has also made the author wonder whether all this is not a pointer to the end of national science!

The paper by Ernesto Fernandez Polcuch provided highlights of the program of the UNESCO Institute for Statistics (UIS), which is aimed at collecting and disseminating, on a global basis, science and technology statistics and indicators. The importance of this goal is reflected in the observations made during the workshop of the need to have in place S&T development indicators as means for monitoring and doing comparative analysis of policy impacts.

The objectives of the UNESCO International Review of Science and Technology Statistics and Indicators are:

- To review priority science policy information needs.
- To examine existing S&T statistical and indicator systems.
- To identify key areas for future development of S&T statistics.
- To define the future role and strategy of the UIS.

The project is expected to obtain data on the following key parameters:

Resources Related Issues

- Quantity & quality of human resources
- Education and training of S&T personnel
- Distribution of resources
- Access to adequate equipment
- Access and barriers to information
- Availability and access to non governmental funding
- Recruitment and attractiveness of S&T careers

- Sharing of S&T data
- Public awareness of S&T and science literacy
- Mobility of S&T personnel

Impact Related Issues

- Impact on economics
- Impact on society
- Impact on environment
- Impact on agriculture
- Impact on culture

Dissemination of Knowledge & Technology Related Issues

- University–industry links in dissemination
- Dissemination and use of new S&T knowledge and technology.
- Access to S&T know-how and barriers to knowledge transfer.
- Adoption and adaptation of technology.
- International technology transfer

S&T Output Related Issues

- Capacities for adapting and applying new technologies.
- Production of new technologies, inventions, and innovations.
- Production of new knowledge and publications.
- Appropriateness and adequacy of S&T
- Value obtained from investments in S&T.

The project has been beset by lack of quantitative longitudinal data, e.g., availability of data on gross domestic expenditure on R&D (GERD) and availability of data on personnel engaged in R&D (FTE). UIS has obtained data from only a very few countries in Africa. As regards the rather lukewarm attitude of countries to the database project, the author wondered if the situation could be due to a combination of the following factors:

- Capacity building problem
- Little interest in R&D
- Difficulties of applying the Frascati Manual
- Methodological problems
- Channel of dissemination of UNESCO R&D questionnaire problematic.

Additional Resource Materials

WELCOMING ADDRESS, WALTER ERDELEN

Assistant Director-General for Natural Sciences, UNESCO

It gives me great pleasure to address such an eminent group of science policy experts drawn from multilateral organizations, development agencies, government science departments, universities, research institutes, and the private sector working in about 35 different countries. First of all, let me welcome you to UNESCO, especially those who are visiting us for the first time and those who are in the process of resuming their cooperation with us. The participation of all of you at this workshop, being held immediately after the Easter vacation, shows your commitment to the science policy issues to be addressed. I am sure that my colleagues from IDRC, as co-organizers, will join me in thanking you for honouring our invitation, and in some cases, cutting short your vacation.

As indicated in the workshop agenda, this opening session is to provide the objectives of the workshop and an overview of the context of the workshop. My remarks, which will focus on the contextual background from UNESCO's perspectives, are also relevant to the UNESCO Consultative Meeting on "International Partnerships to Promote Science Policies for Development" which will be held on April 25 and to which many of you have been invited.

Let me begin by outlining the Organization's contribution to the attainment of the Millennium Development Goals and to the implementation of the Johannesburg Plan of Implementation (JPOI) of the World Summit on Sustainable Development (WSSD). As was well emphasized during the Summit process, the three pillars of sustainable development are the economic, environmental, and social pillars, respectively. The Chief Executives Board for Coordination (CEB) has recommended guidelines for WSSD follow-up and I would like to draw attention to two of them:

- UN system operational activities should advance the integration of the three components of sustainable development;
- There should be building of synergies based on the comparative advantage of each organization.

The integration of the three components of sustainable development require the building, at the national level, of capacities for the elaboration of science and technol-

ogy policies and strategies. As pointed out by Mr Desai, the Secretary-General of WSSD, science and technology must be placed at the heart of policies to promote sustainable development. Indeed many of the means of implementation of the Johannesburg Plan of Implementation are measures in, or related to, science and technology policies.

Needless to say the subject matter of today's workshop is a central concern in this field. The review of national systems of science, technology, and innovation is an important action in the process of elaborating science and technology policies and the accompanying action plans and investment programs for sustainable development.

WSSD and Millennium Development Goal No. 8 also put emphasis on collaboration and partnerships between international organizations to support action at the national levels. Mr Matsuura, our Director-General, is determined that UNESCO plays an active role in strengthening cooperation with other agencies and organizations. As leading experts in the field of science and technology, I am sure that you are all aware of the role played by UNESCO in: (1) setting standard norms and definitions; (2) defining the principles and problems of science policy; and (3) developing methodologies, for example, for technology assessment, for budgeting S&T activities, and for determining priorities in science and technology.

The UNESCO series on science policy documents, published between 1965 and 1991, was regarded as excellent reference materials and many of them are still in demand. In some cases, UNESCO has been requested to update issues. One such demand was received from the scientific community in a European country, which requested an update of SPINES Thesaurus – A controlled and structured vocabulary of science and technology for policymaking, management, and development, a document published in 1976.

I used this example to show that the science policy program of UNESCO was completely international and not just designed to take care of the needs of the developing countries only. Indeed most of the documents published in the series in the 1960s and early 1970s were on science policy and organization of scientific research in Japan, USA, Korea, and many European countries such as France and Germany. Another prominent action of our former program was the organization of regional conferences of Ministers responsible for S&T Policy: MINESPOL for the European and North American region; CASTLAC for the Latin American and Caribbean region; CASTAFRICA for the African region and CASTARAB for the Arab region. The last of such regional conferences, CASTAFRICA II was held in 1987 in Arusha, Tanzania. We are now considering holding similar meetings within the framework of the NEPAD process. We are also planning a conference on science, technology, and the environment for the Caribbean region.

In spite of its valuable contribution to science-policy development, measures aimed at concentrating UNESCO's programs lead to the scaling down of the former Division of Science and Technology Policy to the Science, Technology and Society Unit, and eventually to its abolishment at the beginning of the nineties. Thus, for over a decade, we have responded to requests from member states on a piece-meal basis. The good news is that as part of the overall reform process in UNESCO, a new Division of Science Analysis and Policies was established at the beginning of the current biennium (2002–2003). The Organization has now rejoined the international science policy community where it expects, given its mandate, to fulfil a leading role, particularly within the United Nations System. I hope that our science policy mission and the envisaged program thrusts have been made available for the Workshop. I want to put emphasis here on the elements of the operational strategy of the new Division, namely: international partnerships.

This workshop, and the Consultative Meeting to be held, constitute, for us, the launching of a process to promote partnerships in promoting science policies for development. I am happy to note that as you evaluate the different methods of conducting reviews of national science, technology, and innovation systems, you are going to examine the forms of partnerships which can be developed to maximize the effects of these reviews. I am also delighted to learn that some of your working documents have drawn attention to opportunities for South–South cooperation between client countries, in addition to partnerships among agencies.

Ladies and gentlemen, these are the remarks I wish to share with you this morning. I am sure that Mr Brent Herbert-Copley will dwell more on the specific objectives of the workshop, the recommendations of which will certainly help us in shaping up our strategy of providing science and technology policy advice to our member states. I wish you successful deliberations and a happy stay in Paris.

WELCOMING ADDRESS, BRENT HERBERT-COPLEY

Director, Social and Economic Equity, IDRC

On behalf of the International Development Research Centre (IDRC), it is my pleasure to join Walter Erdelen in welcoming you to this workshop. Let me begin by thanking Walter and his colleagues Mustafa El-Tayeb and Folarin Osotimehin for their work in organizing this workshop. IDRC is pleased to be able to collaborate with UNESCO in this effort, which I am confident will help shed light on some of the common lessons emerging from our two agencies' work in support of improved science and technology policies, and possible areas for future collaboration. I would also like to thank my own colleague Paul Dufour — who has been the driving force behind this initiative at IDRC — as well as Pamela Golah and Jean Woo who have been actively involved in planning the event.

Let me provide a few words of background about IDRC and our interest in this workshop, and then turn to the objectives and expected outcomes of the event. As many of you know, IDRC is a public corporation established by the Canadian parliament in 1970 with the express purpose of supporting research and innovation in the countries of the South. Over the course of its more than 30-year history, the Centre has supported literally thousands of research projects led by dedicated scientists from the South — in fields ranging from plant breeding to macroeconomic modelling, from malaria control to community telecentres.

From the outset, however, the Centre has also maintained a strong concern for the overall policy and institutional frameworks within which research, science, and innovation take place. The original Act establishing IDRC calls upon the Centre, not simply to support research, but also to examine the “means of applying scientific, technical and other knowledge to the problems of development”. This concern for the management of science and technology has been a recurrent element in IDRC programming, expressed most recently in the “Research on Knowledge Systems” (RoKS) Initiative led by my colleague Paul Dufour. RoKS is a strategic initiative that cuts across other areas of IDRC programming, focussing on key policy issues affecting the production and use of scientific and other knowledge. RoKS supports a major annual research competition, as well as a number of individual capacity-building and networking activities.

As part of its activities in the field of science and technology policy, IDRC has over the past decade supported a series of national reviews of science, technology, and innovation policy, in South Africa, China, Chile, Vietnam, and Jordan. The reviews roughly followed the country review methodology developed earlier by the OECD, and in each case focussed on a series of key challenges in the management of the overall national system of innovation. It is our experience with these reviews — and our interest in sharing lessons learned with agencies involved in similar reviews in other countries — that led us to begin the planning of this workshop.

For a donor agency like IDRC, the national reviews have an obvious appeal.

- In the first place, they are strongly “user-driven,” with a host-country client contributing not only time and resources, but also sharing in the financing of the overall effort. There is thus a clear indication of demand from the outset, and a constituency committed to making use of the findings of the review.
- Second, they are action oriented. In most cases, the reviews have coincided with a period of rethinking regarding the organization and management of the national innovation system, opening opportunities for change. The reviews are not simply catalogues of institutions and programs but rather help to highlight directions for reform.
- Third, they offer opportunities for networking and sharing of “good practices” across national boundaries, due to the multinational nature of the review team and the interaction between the reviewers and local experts and authorities.

Anecdotal evidence suggests that the reviews have been quite successful, and in some cases highly influential in terms of future policy directions, as we will hear later today when we hear from some of the “clients” for the reviews. Similar positive results have been noted in reviews sponsored by other agencies, ranging from the OECD to UNCTAD to the Inter-American Development Bank. At the same time, there have been concerns raised about the review process — for example, its cost, the relatively heavy dependence on Northern experts, and the difficulty of sustaining momentum for change in the wake of the review process itself. Yet overall, there has been little effort to compare and contrast the lessons from the various reviews. What are the factors that explain the relative success of the review exercises and in particular their ability to facilitate a process of policy and institutional change? How can review methodologies be adapted to meet the needs of countries with widely differing S&T systems and policy demands? How can we ensure that the reviews contribute to strengthening local analytical capacity, and to networking across countries to share lessons and experiences? As demand for national reviews continues, these are questions which IDRC and other sponsoring agencies can and must grapple with.

I believe that the timing of this meeting is propitious in at least three senses. In the first place, the accumulated experience of IDRC and other agencies with these reviews is now sufficient to allow us to step back and begin to extract some general conclusions and lessons: simply put, we now have enough of the reviews “under our belt” to engage in meaningful analysis of this experience. Second, there is continued strong demand for this kind of effort — as evidenced by the participation of representatives of various potential “client countries” at this meeting. And, finally, there is an increasing level of interest from the donor community and international agencies in supporting the development of national strategies for science, technology, and innovation. I am reluctant to say that such issues are at the centre of donor programs at present, but certainly there are encouraging signs, from the World Bank’s adoption of a science and technology strategy, to the discussions within UNESCO about its own future role in the field of science and technology policy.

Over the next two days, we hope to achieve two broad objectives. The first is to develop a shared understanding of the lessons of the national reviews conducted to date — what has been their impact? What are key success factors? What have been the limitations of the review process as practised to date?

The second objective is more forward looking. By the end of the workshop we hope to have advanced our collective thinking about the way forward — how might we approach such national reviews in the future, and what might this entail in terms of collaboration among agencies involved in this field? In particular, can we envision alternative approaches to the review process, which will help to strengthen indigenous Southern capacity to critically analyze science, technology, and innovation policies and programs, and which will foster networks of learning across developing and industrialized countries? And if so, what might be some of the early actions that agencies like IDRC, UNESCO, and others could take to facilitate such a vision?

The products of the workshop, I should stress, will be both formal and informal. We will of course endeavour to capture the main conclusions in rapporteurs' reports and a final workshop report. But as in any event of this kind, I expect that many of the richest discussions will be those less formal ones, over lunch and in the corridors. Similarly, I expect and hope that the process of discussion launched over the next 2 days will be only a starting point, and that we will continue to discuss concrete opportunities for collaboration over the coming weeks and months.

I look forward to the discussions over the next 2 days, as well as the opportunity to interact with each of you on a more informal basis. I am confident that the discussions will be provocative and productive, and I encourage you all to participate actively in the debates. Thank you. Let me now turn the floor over to my colleague Paul Dufour, who will provide an overview of the meeting agenda and introduce our first presenter.

JAMAICA'S PROGRESS IN BUILDING AN INNOVATIVE KNOWLEDGE SYSTEM

Arnoldo Ventura

What I shall say will revolve around

- The importance of the innovations reviews in general;
- Their contribution to strengthening our S & T system; and
- Finally the lessons learnt.

The STIP reviews, conducted in conjunction with UNCTAD in Jamaica, have proven to be stimulatingly useful, and the report prepared by UNCTAD is still being requested some four years after the work was completed. Many have commended the effort.

Innovation as a strategy is much more easily accepted as a critical element in the development process, and there is a greater sense that local technological capacity is worthy of being deliberately cultivated.

One of the main reasons for the success is that these reviews followed and were guided by an intense national industrial policy process, which was crucial in setting priorities for action. The STIP reviews were a fitting defining follow-up to this work as they revealed S&T organizational weaknesses in the sectors that were investigated, and generally, provided new insights to stimulate growth and transformation in these sectors contributions to the national economy.

The influence of these reviews was not so much in the positing of prescriptions to solve individual problems, or filling obvious gaps, but they have heightened the national awareness and recognition of, as well as, added confirmation to, the imperative of using scarce S&T resources, in a much more integrated, targeted and novel way to build competitiveness.

It is interesting to note that the STIP Reviews were followed by a detail determination of the competitive position in the island's major economic sectors and their prospects for contributing to trade. Where to inject short and long term investments are also being identified.

Strengthening the S&T Infrastructure

Although it cannot be said that the STIP Reviews were totally responsible for a more critical approach to the management and use of the island's capabilities and institutions, it did much to demonstrate that innovations, both incremental and dramatic, are vital to our development prospects in all areas of socio-economic development. The National Commission on Science and Technology (NCST), which was the main local architect for the reviews, was able to use the contents of the report to further

solidify confidence among members of the S&T community, the political decision-making machinery and the private sector, in its coordinating and advisory work. It was consequently easier to promote the absorption of new technologies, as well as, pursue efforts to foster S&T development and applications.

Identifying indicators of S&T to signify process, fostering private-public sector partnerships and encouraging more integration within R&D institutions, were embraced instead of greeted with customary suspicion. Already new higher skilled jobs are being created, and efforts to increase production and productivity in traditional sectors, using new methods, are more widely accepted, even among member of the informal and small scale sectors.

In the pursuit of these activities, vital institutional connections and collaborations are being formed, and an innovation system is slowly emerging. The concept of working in teams to tackle focused objectives is receiving better acceptance. The need to revolutionize production and service is more widely acknowledged by most of those involved directly in these activities, as well as, the civil society as a whole. This is exemplified by the fact that the national trading strategy is not only about market access, but also now about market penetration as well.

Agro-industry Development

To indicate in a little more detail the nature of these advancements, I shall briefly mention activities in the agro-industrial and information and communication technologies (ICT) sectors, two that were examined in our STIP reviews.

Since the advent of the reviews, the government has explicitly stated that the agro-industrial and ICT sectors are major national priorities. What this policy has done is to demonstrate quite unequivocally that primary commodity agricultural production must be regarded as the first phase in more value-added activities. This leaves no doubt that innovative approaches, deploying both domestic and foreign R&D results, transfer of technology, harnessing of information for manufacturing and service, and more forward looking marketing strategies, have to be fully embraced as part of a national development policy.

The role of ICTs in these value-added endeavours is crucial, not only to increase efficiency and scope in industrial and service processes themselves, by reducing the proportions of unskilled labour, but also to allow closer working relationships between farmers, researchers and marketing organizations, as well as, better coordination and communication within these groups as well.

In expediting these applications in the local context, new ICT arrangements, and more appropriate software and hardware are necessary, along with new institutions, firms

and businesses to deliver them. Essentially, innovations across a range of actors and actions are emerging as absolutely necessary.

In these strategies there are few ready-made solutions or experts, new ways of doing old things and radically new things have to be contemplated, tested and applied, with some amount of urgency. A classical case of how this approach is unfolding is the adaptation of an old World War Two isotope separation technology to capture the aromatic volatiles in the high value produce that are trademarks of Jamaica agriculture. This technology will become the centre of a cluster of operations to extract flavours, essences and other aromas from a range of Jamaican agricultural and natural products for import substitution and export, with the rest being harvested for purees, essential oils, and other non-volatile elements, for food, feed and fertilizers. With the deployment of other related equipment and technologies, a cluster of extraction industries is being installed near to raw material sites. For these innovations to succeed, other innovations, such as the production of higher quality raw material, their safe and reliable transportation and adaptations to meet the changing demands of the market, are necessary. Furthermore, predictable quantity, quality and delivery are possible only if there is proper efficient and cost-effective transportation, irrigation and improved management of small farms. All of these requirements are now being met ahead of the arrival of the extraction equipment.

Information and Communication Technologies (ICTs)

To further these operations, one of the most important steps to be taken is the harnessing of the potential of the internet, especially as it relates to strengthening linkages between research and extension, in both agriculture, the music industry and a variety of small-scale industrial applications. In agriculture, this anticipated innovation is crucial to small farmers in their efforts to obtain adequately priced, quality inputs, and to identify and reach both local and foreign markets in a predictable fashion.

This will have a positive effect on food security and other agricultural practices, which will raise farm incomes and quality of life, as well as, deepen farmer's participation in governance and democracy. These types of endeavours also mean the creation of a different type of extension workers, one, for example, that is comfortable with using small hand-held computers, to collect and disseminate current information. What one sees is one set of innovations leading to others.

Lessons

Briefly I shall mention a few important observations, lessons if you will.

Innovative Clusters

What these experiences say is that, since the STIP Reviews, once an important innovation takes place, most likely others, upstream or downstream of them, quickly become necessary, if success is to be achieved and sustained. So in a sense, it is not just innovation in a singular sense that has to be considered in an action, project, process or service, that makes a competitive difference, rather, usually, it is a series of allied innovative initiatives, not only within core operations, but also among the necessary ancillary and complementary ones as well. Therefore, in characterising the effectiveness of innovative systems we should therefore be talking about innovation series or clusters, and not just an innovation event in one activity or place.

Demand Side Considerations

Because of the inordinate emphasis on the supply side of S&T for development, R&D, standards, education and government policy institutions, were recognized and targeted for support and measurement, but the elements of the demand side, the requirements and demands of businesses and other users of scientific results, technological events on the shop floor, management of technology in firms and maintenance, and inter-firm and cross-sectoral linkages, among intermediaries, in these processes, were often not paid sufficient attention. What is emerging is that R&D and technological collaboration among enterprises, and interactions among businesses, universities and R&D institutions, to increase technological spread and performance, are crucial imperatives for achieving innovations.

The Private Sector

To improve the economic environment for innovations to occur more regularly, the responsibilities and capabilities of the private sector needs radical change. Here S&T requirements and answers were often met from foreign sources, under the influence of outside expertise and advice. The cultivation of local technological capability was never seen as worthy of support by the private sector. The building of an innovation system in these underdeveloped circumstances requires the deliberate and calculated inclusion, by top private sector leadership, of domestic knowledge and skills, in their operations, for a local innovation system to emerge and to become effective.

Unfortunately, traditional companies are usually comfortable, influential and resistant to change. The many meetings between government bosses and themselves are largely about financial incentives and other business concerns, devoid of human resource improvements, and of S&T and innovation considerations. Demonstrations of possible bottom line benefits and other worthwhile possibilities will have to be offered, to solicit their participation in, and support of, the innovation system, to make it fully operational.

Their introduction into the innovation loop requires intimate knowledge of their operations and leadership, in order to find ways to convince them of the benefits of local S&T involvement in their operations. Many may not want to innovate, but they can be encouraged to support innovation in their complementary assets, as well as, ancillary services and providers. Their operations must also stress human resource development and application, instead of the many capital aspects and dealings.

Weaker sections of the formal private sector and their informal counterparts, must link with the knowledge generating capacity of their local S&T systems while the S&T community must be willing to respond in what may seem to be less high profile or rewarding endeavours. This will often require political sanctions and support from the highest levels of government, especially that of the leader of Government or the France Minister.

Funding

Then there is the funding dilemma. A set of activities of the supply side of the innovation equation that is regularly neglected, is funding, timely allocations, management, monitoring and learning activities. These are common innovation infrastructure components that allow cross cutting investments to be made to boost the system.

Risk and venture capital, and how to allocated, monitor and ensure their proper use, are components of the innovation system that needs dedicated attention. This perhaps is the most stultifying and dislocating aspects of fledging innovation systems. Bankers are by nature risk averse, they often do not understand S&T, and therefore do not readily accommodate technology-led projects. Furthermore, to make matter worse, banks usually do not have the capability to judge the potential of such projects. New ideas, new businesses and new approaches are often stopped dead in their tracks by lack of funding. A greater readiness to regulate in this area may be what is required to give a better balance in what is funded.

Bidding

Finally, there is a growing trend to put to bid all projects in the developing countries, to override corruption. What this does is shift the emphasis away from S&T and timely innovation to classical economic cost-effectiveness. Under this new disposition, the more conventional the better, which stymies innovation.

In this scenario, often it is the group, or person, best able to submit well written forms, or the better profiler, rather than those who understand innovation, who is selected. S&T excellence and application is quite likely not a major consideration. I suppose we have to learn how to attract the best innovators to bid for innovative type projects, and how to balance risk with innovative possibilities.

Conclusion

Since competition and the development it fosters, is not a one off process, the challenge is to keep a continuous process of innovations going. This cannot be done without a functioning local innovation system.

There is much that has been achieved but there is much left to be done. Meetings such as this one, put on by the IDRC and UNESCO, are therefore a valuable source of learning and sharing. The Jamaican's case is well positioned and the timing is right for follow up work, with a view not only to empirical considerations but also the elaboration of theoretical constructs.

DONOR-FUNDED REVIEWS ON SCIENCE, TECHNOLOGY AND INNOVATION IN VIETNAM: THE IMPACT, THE CHANGE, AND SOME THOUGHTS FOR THE FUTURE

Tran Ngoc Ca

The IDRC Review 1996-1997

In 1996, Vietnam is in the middle of the exercise to draft a science and technology strategy for the country until 2010. In January 1997, Dr. Pham Gia Khiem, then Minister for Science, Technology and Environment (now Deputy Prime Minister) has met Dr. Keith Bezason, then President of the IDRC and on behalf of the Vietnamese government, asked IDRC and the Canadian International Development Agency (CIDA) to conduct an S&T policy review, along the broad lines of an approach pioneered by the Organization for Economic Co-operation and Development, as adapted by IDRC.

The central feature of an S&T policy review is that it attempts to capture and distil the experiences, assessments, and views held of national policy and to engage in dialogue (to provide a mirror) about those experiences and experiences from other parts of the world. The IDRC and CIDA agreed with the request, and in September 1997 the international review team spent 3 weeks in Viet Nam, conducting the review. The government appointed the National Institute for Science and Technology Policy and Strategy Studies (NISTPASS) under the then Ministry of Science, Technology and Environment (now Ministry of Science and Technology) to be the Vietnamese counterpart in the review.

Implementation of the Review

Based on its own experience and consultations with developing-country partners, Canada's International Development Research Centre (IDRC) has adapted the OECD approach in slight but important ways. Local authorities' role is coming after, not before the international review team conducting their first visit. More time spent in the country has been decided and also the return visits are crucial for exchange of views.

The international review consisted of 6 members: Dr. Keith Bezanson, Prof. Geoff Oldham, Prof. Jan Annerstedt, Dr. Fransico Sagasti, Dr. Dennis Hopper, and Prof. Kun Mo Chung. In addition, other two experts have been invited to provide additional support. Dr. Jack Smith from National Research Council of Canada provided a training course on methodology for strategy making, and Prof. Martin Fransman from Edinburgh University gave experiences of some East and Southeast Asian economies in science, technology and innovation policy.

During the visit, the review team met with some 70 organizations, institutions, departments, firms, and associations and some 320 Vietnamese S&T policymakers, policy implementers, and people affected by the policies.

Recommendations of the Review

In addition to the general report and its unquestionable impact on the knowedge and information input for Vietnamese policy making process, the Review report specifically put out 16 specific recommendations on various aspects of the Vietnamese science, technology and innovation system. These 16 recommendations are as follow:

Suggestion 1: A possible fast track for improving coherence in S&T policy. The Government of Viet Nam in 1998 established the new position of Vice Prime Minister responsible for Science, Technology, Education and Training, Health and Social Affairs, Culture and Environment. This elevates the importance of S&T as a central instrument of national policy and affords an opportunity to bring a broad range of policies into greater harmony. To take advantage of this opportunity and to bring about needed changes and results in the short term, the Vice Prime Minister might form a Special Task Force, of no more than 24 members, with one-half from within Viet Nam, some of the country's principal stakeholders in the use of S&T for modernization and industrialization [that is, the most senior individuals in Viet Nam's business and industry community and the heads of a few of Viet nam's leading R&D institutions]. The remaining one-half would be mainly the chief representatives of foreign MNCs that have made significant investments in Viet Nam, along with very senior representatives of financial and development agencies, such as the World Bank and the Asian Development Bank. The Special Task Force would be needed for no more than 3 months and its mandate would be to recommend to the Vice Prime Minister a package of specific measures, policies, and actions to be implemented without delay to reduce the contradictions in current S&T policies (explicit and implicit) and eliminate certain immediate barriers to effective technological transformations (for example, aspects of licensing policies, customs policies and practices, and certain aspects of taxation).

Suggestion 2: Given the need for integration into the broader 2 economy, it may prove most valuable to commission an independent and brief review of Vietnam's four high-tech research programs, with a view to finding effective mechanisms to more broadly involve the industry and other firms.

Suggestion 3: Revision of S&T Law. A law on S&T should be simple, clear, concise, and enabling. It should remove ambiguities about, for example, intellectual property rights; facilities ease of interpretation; and, above all, encourage investment and creativity. Vietnam's draft law has many strengths, but it falls far short of these requirements.

Suggestion 4: Accelerating S&T reform to build Center of Excellence. A new policy could be announced making clear that support for S&T institutions is to be consolidated into a limited number of large, multiyear grants, directed to establishing national Center of Excellence. The government would need to specify criteria and then invite proposal to meet these criteria. The proposals would be adjudicated by peer reviews, including regional and international assessors. Policy approaches along these lines were followed by Korea and Singapore in building their strong and integrated S&T institutions.

Suggestion 5: Possible measures to address the problem of an aging scientific community:

- Launch, for the next 10 years, a selective postgraduate fellowship program in selected fields of science and engineering. This would send a significant number of outstanding young graduates to leading universities abroad for periods of 2-3 years.
- Establish short-term programs, possibly with a summer-school format, to bring university professors up to date with new developments in selected fields of science and engineering.
- Establish a significant program of small grants for young researchers returning after completing postgraduate studies abroad. This could be structured along the lines of the existing program of the Stockholm-based International Foundation for Science.

Suggestion 6: A Vietnam Science and Engineering Foundation. Vietnam's current process of rationalization of government support for S&T might be enhanced if an appropriate mechanism is established to accelerate the process and sharpen the focus. To manifest more clearly a long-term commitment to S&T development and to overcome the present uneasiness in the Vietnamese scientific community, the Government of Vietnam might wish to consider establishing an endowed foundation for science and engineering (the Vietnam Science and Engineering Foundation (VISEF). VISEF could be structured to ensure long-term support for basic research and human-resource development for Vietnam and could, at the same time, serve to quicken the pace of reforms intended to support the revitalization of basic science in Vietnam. International financial support might be feasible for such a foundation. If a decision is made to establish the VISEF, consideration should be given to making international peer review integral to its operations. This would add greatly to the Foundation's prestige, help serve to invite financial support from outside Vietnam, and build long-term international linkages in S&T.

The VISEF might carry out some of these activities:

- Evaluation of proposals for award of support;
- Selection and awarding of fellowships;
- Evaluation and award of block grants to universities and research laboratories;
- Administration of international cooperative research projects;
- Science and Engineering Awards for excellent research work;
- Improvement projects for science education; and
- Assessment of new scientific breakthroughs

The VISEF would be able to undertake a leading role in promoting education and train in applied systems engineering.

Suggestion 7: Measures to facilitate acquisition and assimilation of technologies:

- Implement policies that facilitate technology importation but require the full transfer of technological know-how from the overseas suppliers.

- Encourage the development of export-led industrialization by facilitating overseas business travel, together with similar measures.
- Ensure that training and education provide an appropriate balance of the many technical (and scientific) skills needed to staff the emerging industrial enterprises. In particular it has been urged to introduce a program for training the management personnel in charge of technology.

Suggestion 8: Constructing S&T policy innovation policy. It would be most useful to have a more thorough analysis and deliberate attempt to construct an NSI using this approach, together with other factors the Mission had not enough time to examine. To this end, a Vietnamese task force be comprised under the direct authority of the Vice Prime Minister and that its work be completed quickly and in time for inclusion in the White Paper on S&T strategy.

Suggestion 9: Including issue of international collaboration in a long-term S&T strategy. Vietnam should include the issue of international collaboration in long-term S&T strategy, to ensure that maximum benefits accrue to Vietnam from collaboration. In particular, Vietnam should assess carefully its collaboration strategy with other countries in East and Southeast Asia. It should aim to produce a Vietnamese strategy for International collaboration. In addition, we suggest that the Vietnamese government establish a new international consultative mechanism to deal with S&T and the modernization of Vietnam. A few years ago, China established the China Council for International Co-operation for Environment and Development. The members of this council include very distinguished leaders of government, industry, policy institutes, finance, and academia, and its purpose is to counsel the Government of China on environment and development. Vietnam international Science and Technology Advisory Council could be structured along the same lines. It could function under the chairpersonship of the Prime Minister or Vice Prime Minister and be composed of leading industrialists, financiers, and technology and development specialists. In addition to regularly counseling the Government of Vietnam, its very existence would serve to encourage investment in Vietnam.

Suggestion 10: The United Nations Commission on Science and Technology for Development has considered the issue of women's participation rate in S&T. The specific suggestions made in its report (see Gender Working Group (1995), Missing Link: Gender Equity in Science and Technology and Development) may be helpful to the Government of Vietnam in addressing and redressing this imbalance.

Suggestion 11: To set up a Vietnamese techno management program with objectives:

- To educate and train the leaders of Vietnamese industrialization in techno-management systems;
- To perform technical assessments, systems analyses and syntheses, and planning and management of both public and private projects at all levels; and
- To function initially as Vietnam's principal cooperative window for international collaboration in techno management.

Programs: Postgraduate-level programs should be offered to both young college graduates and to managers and decision-makers already on the job. Programs would include:

- A formal techno management program focused on techno management project administration;
- No degree, advanced special programs to gain an overview of modern-day techno management, directed to incumbent government official and enterprise managers; and
- Short courses and seminars to provide packaged training on specific topics for people who need it quickly to meet specific demands from industry.

Organization: The proposed techno management program should be offered at the newly established and reorganized Vietnam national university. The Vietnam National University will certainly become the elite school for the future leaders of Vietnam. Its reform-minded leadership is ideal for organizing and operation the proposed techno management program. The program can be run as an independent unit of the Vietnam National University, with a world-class facility and program at, other institutions of excellence in the region and internationally. To overcome the proposed techno management program should be run under an international arrangement. It is also suggested that this idea be placed before the World Bank, as a matter of highest priority for funding under the very large educational-reform program being considered.

Curriculum: The detailed curriculum, mode of teaching, operational pattern, and business aspect should be designed on the basis of careful comparative analysis and feasibility studies. Many important models and outstanding examples should be taken into account (for example, MIT's techno management program, KAIST's Techno-MBA program, Thailand's Technology Development Research Institute, and the Science Policy Research Unit and Institute for Development Studies at the University of Sussex). In Vietnam, students may require remedial work before being admitted to formal programs, and this should be considered in the design of the program. Also, Vietnam has a substantial pool of well-trained professionals abroad, and some of these people can be invited to work with an international team of experts and domestic stakeholders in planning the proposed Vietnamese techno management program.

A four tier program consisting of the following should be offered:

- Short-term seminars for senior decision-makers;
- Six-month programs designed for managers on the job;
- Regular masters degree program for university graduates of engineering and social sciences; and
- International study programs in overseas centers of excellence and industry.

The main skill-requirement areas to be addressed (some mandatory and some optional depending on orientation and needs) would be the following:

- Introduction to, and familiarization with, the application of IT;
- Management information systems;
- Decision analysis through case studies;

- Systems engineering and design;
- Project formulation and assessment;
- Project-management systems (schedules and costing);
- Technology sourcing and intellectual property rights;
- Marketing and after-sales service;
- Operations and maintenance for small and large facilities; and
- Total-quality management systems.

Suggestion 12: Some instruments to consider in economic transformation. Public funding for S&T is severely constrained. To generate the medium-term public savings needed for industrialization, the government should give priority over the next few years to allocating a significant percentage of the new funds to R&D in the agricultural sector. Eliminating the “green disease” in Vietnam’s fruit crops will in itself pay handsome short-term dividends to the Vietnamese economy. Resolving the technological barriers to increased postharvest marketing will do the same. It should be noted that a significant percentage of such S&T in agriculture is likely to be at the very frontiers of science in plant breeding, genetic engineering, and biotechnology. An agricultural Price Board, or Commission, might be created with a mandate to announce, in advance of the planting season, a set of floor prices for major agricultural commodities, with the assurance that the government of the state bank will purchase designated products if prices fall below the announced floor prices. Commodities purchased under this program might be stored as a future buffer stock to bring greater stability to product prices within the country or to even out the year-to-year flow of export earnings from foreign sales. Similarly, most farmers depend at present on local money lenders for a large share of their capital. This dependence discourages these farmers’ adoption of new farming practices, and in the case of crop failure the government has no crop-insurance program to help farmers and their families to face the risk of bad weather. An existing official system provides credit to farmers to purchase nonfarm production inputs, but by all accounts the system is seriously underfunded. This results in significant losses of national revenue. In sum, to support a conjunction of S&T-and economic-development strategy, with initial priority given to the primary-product sector. This approach would hold major promise for the modernization of Vietnam’s rural areas, provision of a large number of new, low-capital-intensive rural-employment opportunities, and generation of the domestic savings and foreign-exchange needed to support a medium-term program of industrialization.

Suggestion 13: Removal of impediments to widespread use of the Internet. The application of IT to the development and modernization of Vietnam is crucial. It will affect all aspects of life and will be an important tool in linking Vietnam to the outside world. If Vietnam is to achieve its goal of becoming an industrialized society by 2020, it will be essential to remove impediments to widespread use of the Internet. This is a case in which both implicit and explicit policies must be in harmony. Vietnam’s new long-term strategy for S&T should pay specific attention to this issue.

Suggestion 14: A pilot program to bring IT to communities in the Mekong Delta. It is suggested that donor funds be solicited to help fund a pilot program to bring the benefits of IT-improved access to information and knowledge to communities in the Mekong Delta. The idea would be to install ITs as a community-centred resource, along the lines of public libraries, which sprang up across the world in the early part of this century. It would be imperative that the system be interactive and that it include the knowledge and information needed by the community (for example, information on agricultural and health issues). A logical choice of a base for such a program would be the university in Can Tho. Similar programs for poor communities are being developed and tested in other parts of the developing world. Vietnam might benefit from studying these pilot schemes and adapting them to suit the needs of the Mekong Delta. IDRC's Acacia program in Africa is an example.

Suggestion 15: Streamlining criteria for decisions on high-tech parks.

- Be careful in selecting the location – The criteria for selecting the most appropriate site (or sites) for a high-tech park should be elaborated before any decision is taken. Decision-makers should consider carefully both the advantages and disadvantages of each site. Alternative locations should also be discussed in detail. Experiences from other countries show that the choice of location is of paramount importance. Detailed site analysis may even determine at a very early stage the probability of success or failure of a high-tech park.
- Look into the strengths of the existing techno industrial infrastructure – For instance, a survey of R&D resources in the Hanoi area was completed in 1997, to provide a general overview and an analysis of available (and some potential) resources for the Hanoi high-tech park. The survey contained an analysis of available S&T facilities and other resources for industrial innovation, which could be linked to a high-tech park in the greater Hanoi area. Ideally, the decision regarding the location of a high-tech park should accommodate the survey results.
- Identify short-term benefits – success is more likely if the high-tech park has both short- and long – term benefits for tenants. The final version of the conceptual design for a park should include everything considered achievable in the first few years of operations and in consecutive time periods.
- Combine the efforts of central and local governments- The chances of success for high-tech park will greatly improve if decision-makers in the central and local governments achieve a clear consensus on the goals of the high-tech park and the means to reaching these goals.
- Consider carefully the implementation strategy. Developers should not underestimate the complexities of high-tech parks. To succeed, the developers will have to draw on a variety of financial, technical, and human and other resources – to be combined in joint efforts. The criteria for choosing the first domestic and foreign partners to become anchor tenants may influence the profile of the park for a considerable length of time.
- Develop a comprehensive policy framework – This is to be used to clarify problems facing the developers. A blend of policies will influence the development of a high-

tech park. The current policies (rules and regulations, government support schemes, etc.) should be discussed in detail, and changes in the regulations should be introduced to make the early implementation of the park effective.

Suggestion 16: Creating an observatory for S&T and innovation. Vietnam should create a more advanced system for the production and distribution of indicators of S&T and innovation and encourage use of these indicators for assessments and prognostics. Internationally comparable indicators should be used more frequently in performance evaluations of R&D institutions and assessments of technological services, trade in technology, human-resource development, etc. In cooperation with other government bodies and other organizations, a well-stated unit, or observatory, of professional statisticians should be made responsible for providing government and other stakeholders with up-to-date data on the actual performance of the institutions (and firms) involved in R&D and related innovative activities. International training should be granted these statisticians to make their output fully comparable with that of other countries.

The Responses and Changes

General Responses

After the completion of the review report, the members of the international team returned to Vietnam in February 1998. The report had been very widely distributed and, in preparation for the return visit, NISTPASS had organized a series of discussions with stakeholders. These had been organized in each of seven working groups, one for each of the main themes addressed by the team. These groups reviewed the relevant sections of the report and drew up a list of issues for further debate with the international team. These issues were raised in the course of a full-day discussion on 12 February 1998 in Hanoi. More than 100 Vietnamese stakeholders participated. In addition, discussions were held with representatives of NISTPASS and with the Minister of Science, Technology and the Environment on 11 and 13 February.

The international team was advised during the stakeholder meeting that its report had been very well received, met with widespread approval, and was regarded as provocative and candid. It was emphasized that the report had stimulated extensive debate and questioning.

Given that it was widely viewed as provocative, however, what was surprising was that's the areas of disagreement and dispute seemed to be so very few. On suggestion was that the report would have benefited from paying more specific attention to factors of Vietnamese history and culture.

The international team was advised that Vietnam's political leadership wished to proceed after that expeditiously to formulate a national S&T strategy, establish the pro-

posed Vietnam forum for Science, Technology, and Modernization, structure a new techno management program, and apply S&T in traditional sectors. On these matters, the NISTPASS team requested further information.

Thus, the international team believed that a carefully structured and well-supported Vietnam International Science and Technology Advisory Council (VISTAC) would provide a most valuable service to the country.

Some Specific Nuances

After the stakeholder meeting, it was agreed between IDRC and MOSTE that the report of the international team would be published. This would include a chapter summarizing the follow-up discussions in Hanoi. IDRC would be responsible for the publication in English; and NISTPASS, for that in Vietnamese. In 1998, English version of the Report has been produced by the IDRC with the title: Vietnam at the Crossroad. When NISTPASS has got the printing of the report, there has been some advised that it keep the book in the library without to diffuse it widely, mainly for internal use and analysis. There is no explicitly explained reason for this, but the common understanding was that the report is too provocative and measures suggested, although correct and candid in many places, seem too early to be discussed and applied.

On a less official note, even the title of the report caused some concern. The question has been asked was: Vietnam is at the crossroad, but to where (or between what?)? The essence of the report emphasised that the country should make a choice between stronger, more decisive reform and change and not change, it has been interpreted by a question whether the country should make a choice between political course that it has adopted to something else. Also, some phasing or metaphor used in the report have been considered as too strong (something like “Vietnam is at the same time push a gas to accelerate reform, and pull the brake to slow it down”). In this context, there is no publication of the Vietnamese version of the Report, although its translation is widely used and quoted in many official Vietnamese and international reports and studies.

Absorption Process and the Results

Not publishing a report does not necessarily mean that the report is bad or not welcome. Far from that, during 1998 and 2002, the Review report has been discussed, although mainly among research community concerned with policy and strategy for S&T, and studied, has been quoted, referred to and used extensively. Moreover, its findings and recommendations were referred to not only by people from NISTPASS and MOSTE, but from other Ministries, government organisations such as the most powerful Ministry in Vietnam: Ministry of Planning and Investment (MPI). Over time, some of the ideas of the Report, together with changes of the Vietnamese practice of the S&T activity made the subjects of recommendations more actual and feasible, and together with this, the recommendations themselves became more acceptable and practical. NISTPASS continued its process of drafting the S&T strategy for Vietnam

until 2010. Although only until now, the draft (after many time of re-drafting in the constantly changing context) is close to official approval of the Government, its content has been adapted along the lines of many issues addressed by the review. Some ideas of the report and drafted Strategy were incorporated into more important documents of the leading Party and the government such as 5 years socio-economic plans.

As such, during the long process of so call “absorption”, Vietnamese policy makers have studied carefully many recommendations of the report and actually applied, if not all, most of the recommendations to their policy making process. A comparative review of each of the recommendations with current situation could be useful.

Suggestion 1: A possible fast track for improving coherence in S&T policy. There is no Special Task Force so far aiming at supporting S&T for modernization and industrialization. However, the dialogue of the government and private sector, representatives of international organisations, such as the World Bank and the Asian Development Bank, UNDP, other donors and MNC have been held from time to time (in a format of Private Sector Forum) to discuss mainly economic issues, including sometime issue like knowledge based economy. Still, the Task Force dedicated to science, technology and innovation is not yet the concept that generally deemed necessary by the government.

Suggestion 2: To conduct an independent and brief review of Vietnam’s four high-tech research programs. Ministry of Science and Technology oversees about 8 state research programs and four technico-economic programs on high tech areas such as information technology, biotechnology, new material and automation. These programs have been reviewed from time to time, including that by some outside MOST reviewers. However, the independence of the review remained to be improved since there was no involvement of high calibre experts from outside Vietnam.

Suggestion 3: Revision of S&T Law. The Law has been promulgated in 1999 with some changes adopted in the last minutes. As any legal document, the Law still caused some debates and arguments. But the core essence of the Law is indeed the liberation of the creativity of the science and technology community.

Suggestion 4: Accelerating S&T reform to build Center of Excellence. The new policy is adopted as exact as recommended by the Review, although with a different name. The government decided to set up 16 state focused laboratories with concentrated investment and call for submission from all over the country.

Suggestion 5: Possible measures to address the problem of an aging scientific community. A scholarship program funded by the state budget to send a large number of young student to study in top universities overseas has been implemented for the last 3 years.

Suggestion 6: A Vietnam Science and Engineering Foundation. The National Foundation for Science and Technology Development has been proposed and its preparation listed for 2 years. The Charter of the Foundation, its function, etc. are in the process of approval by the Prime Minister and the Foundation should come into the operation by the end of 2003, with initial endowment fund is about 200 billion VND (or 14 million USD), plus annual review. Still, this Fund is mainly for those in natural and engineering sciences outside the state targeted programs which receive fund outside the system of open call for proposal applied by the Foundation.

Suggestion 7: Measures to facilitate acquisition and assimilation of technologies. Many measures have been revised regularly to attract more technologies via foreign investment. Training component and management skills have been paid more and more attention. These measures generally were taken care of by MPI and other production ministries, under the recommendations of MOST.

Suggestion 8: Constructing S&T policy innovation policy. The concept of NSI was first officially introduced into Vietnam in the Review report. Although a special task force to deal with this was not set up, many team and other task forces drafting S&T strategy, vision have been familiarised with the concept and tried to find ways to adapt this to Vietnamese situation. Firm increasingly became a central factor in all policy measures for S&T.

Suggestion 9: Including issue of international collaboration in a long-term S&T strategy. Although in many policy and strategy documents, international cooperation has always been a central component, only last year, an official project to look into this matter more specifically started by the International relations of the MOST. While the end product of the project will only be available by the end of this year (see below in section 3.2), some of the recommendations of the review report could be useful for the project such as setting up some kind of China Council for International Co-operation for S&T Development (or Vietnam International Science and Technology Advisory Council/Forum).

Suggestion 10: Paying more attention to the issue of women's participation rate in S&T. In every government agencies, science and technology organisations were set up a committee for the progress of women, with the top managers (Directors) usually to be the chair.

Suggestion 11: To set up a Vietnamese techno-management program. Interestingly, this recommendation seems to get most of the consensus and endorsement, and is one of the slowest actions to take place. One of the reasons is that training in this area is the blurring one in function of two Ministries of S&T and Training and Higher education. Some universities have set up their own programs on technology management, or close to MBA style with some components of technology management. Still, no university or training organisation is specifically designing the program with structure and content similar to that recommended by IDRC Review. More recently, the

new Minister for S&T expressed his will to set up new style of techno-management program to be run by the Ministry for enterprises.

Suggestion 12: Some instruments to consider in economic transformation. Agricultural sector became one of the top priorities in the S&T activity. A special state research program on S&T supporting models for agriculture, rural and mountainous areas has been implemented for several years now.

Suggestion 13: Removal of impediments to widespread use of the Internet. With the Resolution 58 of the Party Politbureau on ICT development, a lot of new policies have been introduced to speed up the process of using ICT as both economic sector and enabler of the socio-economic development of the country. The establishment of the new Ministry for Post and Telematics (ICT), regular reduction of connection fees for telephone and Internet services are among these measures.

Suggestion 14: A pilot program to bring IT to communities in the Mekong Delta. Although official plan of actions to bring ICT closer to rural and remote areas (Mekong river delta is just one of them) is not properly set up, many attempts to do so are undertaken in this direction. One example is project “Electronic farmers” in the An Giang province (Southwest province of Vietnam). Involvement of some Vietnamese organisations in interntional collaborationprojects such as Pan Asia (IDRC funded) also contributed to this activity.

Suggestion 15: Streamlining criteria for decisions on high- tech parks. For several years, creation of two high- tech parks in Hoa Lac (near Hanoi) and HoChiMinh City has some problems in concept, consensus and resources allocation. Recently, together with S&T based agriculture, the government put high-tech development in general and high-tech park in particular as one of the top priorities. Two task forces currently working full time to produce new measures to promote high-tech park practice in Vietnam, learning from experiences of other countries.

Suggestion 16: Creating an observatory for S&T and innovation. Although there is no such a S&T observatory, the idea of detecting trends of S&T development and implication for Vietnam are getting more and more attention from the stakeholders. Foresight is recommended by NISTPASS (with creation of a new department in the institute) to MOST as one of the most effective toll to shape the future and priority settign for all S1T, innovation activity. This concept got positive rrsponses from the industry and now some economic sector (like food preocessing) or specific product (tea processing) began to adopt Foresight in their qcivity, with support from NISTPASS.

As we have seen above, most recommendations of the IDRC Review report have got into practice. It would be unfair to conclude that all changes and actions in S, T and innovation policy in Vietnam have steemed from the recommendations of the IDRC Review. But it would be safe to say that most of the recommendations have con-

tributed positively into the process of designing new policy measures for promoting science; technology and innovation in the country. These recommendations have found a strong resonance from the community of Vietnamese policy makers. The practice of policy making for science and technology in Vietnam just evolved along the direction pin pointed in the Review. Most importantly, there is seen a strong shift from science and technology policy to innovation policy with emphasis placed on the enterprises, especially SME which are the central to any productive sectors in Vietnam.

Other Reviews and the Future

UNDP/MPI/UNIDO Exercise: Science, Technology and Industry Strategy Component

In 2000, the Ministry of Planning and Investment in Vietnam started the process of drafting the socio-economic development strategy for the country until 2010. This document should serve as the backbone paper for the Party Congress in 2001. To support this process, it has got funding from SIDA and UNDP to do a review of various aspects to contribute to the strategy document. The review project has 5 components, one of which was the science, technology and industry strategy for Vietnam until 2010. The joint team consists of international experts (Keith Bezanson and Geoff Oldham were again invited, at the recommendation of NISTPASS to UNDP, showing the appreciation for their works in the previous IDRC Review) and two local experts. With NISTPASS having one of the senior research fellow in the team (author of this paper), it makes sure that there is continuity of all these exercises, and incorporate them into an action plan of the socio-economic strategy of the country. The UNDP led review seems to place more attention on industrial development of the enterprises. Though, several recommendations of the IDRC Review were re-instated and accepted by the MPI, lead drafter of the socio-economic strategy which was later adopted at the Party Congress. Some examples are more explicitly supporting S&T application for agriculture, high-tech development and specific measures to support technology innovation in SME.

IDRC Supported Review on International Cooperation in Science and Technology (ICST)

In 2002, the Department for International Relations of the Ministry of S&T has asked IDRC to support with their attempt to design strategy for developing international collaboration in science and technology (ICST). This is to serve other important policies to be adopted by the government. To deal with this task, a task force has been set up and drafted the structure of the report which is in fact looks at the issue from different aspects. These aspects indeed are important components of the innovation policy itself, such as human resources, financing, linkage with and support to enterprises, change of S&T management mechanism, link with FDI and ODA activities, etc. Once again, IDRC Review has been studied and as such, it serves as both the catalyst and input in terms of content for ICST study.

Conclusion and Thought for the Future

Experiences of Vietnam in creating and using various internationally backed reviews for science, technology and innovation issues show that these reviews are very useful for the country in the policy making process. It provided background information, new knowledge on basic concepts, updating on latest trends, and most importantly, provided the analytical tool and framework.

However, the way these review have been responded to, studied, accepted, and dif-fused may not be the same in every societies and countries. Depending on the policy window, on the specific context and on the cultural circumstances of each country, the recommendations of the reviews may have been adopted, appreciated to differ-ent extent and in various forms. Vietnamese experiences show that it takes time for the society like Vietnam to absorb the new vision suggested by external experts (National System of Innovation is one of such examples) and turned them into own action by the local efforts. Without this slow, but firm, “policy assimilation” attempt to make changes could be short lived. Donor organisations should take this into account and ready to accept some kind of policy time lag.

In addition, having macro review probably is not enough for having a profound impact and lasting change. To turn the recommendations aimed at the macro level into some-thing more substantial and concrete at the micro level, more specific experiments and studies could be useful. This is an area where the donors could pay more attention to. There could be two layers of the assistance: the macro review and the action pro-grammes/projects aiming at more specific targets as components of the review. For example, after the Review, some smaller studies on feasibility of TMP could be very practical. These studies could be focused on one or two sectors, industries or even products to examine how general macro policy recommendations work in practice. It is no doubt that IDRC review type is very useful and actual for country like Vietnam. To make review a more effective exercise for both donor and host country, it is required the understanding from both sides on the need and purposes of the Review, the specific circumstances before, during and after the Review completed.

Last but not least, we need policy partners or policy making alliances consistng of external experts, local partners in the country who understand and appreciate the efforts made from outside, for them to be a policy carriers in the specific society and economy context.

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THE CURRENT STATE OF RESEARCH IN SENEGAL

Khadidiatou Tall Thiam

Senegal inherited its Scientific and Technological research system, mostly, from the French colonial system. For a long time, the research institutes and organisations active in Senegal have included very few local researchers. Examples include:

- IFAN: the French Institute for Black Africa, now called the Fundamental Institute for Black Africa;
- CNRA or the National Centre for Agronomic Research in Bambey, now called ISRA - the Senegalese Institute for Agricultural Research;
- ORSTOM or the Office for Scientific Research in Overseas Territories, now known as the Institute for Development Research (IRD);
- RGM or the Bureau of Geological and Mining Research; and
- The Pasteur Institute.

No solution has been devised to pursue research work using generally agreed terms of cooperation to get these increasingly exogenous bodies to include a national or nationalized component for Scientific and Technological Research in their work. Consequently, successive governments have been attempting to develop a national policy on scientific and technological research. This paper presents the state of progress in this regard. Our paper reviews three main points: the general aspects of research; sectorial analysis; and orientations and prospects.

Scientific and Technical Research in Senegal

Reviewing Institutional Change

Over the past thirty years, several changes have occurred in the bodies in charge of scientific and technical policy. This has put a major barrier to development in this sector.

From the Directorate for Scientific and Technical Affairs in 1968, the decision and policy-making body became the General Delegation for Scientific and Technological Research (DGRST) in December 1973, and then the Secretariat of State for Scientific and Technological Research in April 1979. In April 1983, it was transformed into the Ministry of Scientific and Technological Research. Barely 3 years later, in January 1986, this Ministry was dissolved and things stayed this way for about ten years.

In March 1995, a fully operational Ministry was set up for Scientific and Technical Research. With the advent of a new regime in April 2000, the situation changed again. This time, it was the Ministry of Higher Education, which later became the Ministry of Higher Education and Scientific Research, which was responsible for Scientific and Technical research. Thereafter, the scientific and technical research sector was put under the Ministry of Education and in 2002 under the Ministry of Scientific and Technical Research (MRST).

Because of this institutional instability, our country has not been able to build strong capacity in planning, programming, managing and steering policy on science. This situation is aggravated further by the lack of a complete and updated list of scientific and technical potential that is indispensable for developing viable policies on science. The lack of coordination in activities and programmes delivered by the various Research Institutes and Centres in Senegal is another problem for the sector.

The Presidency issued a circular on May 17 1989, obliging Research Centres and Institutes to submit their research programmes and projects to DAST for endorsement even before submitting them to donors. But, this has never been applied effectively.

The mission assigned to MRST seems difficult to implement because all research bodies are placed under the authority of other Ministerial departments.

There is no operational consultative body that covers the various stakeholders in the research sector (researchers, administrative authorities, the private sector, donors, and users of research findings), and which can spark thinking on the orientations, objectives and programmes for the sector as well as the policy and operational changes needed. The lack of such a body hinders private sector involvement in setting priorities as well as delivering and assessing programmes for research.

Organizational Framework for Research

Scientific and Technical research is a strategic activity. Its cost-effectiveness is assessed by how well its findings contribute in promoting and sustaining social and economic development.

The mission of research institutes is not about industry, trade or administrative matters. The relevance of research should not be assessed only from the financial gains made by research centres, but rather in the light of the technologies and knowledge that they provide to the nation and the benefits that this latter draws from them.

It is on account of this specific aspect that the government has instituted a scientific and technical establishment, with the status of a public service, among other public establishments. A specific law was passed in 1997 enacting this Status, which is more flexible on certain aspects (adoption of more flexible regulations in the establishment; the possibility of reducing ceilings for funding) than those of industrial and commercial public establishments.

ISRA and ITA — the only research institutes with this status today — have witnessed positive change on administrative and financial matters.

It is worth noting that the laboratories that belong to research institutes and universities do not have an independent legal status. In some cases, this situation hinders

the exploitation of all existing potential for building partnerships, setting up multidisciplinary teams, and diversifying sources of funding.

Funding for Research

The annual research budget of Senegal is about 11 billion FCFA. In the 1970s and 80s, Senegal made considerable efforts to fund research, allocating 1 percent of its budget on average to research work. It is in this respect that the government set up two funds to support the national research effort by funding research and technological development initiatives. These are:

- The Fund for Promoting Scientific and Technical Research (FIRST) with an annual budget of 120 million FCFA between 1991 and 2001. In 2002, this amount increased and is expected to reach 250 million in 2003.
- The Fund for Scientific and Technical Publications (FPST) with an annual budget of 34 million FCFA.

These efforts to develop science and technology in Senegal are praiseworthy. But, much still needs to be done, especially with the drop in efforts observed over the past years. There has been a status quo, or even a drop, in the means provided by the State to cover its several financial obligations.

Some signs of improvement have been observed since the 2000 financial year. The trend has been changing since the government's decision to increase the funds allocated to FIRST and the launch, by World Bank, of the National Agricultural and Agro-industrial Research Fund in the programme for Agricultural Services and Assistance to Farmer Organisations (PSAOP).

The Government of Senegal needs, however, to strengthen its efforts in order to make research less dependent on foreign assistance. In the 11 billion FCFA that Senegal devotes to research today, over 60% comes from foreign partners. One way to do so would be by stimulating the private sector and encouraging it to play a more active role in funding research activities.

In the '80s the private sector provided about 2% of the total budget. As far back as 1983, the authorities decided to set up the Foundation for Promoting Scientific and Technical Research (FIRST) that includes members from the private and public sectors. After operating for fifteen years, the Foundation's results are far from our expectations.

Building on Research Findings

Research is no longer beneficial, even occasionally, to the national economy. A country's economic and social progress depends, in large part, to its capacity to exploit the results of its research and to master technological innovation in a well conceived programme for the transfer of technology.

Thanks to the joint efforts of national and foreign researchers in Senegal, commendable results have been achieved in national research on the various sectors of economic activity. However, there have been some difficulties in translating the results obtained on application fields, pilot units, and experimental laboratories into gains for development. It is worth noting, though, that less than 5% of research findings worldwide are used directly to promote development. Senegal's situation is no better.

The then Ministry of Scientific Research and Technology conducted certain activities to that end, including:

- The creation of a “technopôle” in Dakar [an area specially designed to accommodate and foster hi-tech industries];
- The creation in 1990 of a Grand Prix for Science offered by the President of the Republic [to encourage the national scientific community, re-launch national scientific production and build on the research findings of our Researchers];
- The establishment of a Biennial Science festival in Dakar (AFRISTECH) initiated in 1993 by the Ministry for Research.

While these measures and actions have had a positive impact, they remain insufficient to provide lasting solutions to the difficulties in making use of research findings. In fact, the efforts made to build on research findings are still constrained by real difficulties, such as:

- The lack of risk capital to fund technological development. The biggest enterprises based in Senegal are branches of multinationals and depend on their parent companies for technological innovation. As such, these branch offices have little use for locally produced technology;
- The lack of fiscal incentives that can promote the use by industries of research findings;
- The lack of dynamism in Senegalese Agency for Technological Innovation (ASIT) that is a body responsible for encouraging the use of research findings.

Sectorial Analysis

Social and Human Science Research

The social and human sciences include disciplines, such as philosophy, sociology, history, geography, ethnology, territorial administration, law, political economy, anthropology, and architecture. They are a package of instruments that can enable us to have a better understanding of development phenomena. This sector has a multitude of bodies that work under the various Ministries.

With the exception of IFAN, these bodies have low and insufficient financial and human resources with which to conduct large-scale research programmes. The duplication of programmes and the lack of coordination among the various institutions are

among the constraints which have been identified. The significant pool of human resources available at the University is not always used in an optimal manner. In fact, teaching assignments in this body leave little space for research activities. This is a major gap in developing university research in general and on the social sciences in particular.

Medical and Pharmaceutical Research

This component occupies a key position in the health development strategy of the Senegalese Government. The UCAD's Faculty of Medicine, Pharmacology and Dental Surgery and several other research institutions that play an active role in efforts towards these objectives have obtained significant results at the international level.

Senegalese researchers have been involved in some world-class achievements that include:

- the development of the hepatitis B vaccine;
- the development of multipurpose vaccines against leprosy;
- the discovery of a new retro-viral component called HTLV4n that is a variant of HIV1, which causes AIDS.

These results contribute to:

- treat parasitic, bacterial and viral endemic diseases;
- improve conditions for hygiene and nutrition;
- make good use of traditional medicine.

Agricultural Research

This is obviously the most significant sector, considering the volume of financial and human resources that it uses. The main bodies in this sector include the:

- The Senegalese Institute for Agricultural Research (ISRA);
- The National Higher Institution for Agriculture (ENSA);
- Cheikh Anta DIOP University (UCAD) in Dakar.

In addition to these national bodies, there are foreign or international research bodies that undertake research activities in the field of agriculture in Senegal, with the aim to:

- Develop vegetation adapted to our environmental constraints
- Improve animal health and production
- Assess marine resources.

ISRA was established in 1974. It is the most significant research body with over 170 researchers and an annual budget of 5 billion FCFA. Its accomplishments include:

- The discovery and improvement of crop varieties;
- Developing vaccines, notably vaccines for animals;
- Improving cattle breeds.

Agro-Industrial Research

Agro-industrial research is conducted mainly by the Institute for Food Technology (ITA), which collaborates with other institutes, such as IRD, CIRAD, ISRA, UCAD and ORANA.

ITA works mainly on:

- Preserving and processing agricultural and sea products
- Food biotechnology
- Nutrition
- Developing equipment for processing foods.

ITA has made considerable accomplishments that have not been built upon.

Table 1: Summary of strengths and weaknesses in scientific and technological research.

Weaknesses	Strengths
• Severe institutional instability	• Significant technical potential
• Gaps in planning, programming, managing and steering policy on science	• Political will to make research a top priority
• Multitude of governing bodies for research institutes and centres	• Availability of funds providing assistance for research
• Lack of activity coordination	
• Lack of qualified staff	
• Lack of consultation	

Technological and Industrial Research

Three research centres work specifically on this sector:

- The Study and Research Centre for New and Renewable Technologies (CERER);
- The Equipment Study and Research Centre (CEREEQ);
- The Institute for Applied Nuclear Technology (ITNA).

Senegal has no specific bodies working in areas such as computer science and remote sensing, even though several institutions cover these areas, including:

- ESP, UCAD in computer science
- CSE, UCAD, ISRA in remote sensing.

New Information and Communication Technologies (NICT)

ICTs have been chosen as a central area for research by 2015. Senegal seeks, as such, to become a service provider, especially through distance service delivery. Various projects have been implemented in this regard. They include:

- the administrative voice and data network;
- the industrial observatory; and
- Trade point.

Orientations and Proposals for Action

With the creation of the Ministry of Scientific and Technological Research, the goals are to:

- Build institutional capacity in the Ministry of Scientific and Technological Research
- Improve the system for coordinating research (to ensure sustainability)
- Reinforce funding for research by strengthening existing mechanisms and creating new ones
- Promoting teaching, research and development at the same time
- Promoting technological innovation, while replicating and building on results (the Senegalese Agency for Technological Innovation has been set up to that end)
- Review and update existing scientific and technical potential
- Establish a system for evaluating research on the impact of Scientific and technological research on people's lives.

To do so, The Ministry of Scientific and Technological Research has set up a system for gathering global data on scientific and technological research. This will make it possible for the Ministry of Scientific and Technological Research to have a database on research institutions, programmes and projects, and to take concrete measures for improving the Senegal system for Scientific and Technological Research.

In the light of this environment that is not conducive to institutional assessment, the mechanism will be established progressively. It is important for stakeholders in the research sector to participate fully in the assessment that will include three stages:

- Information and data gathering (Indicators);
- Self-evaluation; and
- Evaluation by external experts

LEBANON'S EXPERIENCE WITH SCIENCE POLICY REVIEW

Mouin Hamzé

It is my pleasure to congratulate UNESCO and IDRC, the organizers of this Workshop and to thank them for giving me the opportunity to address this panel today, on behalf of the National Council for Scientific Research - Lebanon.

The CNRS, is a public institution originally created in 1962 to assume major responsibility in the advancement of scientific research in Lebanon. Indeed, the CNRS assumes an advisory role consisting of drawing the outlines of the national science policy and an executive role by funding STI and through its 4 research centres and various programmes.

Let me start by giving you a general idea about the scientific research capacity of Lebanon. To illustrate this in 2003, CNRS has clearly favoured financing new projects implemented by multidisciplinary teams. Priority was also be given to research having a potential positive impact on the main productive sectors such as environment, public health and hopefully on human and economic development.

As a result of this approach, the CNRS received 141 projects compared to 90 in 2002, of which 40% are in medical and public health fields, 17% in the engineering sciences, 15% related to environment and another 15% in agricultural and food sciences, 11% in both mathematics and physics and unfortunately only 3% in social sciences.

Six months ago, with the support and assistance of UNESCO (Mr. Moustapha el Tayeb) and ALECSO (Mr. Bahloul Eliagoubi), and under the guidance of the international expert Dr. Peter Tindemans, the CNRS has launched an initiative for the development and adoption of a New Science, Technology and Innovation Policy for Lebanon. A participatory approach was followed and more than 60 Lebanese scientists are now contributing in drawing up this policy. Three task forces were formed dealing with: Medical sciences and public health, Physics and Mathematics, Industrial Technology and Engineering Sciences; Environmental, Agricultural and Biological Sciences. The three task forces met regularly and drew useful recommendations on the direction of research based on a SWOT analysis approach and derived from basic societal needs. Task forces included university professors, researchers, NGO representatives, engineers, social scientists, professionals and lead industrialists.

Although some of the findings reached were specific to Lebanon, the main findings (SWOT analysis, constraints, perspectives, etc.) had a general character and drew universal recommendations such as favouring quality and integrating STI with the national socio-economic policies.

Allow me to summarise some preliminary findings of the three task forces:

The medical and public health task force (TFM) drew 4 specific aims namely:

- Improvement of higher medical and health science education
- Improvement of the quality and cost-effectiveness of medical and health care
- Creation of academic/industrial/community bridges through biomedical and health related technologies transfer and development
- Establishment of a Centre of Excellence to host and develop qualified research and innovation in the field of biomedical sciences.

The task force on environment and agriculture (TFE) identified 4 general societal needs:

- Stabilize coastal deterioration through sustainable management
- Integrated supply-demand water management
- Grasping new agricultural economic opportunities
- Improved nutritional food quality

As for the Task force on Industry (TFI), it has built its debate on the following identified societal needs:

- Integrate/Sustain the management of energy, water, and other natural resources.
- Lower industrial operating cost (energy, equipment, and maintenance), improve productivity in industry and increase technology and information content
- Link information and communication technologies and strengthen basic science research for development
- Establish new suitable industries based on material sciences and technology for development and shift focus to higher value, skill intensive, export oriented industries in order to increase shares in regional trade and export performance and to secure access to developed markets offering “Special order and fast delivery”

Based on these societal needs, TFI reached the conclusion that human resources development and networking should be fostered and that the CNRS should favour research programs for industrial competitiveness and innovative applications. We expect to finalise STIP by end of 2003. The CNRS will be then be able to derive a scale of research priorities to propose to the universities and other research centres in the country.

STIP is an initiative launched by UNESCO and ALECSO with limited resources but with a great impact on the optimal utilization of public spending and a mean to attract national and international funds. STIP is meant to be a dynamic procedure that will be updated on a regular basis, a procedure for implementation, financing and monitoring will be adopted.

In conclusion, I believe that, in view of the present grim international context, this workshop convenes at an appropriate time to assist the research institutions of developing countries. We do hope that your debates and recommendations will lead to a better cooperation and visibility based on the “unshakable” principle, that the advancement of science and technology is an undisputable policy to alleviate poverty but also to support developing countries initiatives to better participate in the current efforts of the international community.

SCIENCE AND TECHNOLOGY IN THE WORLD BANK

Erik W. Thulstrup

The World Bank S&T Strategy: Recent Improvements

Over the years, the fate of science and technology (S&T) as a subject for studies in the World Bank (WB) has changed with regular intervals. The WB has at times felt a need for support from small, enthusiastic S&T teams, assigned to provide training for operational WB staff, to do strategy work on how science based projects should best be designed, and to provide a background for planned S&T activities in selected developing countries. At other times, such specialized support for strategic considerations and operations by the Bank has not been considered necessary. Furthermore, learning from WB experience from S&T lending has in general been limited, since proper evaluations of outcomes of S&T WB projects have only rarely been carried out.

Instead of investing in an extensive intellectual base for S&T, the WB has been action oriented, and WB lending for S&T in a wide sense has remained very high. While lending in connection with specific S&T projects on the average has been limited to a few hundred million USD annually, lending for science in sectors that are at least partly based on science, such as agriculture, industry, environment, energy, health, education, etc., has been huge.

It is therefore highly satisfactory that the WB in very recent years has made a concentrated effort to define its S&T strategy more clearly. In the spring of 2003 an important paper, discussing a strategic approach to S&T, was published by Watson, Crawford, and Farley.⁶ The paper had reached its final form through a number of extensive background studies, several meetings with bilateral donors, international organizations, and developing country specialists, and written reviews provided by a large number of specialists around the world.

The resulting paper examines the ways in which S&T may support the key goals of poverty alleviation and economic development in developing countries and how these themes have been dealt with in WB projects over the years. It is emphasized that a country's ability to understand, interpret, select, adapt, use, transmit, diffuse, produce and commercialize S&T knowledge is critical for its development. The paper further describes the importance of S&T for development within specific sectors and presents policy options for improving the effectiveness of S&T systems in developing countries. The paper discusses the experiences gained by the World Bank and some

⁶ See R. Watson, M. Crawford, and S. Farley: "Strategic Approaches to Science and Technology in Development." Policy Research Paper 3026, Human Development Network, The World Bank, Washington, DC. See also <http://econ.worldbank.org/view.php?type=5&id=25709> for an updated version of the paper.

donors in connection with S&T activities, and suggests some changes that the World Bank and its partners can adopt in order to improve the effectiveness of S&T projects. The main messages are:

- S&T has always been important for development, but the unprecedented pace of advancement of scientific knowledge is rapidly creating new opportunities for and threats to development; most developing countries are largely unprepared to deal with the changes that S&T advancement will bring;
- the World Bank's numerous actions in various domains of S&T could be more effective in producing the needed capacity improvements in client countries; and
- the World Bank could have a greater impact if it paid increased attention to S&T in education, health, rural development, private sector development, and the environment.

The strategy emphasizes four key S&T policy areas: education and human resources development, the private sector, the public sector, and information and communication technologies. A summary of the proposed actions and the goals to be reached is given in Figure 1.

Figure 1: Goals for the Proposed WB S&T strategy
(source: <http://econ.worldbank.org/view.php?type=5&id=25709>).

- To increase awareness of S&T and its role in development: The World Bank could foster communities of practice within the organization itself so that sectoral and cross-sectoral S&T issues can be addressed productively among the staff working on these issues and with the client countries. At the same time, the World Bank's comparative advantage in dealing with global public goods priorities and cross-sectoral S&T issues would be leveraged internally as well as externally under the auspices of the WBI's outreach capabilities.
- To increase attention to S&T in four key policy domains (human resource development, promoting private sector demand, public sector support to S&T, and ICT): Among the many actions that can be recommended in these areas, the World Bank might increase the emphasis on science education in basic and secondary education lending, include S&T as part of the renewed and expanded emphasis on tertiary education, place emphasis on the creation of linkages between firms and knowledge institutions, reform enabling environments for better use of knowledge, help governments with their multiple roles pertaining to S&T, and promote access to and use of ICT.
- To achieve greater integration of on-going S&T support: The World Bank could build on current "knowledge assessments" and pilot coordinated lending efforts across S&T-related sectors (Education, Private Sector Development, Rural Development, Health, etc.) and promote other synergies among the S&T-related initiatives.
- To increase and strengthen S&T-related analytical work: The World Bank could provide analysis and policy recommendations on global public goods priorities such as brain drain, food security and new agricultural technology, and effective S&T education in developing country settings. The World Bank would also expand its participation in international scientific assessments (such as the IPCC and the Millennium Ecosystem Assessment) that have global public goods characteristics and produce policy-relevant knowledge on critical development issues.
- To foster collaboration with a range of international partners: The World Bank would support and build upon the successful S&T capacity building initiatives of various bilateral NGOs and foundations, and increase professional contacts with representatives of the international science and technology policy community, including the OECD, UNESCO, the Third World Academy of Sciences, the Inter-Academy Council, the International Council for Scientific Unions, as well as national academies, science foundations, and especially experienced private sector partners and technology development specialists. ç

The Tasks at Hand for the WB: Operational Action and Learning

There is now an urgent need for the WB to implement the new, strengthened S&T strategy in connection with WB lending. In order to do so, a closer cooperation with donors and other agencies that have detailed experiences on what works and what does not, for example based on proper evaluations, and with experts from the WB client countries, is likely to be very useful.

One important issue is the need for conducive national S&T policies, or more precisely S&T and innovation policy, following an OECD suggestion. Many developing coun-

tries have at best weak S&T and innovation policies and an improvement of such policies would ensure a more fertile ground for future S&T based projects. But it is not always easy to decide how a national S&T policy can be established or strengthened; a standard solution does not exist, and different countries are likely to require different actions. National S&T reviews of selected countries, done in cooperation with donors and local experts, may be one of the activities from which the WB may benefit considerably in connection with project preparation and design.

Also on a more practical level the WB is likely to benefit from cooperation with other players in the field. Numerous questions in connection with concrete S&T investments do not have simple answers and such uncertainties frequently cause problems in connection with WB lending. There are numerous examples of such questions:

- How can the conducive national S&T and innovation policies best be supported?
- How should research funding be provided – by government decree, through free competition between proposals, or by regulated competition?
- How should research training be organized in order to both maximize useful outcomes for the developing country and limit brain drain?
- How can instrumentation best be provided to developing country researchers or industry?
- How can the (often very high) operational costs of modern equipment, as well as maintenance and repair, be paid for? And how should such equipment be replaced when it is outdated?
- How can it be ensured that laboratories and industrial activities satisfy modern safety and environmental standards?
- How should dissemination of research and development results take place – should it target the international expertise in the field, local knowledge users, or both? Does this require a reconstruction of the (often extensive) system of S&T journals in the country?
- Should innovations be patented?, and if so, where, and who should pay?
- How can a better gender balance be ensured in S&T projects?

By pooling experience from a variety of S&T support activities by the WB, donors, international organizations and their partners in developing countries, it will be possible to improve the present answers to such questions. Therefore, today the WB may be more ready than ever, not only for a more active participation in international S&T assessments, but also for increased sharing of experiences with the international S&T community, including S&T expert groups in developing countries, donors interested in S&T, S&T organizations, such as the Third World Academy of Sciences, relevant UN organizations, etc.

COMPETENCE BUILDING AND POLICY IMPACT THROUGH THE INNOVATION REVIEW PROCESS: A COMMENTARY

Lynn K. Mytelka and Banji Oyeyinka

At a recent ATPS network meeting, Banji Oyeyinka presented a paper dealing with the growing exclusion of Africa from the benefits of an integrated world economy (Oyeyinka: 2002). The data he presented on Africa's loss of global market share and competitiveness in traditional exports and the sharp decline in government spending on education, especially tertiary education, were startling. They are startling not only because of their magnitude but because they tell a deeper story about the inverse relationship between changes in the governance of technology at the global level and the evolution of national innovation systems in Africa. These two sets of changes have been moving in opposite directions ever since production became more knowledge intensive in the 1970s and competition, based on a continuous process of innovation, diffused widely around the globe as a result of liberalization (Mytelka:1999). If such trends continue inclusion of Africa will likely take place only at the margins of society and the economy. As recent financial shocks in Asia and Latin America, moreover, illustrate Africa is not alone here. To meet this growing challenge required closer attention to the processes of learning and innovation in developing countries.

In the mid-1990s, UNCTAD brought together a small group of consultants to discuss the creation of a series of Science, Technology, Innovation Policy (STIP) reviews for developing countries. The field had moved on from the quantitative, supply driven approaches based on science and technology indicators and organizations adopted in the classic Science and Technology reviews, of which a considerable number had been undertaken by the OECD at the request of its member countries, to a focus on innovation and a reconceptualisation of the innovation process as an interactive one. The OECD study, *Technology and the Economy* published in 1992 but preceded by extensive meetings among policymakers and academics and the introduction of Innovation Surveys in the European Union, the United States and a number of other developed and developing countries, were indicative of this change (Mytelka & Smith: 2002) and an innovation system approach was now thought to be more useful in uncovering the strengths and weaknesses of developing countries in the new global competition.

A year and a half later Mytelka joined UNCTAD as Director of the Division on Investment, Technology and Enterprise Development, the division within which the STIPs were carried out. The first two STIPs—Colombia and Jamaica—were undertaken by a team led by Zelka Kozul-Wright and the third, a hybrid review of Ethiopia was prepared by a team led by Taffera Tesfachew that included Banji Oyeyinka. whose work on innovation in small and medium-sized firms and his knowledge of policymaking within Federal Structures made him particularly appropriate in the new Ethiopian context. A short time after, we brought this experience to UNU-INTECH where we have since developed a research programme in the field of innovation systems at national, local and sector levels. Currently we are working with the Iranian and Nigerian governments to put in place some of the

ideas that have emerged from this earlier experience. We wish to share three of these with you today: the distinctions between capabilities and competencies and between institutions and organizations that add value to the innovation system approach and the utility of embedding a sector-specific focus within reviews of the national system of innovation. We conclude with a number of possible roles for donors in contributing to the strengthening of innovation systems in developing countries.

Why a Focus on Competence Building Within an Innovation System Approach?

Much of the traditional literature approached the problem of building local technological and productive capabilities in the developing countries from the perspective of North to South technology transfer. In this model, learning was imitative and 'practice made perfect'. These notions were embedded in the economic literature in concepts such as 'learning by doing'.

Only slowly, and largely as a result of the increased knowledge intensity-of production and the growing importance of innovation in sustaining competitiveness, has attention begun to refocus on learning to learn, learning by searching and learning interactively. This new approach to learning and innovation has involved a broadening of the range of knowledge capabilities that are needed beyond the technological and managerial *stricto sensu* and a recognition that these are not solely those at the level of the firm.

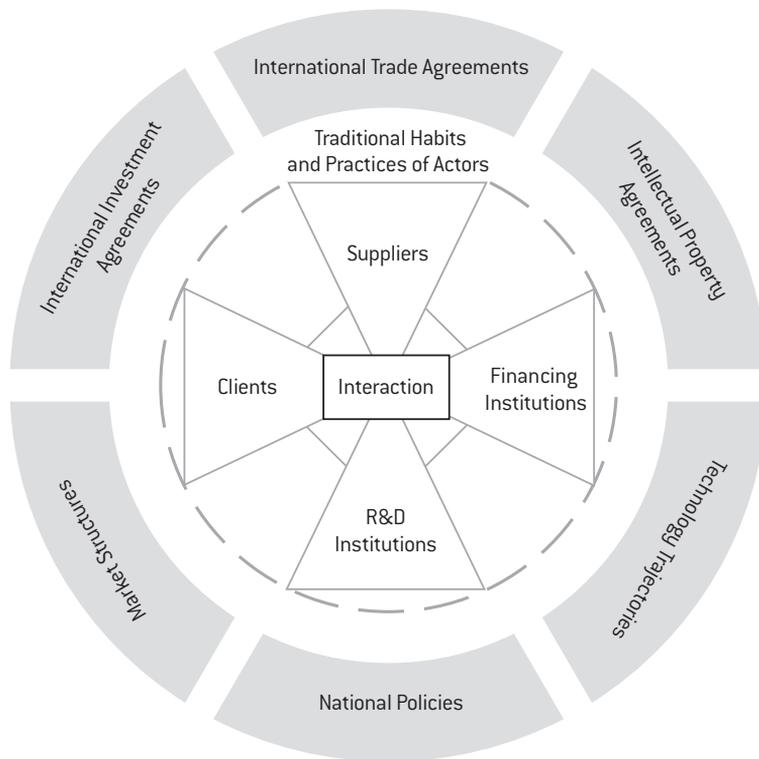
We thus distinguish a set of broader competencies from the more usual set of capabilities found in the development and innovation literature. These include openness, experimentation, coping with uncertainty, dealing with change, questioning established truths, building trust, and working within collaborative partnerships both across ministries as well as among firms and between firms and universities or research institutes. Competencies such as these, are not as amenable to standard training processes in which codified knowledge is transferred or through traditional apprenticeship practices where existing bodies of tacit knowledge are passed along. They cannot simply be acquired from outside or imitated by rote, because the very ability to build such competencies requires that they be internalized by the individual or organisation and subjected to continuous scrutiny, feedback and change. All actors in an innovation system must thus become learning organizations.

The Policy Dimension in the Design of Innovation Systems

A system of innovation is defined as a network of economic agents, together with the institutions and policies that influence their innovative behaviour and performance [Nelson: 1993; Nelson and Winter: 1982, Lundvall, 1992]. Underlying the system of inno-

vation approach is an understanding of innovation as an interactive process in which enterprises in interaction with each other and supported by institutions and a wide range of organizations play a key role in bringing new products, new processes and new forms of organization into economic use. Figure 1 graphically represents an innovation system. In this figure we distinguish ‘organizations’ such as universities, public sector research bodies, science councils and firms, that have traditionally been the focus of Science and Technology Reviews, from ‘institutions’ which we understand as “sets of common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals and groups” [Edquist: 1997, 7], that “Eprescribe behavioral roles, constrain activity and shape expectations.”[Storper: 1998, 24].

Figure 1: Graphic representation of a innovation system [Source: Mytelka 2002, p.17].



The utility of this distinction is threefold. First, it lies in the fact that simply having potentially critical actors co-located within a geographical space, does not necessarily predict to their interaction. Actor competences, habits and practices with respect to three of the key elements that underlie an innovation process – linkages, investment

and learning — are also important in determining the nature and extensiveness of their interactions [Mytelka: 2000]. The innovation system approach, moreover, acknowledges the role of policies, whether tacit or explicit, in setting the parameters within which these actors make decisions about learning and innovation.

Second it builds awareness of the extent to which habits, practices and institutions are learned behaviour patterns, marked by the historical specificities of a particular system and moment in time. As such, their relevance may diminish as conditions change. Learning and unlearning on the part of firms and policymakers are thus essential to the evolution of a system in response to new challenges.

Third, it redirects attention towards the flows of knowledge and information that are at the heart of an innovation system. Although these may, on occasion, move along a linear path from the 'supply' of research to products in the market, more often they are multidirectional and link a wider set of actors than those located along the value chain. Which actors other than, suppliers and clients, will be critical to a given innovation process cannot always be known a priori and they are likely to be sector specific. So, while it is important to have an overview of the 'national' system of innovation, sector specificity—in industrial structure and technological terms—and the particular habits and practices of actors in that sector will be major factors in shaping policy dynamics and policy impacts. Continuous monitoring of policy dynamics generated by the interaction between policies and the varied habits and practices of actors in the system, will be of importance in fine-tuning policies for maximum impact. Adaptive policy making is part of what makes an innovation system, a learning system.

It is generally accepted that systems of innovation in developing countries are poorly developed and known to be subject to widespread systemic dis-articulation. The analysis of policy failure from a systems perspective has been described variously as systemic failures, and systems failure [OECD, 1998:102; Edquist, 2001:235]. In addition to the absence of critical actors within the system, firms and other actors are subject to x-efficiencies and do not always perform at optimal levels [Niosi 2002].

Five broad types of systemic weaknesses are common in developing countries and provide a rationale for new sorts of interventions to build competences and promote greater systemic cohesion.

Rigidities in Organizations

The presence of obsolete or inappropriate institutions is characteristic of such rigidities. This may stem from the founding ideals of organizations that resist change in the face of new conditions and challenges. For instance, Clark (2001: 84), in respect of changes required in Africa's higher education system observed: "in a world that is changing very rapidly [i.e. in one in whose systems parameters are shifting almost as fast as its variables] the pure scientific model inherited from the nineteenth century is no longer viable in itself as a core methodology."

Sub-optimal Knowledge Networks

There may be no interaction, little interaction or inappropriate types of interaction among critical actors. The resulting information asymmetry among others, may lead to poor flows of information and knowledge among critical economic agents within the system of innovation. For instance, highly centralized knowledge “producing” institutions, which include universities and R&D laboratories, may be far removed from production systems. This has been observed particularly in developing countries [Forbes and Wield 2000].

Path-dependent System Failure

There is a tendency for organizations to be path dependent. Organizational inefficiency, may thus stem from their history and their connectedness to previous environments. Inertia may result from self-reinforcing networking now obsolete, or at best, needing radical reforms. Institutional resistance may not be solely a result of poor judgement or lack of vision but of fear from the outcomes of change. Innovation brings uncertainty, and as Niosi (2002: 294) points out, “organisations tend to stick to their own obsolescence plans, particularly if they are uncertain about the gains to be realised by the abandonment of existing technologies or organisation, and the adoption of the new ones. Sunk costs, in form of machinery and training of staff are another reason why change becomes a difficult proposition.”

Table 1: Coordination and linkages between selected technology support institutions and regional states in Ethiopia.

Technology Support Institution	Nature of, and Coordination Mechanism with Region	Linkage with enterprises and other centers
Micro and Small Enterprises Development Agency (MSEDA)	No links with regional states for now but expected to train and assist in technical services for similar regional bodies	Ad-hoc
Ethiopian Authority for Standardization (EAS)	No regional bureau on standards quality control assurance and certification. Propose to train personnel from regions in the future	No systematic mechanism for service delivery; presently seeking capacity for greater effectiveness
National Computer and Information Center (NCIC)	No regional center on computer and information	Industry has little capability in information technology limited linkage with enterprises
Research Development and Technology Adaptation Center (RDTAC)	No counterpart in regions and impact limited to Addis Ababa and environs	Ad-hoc interaction, based on demand from users, underutilized machinery capacity high turnover of staff
Leather and Leather Products Training and Development Institute	No regional counterpart but will start training in early 1999	N.A Source: Mission visit, Oyelaran-Oyeyinka, 1998.

Organisational ineffectiveness

A number of different types of organisational ineffectiveness, manifest themselves as system inefficiency (Niosi 2002). The relevance of existing research and training institutes, for example, has been questioned; the former for their lack of linkages with the productive sectors and the later for their limited ties to dominant actors in the economy such as small and medium-sized enterprises (SMEs). This gives rise to the poor co-ordination of knowledge and economic production functions leading to imbalances in the demand and supply for skills of the right kinds, quantity and quality mix at sectoral levels and overtime. Poor resource commitment for meeting organisational commitments including poor funding and inadequate staffing are also common and may lead to x-ineffectiveness.

While there is a general agreement that developing countries need to create organizations and institutions where they do not exist, and reform those that are functioning poorly, institutions for policy-making themselves lack both broad and specific competencies in their coordination functions. This is a serious drawback for developing countries and leads to a situation in which policy coordination is largely politically driven in the absence of strong market coordination. Table 1 shows a simple model of the poor coordination between actors in the system of innovation and the policy coordinating functions.

Institutional Gaps

In developing countries, the systemic weakness found in the innovation system is, in part, a result of the fundamental weakness of political-policy institutions and processes. There are institutional inadequacies that manifest themselves as lack of rules of the game, poor enforcement of contractual laws, and inadequate intellectual property laws, which may constitute disincentives to innovation and technological learning. These lead to inefficiencies in the functioning of innovation systems.

Policy Learning and Competence Building Through the STIP Process

From the above, it is clear that competence building in developing countries is required at multiple levels, individual and organizational, as well as across all actors in the system. Building linkages within an innovation system are critical for innovation and building competences beyond the traditional emphasis on training graduates in the fields of science, technology and management will be needed. We have emphasized four sets of actors and competences in this connection.

- Creating, strengthening and networking knowledge institutions such as universities or research organizations and both productive enterprises in agriculture, other natural resource sectors, manufacturing and services and policymaking processes for greater openness in information and knowledge flows, experimentation and dealing with change.

- Strengthening the ability of producing firms and their network components such as suppliers, contractors to deal with uncertainty; risk-taking and collaborative partnerships;
- Ensuring the kind of interactivity with technical and non-technical institutions providing metrological, marketing, financing and information services, and support that enables actors to problem solve, take a longer-term perspective and engage in strategic planning.
- Building trust –based relationship and channels of communication between policy-makers, enterprises and civil society.

STIP-type reviews based on an innovation system approach provide a useful methodological framework for analyzing the strengths and weaknesses of the actors in an innovation system – their competences and the nature and extent of the interactions between them – and for competence building at all levels. The innovation system approach is an especially useful tool for the development of policy recommendations, which is an expected outcome of the STIP review. For these to be meaningful, however, the STIP process must, in particular, seek to build competences in the policy sector and in its linkages throughout the system. Competence building of this sort, we believe, will also enhance the policy impact of STIP-type reviews.

In designing STIPs in the Nigerian (Bio)pharmaceutical sector and in Iran in both (bio)pharmaceuticals and petroleum/petrochemical sectors, we have thus focused on learning, competence- building and networking for innovation. In each case this has led to a re- conceptualization of the STIP review process as series of activities that combine traditional capability building with the development of new competencies. A few examples will make this clear.

- These STIPs would strengthen research capabilities in a group of local researchers who would largely be responsible for undertaking the STIP review. They would work collaboratively with a small number of individuals, both local and foreign, who have the specific expertise and/or breadth of knowledge and experience required for this particular STIP. Training in methodology and data collection techniques would be built upon local and comparative knowledge bases.
- At the same time, the process will build competencies in working as an interdisciplinary research team. It will also provide experience in networking more broadly with those from whom data and information will be collected. Subsequently, the role of local researchers will contribute to a recognition of the qualities of local research for evidence-based policy-making and help to create a trust-based relationship between the research sectors and policymakers.
- These STIPs will also train policymakers in a systems approach to innovation, the design of innovation policy and interactive policy impact assessment.
- In this process, competence building will take place through the creation of an inter-ministerial policymaking team which will provide opportunities in learning to collaborate across ministries for complex problem solving.
- Competence building through which the research team and an inter-ministerial pol-

icymaking team learn to appreciate each other's interests, experience, needs and the constraints under which each works thus ensuring buy-in by policy makers.

- Competence building through dialogue between stakeholders in the innovation process will also be possible through the STIP Review process.

How Might STIPs be Focused?

For the most part, STIPs have tended to be National System oriented. We should not ignore, however, the growing importance of regions within National Systems of Innovation and of the opportunities when working at the local level to analyze the transformation of clusters into innovation systems.

Though these earlier STIPs frequently look also at specific sectors, they did not embed these sectors within the broader policy environment. Policy dynamics, that is the interface between policies and the habits and practices of the actors in a sector, were lost in this process and so, too, was the need to monitor in a continuous fashion, the impact of policies. To embed a sector in the broader system, it would be useful to do more 'sector-based' STIP reviews but with a clear focus on interactivity among actors and the role of policies in setting the parameters within which actors take decisions. For example, in looking at the pharmaceutical sector, the role of the health care system—including drug policies and the many factors that shape access to health care services and the nature of demand for such services—need to be taken into consideration. The pharmaceutical innovation system is shaped by its interactivity with these other systems.

From a sector perspective, the system of innovation framework could fruitfully be employed to identify critical actors and the nature of their interactions in existing systems using detailed comparative analysis, but this is only the first step in what Edquist (2001:233) described as the need to go beyond the analogous firm-level 'benchmarking' process now so common. The typical benchmarking exercise leads to a static view of the change process as one of 'catching up'. It overly focuses attention on the pathway of the 'lead' firm and the policies of the country in which this lead firm has emerged. It fails to recognize that catching up sometimes means running in a new direction. A recent study of (bio)pharmaceutical innovation systems in five developing countries illustrates the multiplicity of pathways and policies to building an innovation system and these possibilities need to be further explored through the STIP process. It also demonstrated the need to create new actors, and/or redesign or abolish older organizational actors that have become impediments to the change process.

The diagnosis of systems should be followed by a process of dialogue leading to the development of interventions whether of a market or non-market nature, that moves actors closer to the kind of learning and interactivity required for innovation. At the

sector level, a reconceptualization of sectors as ‘innovation systems’ highlights the need for policy coordination as well as for the development of organizations to leverage the different knowledge bases that underlie sectors, promote interactions across actors in sectors and engage in policy coordination.

What Role For Donors?

Donors have a number of critical roles to play in building innovation systems in developing countries. They are important participants in the process of global agenda setting. They have the resources needed to identify the frontiers of scientific and technological change and share their knowledge and insights with developing countries. For this to take place on a continuous basis dialogue channels need to be developed both North-South and across actors in the South and the absorptive capacity of local actors will need to be strengthened.

To absorb such information, most developing countries will have to strengthen centres of excellence in the various knowledge bases required to build innovation systems relevant to their country and to link these knowledge bases to the policy-making process. Donors have a role to play in strengthening local and regional centers of excellence and in stimulating and supporting technology foresight and strategizing activities. They must become true partners in a knowledge creation process.

The technology foresight and strategic planning exercises will be significantly enhanced by studies such as the STIP reviews, which go beyond the compilation of aggregate data to understand the dynamics of the learning and innovation process in specific sectors, taking account of their embeddedness in national systems and historical contexts.

In sum, as investors (funders), in further innovation system studies, donors would contribute to policy learning and competence building in developing countries. From a learning and innovation perspective, their role in technology transfer must be broadened from that focused on technological capability building to one that stimulates and supports learning to learn, that shares experiences and knowledge and thus contributes to the creation of a self-sustaining and self-governing process of choice and change in the developing world.

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REFLECTIONS ON THE PROCESS OF REVIEWING NATIONAL POLICIES FOR SCIENCE, TECHNOLOGY AND INNOVATION (EXECUTIVE SUMMARY)

*Mullin Consulting Ltd.*⁷

Background to the Report

- This paper reflects the experiences of a consultant rather than a researcher) who has participated in some 20 country reviews organized by seven different sponsoring agencies over a span of more than twenty years.

The principal characteristics of the reviews are that:

- They are organized by the host government⁸ of the country in collaboration with some external agency (often but not always a funding agency).
- They are carried out by a small team of independent international experts, jointly selected by the organizers of the review and not including any citizen of the country under review.
- With the exception of the country reviews sponsored by the InterAmerican Bank (which are carried out for a specific purpose different from all of the other reviews), the reports produced are made public and are often the subject of public discussion.

The Origins and Evolution of “Science Policy Reviews”

- The reviews were first developed, in the early 1960s, as a tool within the program of work of the Committee on Scientific and Technological Policy (CSTP) of the Organization for Economic Cooperation and Development (OECD).
- OECD no longer engages in such country reviews, in part at least due to lack of resources.
- Some time after OECD had initiated its series of national reviews of the industrialised countries, UNESCO launched a sporadic series of reviews of science policies in developing countries.
- Regional affiliates of UNESCO, such as ALECSO in the Middle East, have also organized a small number of reviews.
- In the mid 1990s four new sponsors of country reviews appeared
 - Starting in 1992 in South Africa, the International Development Research Centre

⁷ Mr Mullin was unable to attend the workshop, but did provide a resource paper. This is the executive summary. Mullin Consulting Ltd., Kanata, Ontario Canada.

⁸ The sole exception within the list of Reviews discussed in this paper was the 1992-3 review conducted in South Africa in the months immediately before constitutional change in that country and for which the national organization involved was the Mass Democratic Movement, then the principal opposition to the Apartheid Government of the day.

(IDRC) became responsive to a limited number of requests to organize and finance country reviews.

- In the mid-1990s, the InterAmerican Development Bank (IDB)⁹ introduced an Innovation focus into its program of S&T Loans and began to use country reviews of the functioning of national systems of innovation as a pre-investment tool.
- The UNCTAD Secretariat operated a “Program of Science, Technology and Innovation Policy Country Reviews” to complement its work on transfer of technology.
- Very briefly, the National Research Council of the US National Academies of Science offered a program of national “Knowledge Assessments” but only one was ever carried out.

The Changing Objectives of the Reviews

- The OECD Reviews up until the 1980s had *two purposes*:
 - *first to enable countries concerned to appraise the political, economic and structural aspects of action taken to reinforce the role of scientific research in the achievement of national goals; and*
 - *Second, the Reviews help to enrich the pool of available knowledge on the content of science policies and their role as an instrument of government*¹⁰
- In contrast to these broad objectives relating to “Science” or “Research Policy”, recent reviews sponsored by IDRC have been much more focussed on Innovation Policy while those sponsored by the InterAmerican Development Bank have not only focussed on the assessment of the performance of “national systems of innovation” but have been commissioned as pre-investment analyses to underpin negotiations of loans for the strengthening of such national systems.

The Changing Policy Context of the Reviews

- The orientation of the country reviews has followed the evolution of science policy thinking in the world and, most particularly, in the industrialised countries of the OECD.
- The emergence, at the end of the 1980s, of innovation and of ‘national systems of innovation’ as central foci of policy thinking had a substantial impact on the focus of country reviews. While the early interest in the scientific activity of research has not, and will not, disappear, promotion of the economic activity of ‘innovation’ is now central to the design and execution of country reviews.
- In the early 1990s, the Council of OECD concluded that technical change — based on technological innovation and technology diffusion — was a principal driver of

⁹ The policy is documented in the paper “La Ciencia y La Tecnología para el Desarrollo: Documento de Estrategia” issued by IDB on November 19, 1999.

¹⁰ Forward to OECD, Reviews of National Science Policy: Norway, Paris 1985.

economic growth. At the same time trade was being liberalised in many parts of the world and 'globalization' became an important fact in the economic life of all countries, developed and developing alike. As a consequence, investing in the promotion of technological change to enhance national competitiveness has become a priority of most industrialised and some developing countries.

- In developing countries, many are now attempting to design and implement National Plans for Competitiveness, often with the assistance of the World Bank or, in the case of Latin American Countries, of the InterAmerican Development Bank.
- One practical consequence of the attention now paid to "technical change" in the economy of the country being reviewed is that much greater attention (in comparison to that given in earlier days) is paid to the state of the country's technological infrastructure - including, for example, the existence or otherwise of internationally accredited laboratories for the certification of products or processes.
- Given recent experience in small Latin American countries in which, in the short term, creation of a capacity for the diffusion of existing proven technologies is likely to produce economic benefits more quickly than a concentration solely on the promotion of domestic innovative capacity, which is likely to be very weak, country reviews in the developing world might be advised to discuss "national systems for the promotion of technical change" thus recognising that technology diffusion and technological innovation both need to be encouraged.

Methodologies and Resources

- The original OECD country reviews had a four step methodology
 - Step one involved the government of the country under review, with the assistance of the OECD Secretariat, preparing a Background Paper describing activities in the country relevant to the review.
 - Step two involved a visit to the country by a team of "Examiners" to carry out a set of interviews which had been established by the host government in consultation with the OECD Secretariat and the subsequent drafting of an "Examiners Report" by that team:
 - Step three was a "Confrontation Meeting" in which the Examiners debated the conclusions of their report with senior representatives of the Government being Reviewed (In many cases Ministers participated) and
 - Step Four was the publication of a final Report on the Country review which usually contained the Background Report, the Examiners' Report and a summary of discussions at the final "Confrontation" Meeting. the Examiners Report
- There were two main constraints on the OECD process
 - OECD never developed any guidelines for its examiners to use in carrying out their work; and
 - OECD had virtually no financial resources to support the work of the examiners who had to prepare their reports with limited personal contacts after the completion of the field work.

- Important changes in the conduct of national reviews came about in the series of reviews organized and financed by IDRC
 - First the reviews were adequately financed; and
 - Second, and of possibly greater significance, was the evolution of an intellectual framework, based on analysis of the functions of a national system of innovation and the performance of those functions by the diverse stakeholders in the system, which has facilitated the task of combining the expert opinions of the reviewers into a coherent analysis of what was observed during the field work.

The Framework of Functions of a National System of Innovation

The eight sets of functions are:

Central Government Functions

- Policy Formulation and Resource Allocation at the National Level;
- Specialised Advisory Functions
- Regulatory Policy-making;

Shared Functions

- Financing of Innovation-related Activities;
- Performance of Research, Development and Innovation;
- The Creation of Linkages and Knowledge Flows;
- Human Resource Development and Capacity Building; and
- The Provision of Technical Services and Infrastructure.

The main stages in the development of the Framework of “Functions of a National System of Innovation”

- First reference to the “Functions of a National System — IDRC Country Review of South Africa, 1994¹¹
- First full uses of the framework to “map” the roles of stakeholders against the functions of a national system — country Review of China (1995) and South African Green Paper on S&T (1996)
- First use of the Framework as the explicit framework for National S&T Policy — South African White Paper on S&T (1996)
- Development of a self-assessment tool for public technological institutes as stakeholders in a national system of innovation — follow-up study to country review on Chile dealing with public technological institutions (2000)

¹¹ For convenience, national reviews are dated by the publication date of the subsequent report rather than by the period in which the field work or report drafting actually took place.

The Functions of a National System of Innovation as the context for institutional evaluations

- When IDRC has negotiated country reviews in response to specific requests from governments, it has been open to applying the “Functions of a National System of Innovation” methodology as a means of clearly articulating the context in which specifically-requested institutional reviews have been sought. This has been done in two cases:
 - For an evaluation of the funding programs of Chile’s National Council for Research in Science and Technology CONICIT; and
 - For an evaluation of Jordan’s Higher Council for Science and Technology and its associated centres.

Country Reviews as a Vehicle for Promoting South-South Cooperation

- increasingly, the majority of the review team members are themselves from developing countries¹² and, since the same reviewers have participated in several of the reviews, they bring to each new review a broad and fairly current view of what is taking place in other countries of the region.
- Chile’s FONDEF¹³ is seen, throughout the region as a successful model of a financing instrument which potentially could be adapted for use in other countries; and as a direct consequence of this interest, the Executive Director of FONDEF has participated in several country reviews and has been influential in the analysis of potential funding systems.
- One major opportunity for South-South cooperation would lie in the development of a training course on the “Promotion of Technical Change” for officials of agencies in the field of science, technology and innovation policy.

The concept of “Mapping” a national system of innovation

- One interesting way to view the methodology which has been developed is to think of it as a ‘mapping’ of a national system of innovation.
- In this metaphor, a map of a system of innovation is a set of data placed on a matrix defined to by two sets of parameters — the functions of the system and the stakeholders in the system . The metaphor can be carried further in that there can be thematic maps — for example the elements of the map can be either factual statements (a certain stakeholder either does or does not have responsibilities for some specified functions) or can portray expert judgements about how well or poorly a certain stakeholder performs a certain function. In addition, the “scale” of the map can be changed — at one level the map might treat public technological institutions

¹² One notable exception was the 1995 Colombian review in which the Colombian executing agency specifically requested an all-Canadian team (perhaps influenced by, among other things, the desire to obtain Government of Canada Trust Funds to finance the preparatory activity).

¹³ FONDEF, Fund for the Promotion of Scientific and Technological Development was founded in 1991 as a direct government initiative to improve the level and orientation towards problems of economic importance of Chilean R&D. CONICYT is the administrator of this fund.

as a group while at another the stakeholders might be individual public technological institutions.

- One complement received by the review team on the China Review came from an official in Shanghai who said that after reading the report he was “beginning to understand what Beijing was trying to do”!

The use of Country Reviews for pre investment analyses

- The IDB reviews using the methodology have covered primarily the medium and small countries of Latin America as a result of a specific IDB policy to increase assistance to such countries.
- The analyses have identified the most fundamental weaknesses in the innovation systems of the countries examined and have underpinned the design of policy instruments which could address the most severe problems.
- Given that a common methodology has been used, it has been possible to identify common problems, the most complex of which is the lack of a functioning market for technology services. This is particularly acute in the smaller countries of Central America and the Caribbean but also is an important factor in Peru.
- One useful feature of the use of the same analytical framework in each of the reviews designed to be used as pre-investment analyses is the degree of comparability which emerges from the assessments. The sponsor of these particular reviews, as a Bank, can make some relative judgements concerning needs in countries facing similar problems when those problems are reviewed within similar frameworks.

Three key features of IDB sponsored reviews

- The degree of detail and expected focus of the recommendations emerging from the reviews,
 - Reports on these reviews are expected to contain detailed designs for new policy instruments such as financing programs and technology extension systems
- the range of specialized expertise included in the review teams and, in some cases, the volume of resources allocated to the overall process within which the external country review is embedded and
- the attitude of Ministries of Finance to the reviews
 - because they, along with other central agencies of government have to give prior approval to the initiation of the S&T Loan negotiation process and to the overall amounts of loan and counterpart contributions to be involved.

Conditions Affecting the Use of Review Results

- In some countries, the mechanisms for considering issues of science, technology and innovation as they affect the concerns or responsibilities of many ministries are weak and this can hinder actions which could flow from a country review. Even when such bodies exist, they are often given sweeping mandates but chose to focus narrowly on some elements of the list of their responsibilities.

- A second, more sensitive, issue relates to the weakness, in many countries, of the tradition of governments in using independent external advice. In a small minority of cases, review teams have come under pressure to adopt the established positions of a senior official engaged in the review process as a representative of the host country.
- The reviews, in their information-gathering phase, are dependent on the administrative performance of the host country executing agency

Examples of impact of IDRC-sponsored Reviews

Arguably one of the most influential country reviews sponsored by any agency was the review financed by IDRC at the request of South Africa's Mass Democratic Movement (MDM), an alliance led by the African National Congress (ANC), the Confederation of South African Trade Unions (COSATU) and the South African National Civic Organization (SANCO).

It led to and provided an analytical framework for

- South Africa's Green Paper on Science and Technology (A consultative document drafted in late 1995)
- The country's White Paper on Science and Technology adopted as government policy and endorsed by Parliament in late 1996
 - Out of the White Paper emerged a "System wide review¹⁴ of government science, engineering and technology institutions" again supported in part by IDRC, the establishment of a National Advisory Council on Innovation, the creation of an Innovation Fund, reorganization of the support to research in the universities under a new National Research Foundation, and a reallocation of some funding away from budgetary support to government institutions and into the new, competitive, Innovation Fund.
- As a result of response to the country review by the largest public technological institute, CSIR, there was set in motion a process which led in the short term to the creation of two experimental "Manufacturing Advisory Centres" to provide extension services to SMEs. This program is ongoing and there are now nine centers operated by the NAMAC Trust.

Some Administrative Issues

- **The Selection of "Examiners":** The substance of each country review is entirely dependent on the expertise of the small group of people selected to serve as "Examiners" or "Review team members" In most cases, those team members will spend two weeks in intensive visits and interviews and are then expected to provide valid and valuable advice to the government concerned. This task requires not

¹⁴ The Review gave rise to an overview, The System Wide Review, A report of the Panel to the Department of Arts, Culture, Science and Technology, 1998 plus a series of companion reports on the reviews of individual institutions and National Programs.

only good scientific or technical qualifications but also an understanding of how policy processes work and an ability to grasp governmental systems which often have policy traditions very different from the traditions of the reviewer's own country.

- **Opportunities for Mentoring:** The host country executing agency has an opportunity to provide mentoring to their less-experienced staff by having them accompany the members of the Review team on their round of interviews. The organization which made best use of this opportunity was the South African Mass Democratic Movement which had several mainly young members participate. Many of those who did participate in this way are now very senior officials in government.
- **Contributions needed from the host country:** The host country executing agency for the country review needs to provide two things:
 - It needs to have 'convening power' so that when organizations, particularly organizations from outside government, are asked to participate in interviews, the organizations invited are likely to accept; and
 - It needs to have the administrative capacity to organize and follow up on all of the details of often complex interview schedules

Some Lessons Learned

- The need for clarity in the definition of the tasks to be undertaken;
- The need for political interest and support;
- The need for adequate resources
- The need for reviewers with policy experience;
- The utility of an established methodology;
- The need for institutional support of the country's designated executing agency; and
- The need for institutional strengthening of national agencies involved in policy.

Graphic Design Link (www.studio-link.it)

Printing Stella srl, Trieste, Italy

Editor Michael Graham (www.mgedit.com), Ottawa, Canada

January 2006

Future Directions for National Reviews of Science, Technology, and Innovation in Developing Countries

National reviews of science, technology, and innovation are designed to help chart a course that encourages systems of scientific enquiry and broadens the engagement of scientific evidence in the policymaking process. The methods used for these reviews have varied between countries and among the agencies involved. To learn from past experiences, a blend of 60 representatives from 12 developing countries and international organizations discussed the impacts of previous science and technology reviews, studied how ongoing national assessments had been designed and were being implemented, and collectively deliberated on how future reviews might be enhanced. The organisations represented at the workshop included the World Bank, Sida, UNCTAD, OECD, and the Institut de recherche pour le développement (IRD).