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The emerging contextual space for priority setting in development research

Paul Dufour[1]

This chapter examines the changing role of knowledge for development, and the issues that developing countries need to address. It argues that learning and experimentation are a necessary condition for development in the pursuit of S&T and knowledge strategies. It examines the cases of four countries to situate this context, noting the growing renaissance centred on new donor approaches to investing in knowledge for development, and suggesting that more 'joined up' decision-making processes are required for these strategies to be effective. The chapter underscores the need for attention to critical areas such as science advice, science communication and public engagement, and the emergence of participatory science processes. It flags the evolution of South–South partnerships, but also constraints on knowledge for development from trade to security, and from ethical concerns to human resources. It also makes the case for using tools such as foresight to anticipate outcomes and foreign policy and diplomacy to make best use of political memberships in clubs. Developing economies must also be more attentive to their own needs when interacting with donors. In the end, the South will require strong leadership, long-term commitment from society and global partnerships if knowledge is to be fully embraced as a currency for social and economic development.

1 Introduction

In order to grasp the new dynamics of so-called development-oriented research it is critical to understand both history and culture. The stage can be set by two quotes from authors working in very different fields and times. In 1963 Steven Dedijer, who was influential in the invention of modern-day business intelligence, contended that underdeveloped countries 'cannot avoid being aware that they are essentially pre-research cultures. All kinds of forces, domestic and foreign, political and economic, moral and historical, are acting on the governments of these countries with the inexorability of a law

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of nature to take some sort of action to promote the development of science in their own countries'.[2] Some 40 years later the economic historian Joel Mokyr argued that 'What matters clearly is culture and institutions. Culture determines preferences and priorities. All societies have to eat, but cultural factors determine whether the best and the brightest in each society will tinker with machines or chemicals, or whether they will perfect their swordplay or study the Talmud. Institutions set the incentive and penalty structure for people who suggest new techniques'.[3]

There are legitimate reasons for paying attention to knowledge capacity and research-based efforts in the South. In today's knowledge-based society, it has become a challenge for any government to construct its own innovations and knowledge assets. From the perspective of putting in place the required structures and institutions, this chapter explores how the required investments are made, under what institutional settings, with what objectives in mind, and for whose benefit.

2 Learning from others

How states organize themselves to strengthen or improve their knowledge-producing, transfer and research capacities is often a bit of a hit-and-miss exercise. There are different methodologies one can use – the OECD, for example, has made an industry of adopting national innovation systems as a technique for assessing the complementarities among research and innovation actors in any given country or region.[4]

This may be fine and good for the developed world, but what of the developing countries? How can they learn, innovate and shape skills? How can they develop effective mechanisms, policies and tools to encourage science and technology (S&T) – conventional and indigenous – and manage the impacts on their respective societies? How can they ensure that they participate in the global pool of knowledge production and take advantage of knowledge to improve their standards of living, eradicate poverty, and strengthen their capacities for decision making?

In April 2003 IDRC and UNESCO organized a joint workshop in Paris to address many of these issues. Both organizations have a track record in assessments of national knowledge and innovation systems. The IDRC has produced such assessment reports in partnership with Chile, China, Jordan, South Africa and Vietnam, while UNESCO has conducted country reviews involving Albania, Bahrain and Lebanon.[5] The participants learned that the impacts of such reviews may vary. For some of them timing was critical. IDRC's presence in South Africa at the time of the transition to the ANC government

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2 Dedijer (1963: 61).
3 Mokyr (2002).
4 See Mullin (2003).
5 Other institutions that have also used this tool include the World Bank and its S&T assessments in China and Korea (see Dickson, 2003); USAID with its report on S&T and capacity development in cases such as India; Sida with its programming on universities and research in developing economies; UNCTAD with assessments of Colombia, Ethiopia and Jamaica; and the OECD with reviews of China, Korea and Mexico.

was a key factor in ensuring the successful impact of its S&T reviews. Politics almost always plays a role. How Vietnam has implemented the results of the reviews of its knowledge systems is in part tied to the changing nature of the political regime in that country. Champions are required. It makes no sense for outside experts to push recommendations for change unless they mirror the views of those in charge. Funding is also required. Unless states are willing and committed to change by investing in new support for knowledge production or institutional change, little will happen. And luck can be important.

The participants also learned that donors continue to play an important role. They are in a position to identify the frontiers of scientific and technological change in their own countries and to share them with developing countries. They can also open up channels of dialogue between North and South and among countries and institutions in the South. Donors also provide access to resources and programmes that can help strengthen the absorptive capacity of local actors and enhance the areas of expertise resident in various centres of excellence, and they can facilitate efforts to link this capacity to local policy-making processes.

Ultimately, an institutional capacity to absorb the recommendations for change is a must. However, as many in the Paris workshop recognized, unless there are sound frameworks for decision making, data collecting, communications and governance of innovation and knowledge infrastructure, little will come of recommendations designed to improve research and knowledge capacity. This was spelled out in the case of Jamaica, which flagged the need for regulatory and other requirements in order to put in place sound ICT infrastructures. Training is critical. This requires not just a well-developed education system, but also some institutionalized critical thinking on future directions for knowledge and its production. South Africa has put in place a variety of new training and development organizations for innovation since 1994. Ongoing assessments, benchmarking and evaluation are also crucial, as has been the case in Vietnam, where the government has attempted to respond to and update its activities related to the 1999 review conducted with IDRC.[6]

Responsibility for such implementation is not a one-sided issue, but requires the commitment and engagement of all levels of society. Stakeholder activities designed to involve these elements are critical to a successful course of action or policy direction. As the Paris workshop pointed out, learning from good practice is a healthy thing. Enhanced coordination and communication among donor groups on their respective approaches to partnerships for knowledge production needs to be reassessed. As a recent UNDP book has argued, the new network age has permitted alternative tools for capacity development and there is an understanding that local knowledge, combined with knowledge acquired from other countries and institutions in both the South and North, can contribute to a successful paradigm for growth and social development. ‘The notion that the only ideas for development that are worth trying are those that derive from the North looks less and less plausible’.[7]

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6 See Ca (2003).

7 Fukuda-Parr *et al*. (2002).

The same holds true for knowledge production. As developing states engage in advancing their knowledge and research systems, a learning process is taking place. Such processes soon lead to a better appreciation of the requirements for a stronger knowledge base and programme initiatives. But one should be wary of which models are examined. It is important to try to look at other models that are similar, rather than those that are vastly different from your own in order to affect change. The next section therefore examines four states that have undertaken such a transformation: India, the Maldives, South Africa and Vietnam.

3 Four states in search of knowledge

There are huge differences between developed and developing countries in terms of their capacity to generate and utilize knowledge.[8] In fact, there are huge differences *within* countries and *among* regions, which is why one has to be careful when using comparative data to make sweeping generalizations. The following examples of four very different economies show that clear attempts are being made by developing counties to manage and engineer knowledge.

In *South Africa*, the government, in its 2002 statement on research and development, made a point of noting that investments in science, technology and innovation would be designed to improve the quality of life with a focus on poverty reduction and improving national competitiveness in the international environment. The three pillars of the strategy are (1) to develop human resources in science, engineering and technology, focusing in key fields such as astronomy,[9] human palaeontology and indigenous knowledge; (2) to foster innovation centred around various technology sectors; and (3) to create an effective government S&T system. Among the areas of technology to be developed are those related to S&T for poverty reduction (health, energy and indigenous knowledge), new technology platforms in IT and biotechnology (South Africa has already launched a programme to improve the public understanding of biotechnology), and technology for manufacturing and resource-based industries. In the next generation of its national R&D strategy, South Africa has recently committed itself to focus on its human resources and on knowledge production.

In *India*, the government has embarked on the implementation of its 2003 S&T policy, which aims to improve the quality of life of all Indians, particularly of the disadvantaged; to make India globally competitive while utilizing natural resources in a sustainable manner; and to protect the environment and national security. The Indian Department of Science and Technology hopes to ensure greater integration of R&D activities into socio-economic sectors and to adapt indigenous resources and knowledge, particularly traditional systems of medicine. It is also working to enhance the country's basic research strengths in cooperation with the international science community, and to popularize

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8 Sagasti (2005).

9 South Africa is well positioned to become a leading global player in astronomy due to its geographical location; see Mokhele (2003).

science and disseminate information to society. With the efforts to move away from being a donor-assisted country, India hopes to become be an important contributor to the global knowledge pool.

In *Vietnam*, the gradual transformation from a socialist to a more open economy has required an assessment of how knowledge and research can contribute to this process. In 1997 the Vietnamese government asked IDRC to undertake a review of its S&T strategy. Vietnam places high priority on accessing technology from overseas and then applying and adapting it to the needs of the nation. While there was a focus towards a demand-driven S&T framework with the private sector playing a strong role, there is still a tendency among individuals and institutions towards supply-side S&T activities. Vietnam has decided to assess its international S&T cooperation as a key element of its knowledge strategy. This review, in 2004, examined issues such as human resources; mobilizing and using financial resources; promoting enterprises to improve their linkages via foreign direct investment and international trade; and the question of whether to make or buy technology.[10] More recently it has focused on how to promote core areas of strength in Vietnam, notably in the life sciences.

Finally, in contrast to these emerging players is a small island state, *the Maldives*. An archipelago of 200 islands, the Maldives economy has grown considerably over the past few years with heavy reliance on tourism and fisheries-based industries. While the December 2004 tsunami has clearly had an impact, concern for the long-term sustainability of these industries has pushed the government to consider how S&T can be deployed to address new opportunities. Its S&T Master Plan (drafted in 2001) emphasizes the need to use and adapt external technologies to national needs, rather than on specific areas of national innovation and research. The plan includes establishing a new institution, a National Research Foundation, to coordinate research funding in selected areas. The plan recognizes the importance of information and communications technologies (indeed, the responsible Ministry is called Communication, Science and Technology), since such technology is useless without information to be conveyed.

One could go on to map the knowledge strategies of the other 192 nations on this planet, but the point is this: good governance, strong economic development and well developed social and environmental practices are all dependent to some extent on a sound knowledge strategy. A strong, integrated approach to link the objectives of the various functions of governance is critical; otherwise, the right hand will not know what the left hand is doing, or worse, well-intentioned policies could cancel each other out.

Given this, it should come as no surprise that India's objectives are tied, for example, to national security and global competitiveness; that South Africa and the Maldives emphasize indigenous knowledge; and that Vietnam's approach seeks to link to the

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[10] Few countries have actually tried to link their domestic S&T agenda with international knowledge and trade policies in a systematic way. Some recent examples include the Swiss attempts to establish a scientific foreign policy (using foreign policy to link with science issues), and Finland (see Science and Technology Policy Council of Finland, 2003). For further information, see the special issue of *Science and Public Policy*, 29(6), December 2002.

global trade system. It should also come as no surprise given the nature of knowledge transfer that these countries pay particular attention to learning from elsewhere. In South Africa, for example, the R&D strategy is premised with a look at the innovation strategies of Australia, Malaysia and South Korea. As an observer to the OECD's Committee for S&T Policy, and (along with India) a member of the Commonwealth Science Council, South Africa can take advantage of these strategic linkages. For the Maldives, its small size requires international linkages and connections, and for Vietnam, its membership of the Asia Pacific Economic Cooperation (APEC) forum provides it with an opportunity to examine the use of knowledge through the APEC Industrial S&T Working Group in addition to the ASEAN group. In short, membership of such groupings can have its privileges if it can be used strategically and linked to domestic policies. And South–South partnerships are also emerging around innovation and S&T approaches.

4 Towards a global knowledge contract: does science advice matter?

The use of knowledge to advance society will need to be embedded in decision-making structures that are both independent of states, but also linked to some form of accountability. Society will expect nothing else, and with good reason. Turning knowledge into policy and then into outcomes requires a fair measure of integrity and trust. Look at any public opinion polls that measure civil society's assessment of trust in professional groups, for example, and you will invariably find that politicians are at the bottom of the ladder and health professionals and scientists near the top.[11] Dig a little deeper and you will see that public sector scientists are ranked higher than private sector researchers. That is why where a government places its knowledge assets is just as important as with whom.

In Zambia, for example, soon after the government had spent some considerable political capital rejecting genetically modified foods, in 2003 it adopted a $40 million National Biosafety and Biotechnology Strategy Plan to support human resource and infrastructure development. The Nigerian government, in a flashy, expensive insert in the *New York Times* on 14 July 2003, labelled its new approach – 'Towards a knowledge-based society' – as being dependent in large part on plans to make Nigeria a key player in IT by 2005. This approach is currently under review, with a science reform process sponsored by the Nigerian government and UNESCO. Argentina has announced the notion of a 'debt for knowledge' scheme, whereby 1% of the interest it pays to foreign creditors would be reinvested in the country's S&T institutional infrastructure, and has just launched a national nanotechnology strategy with US partners and funding. These examples imply a new, creative engagement with society and, of course, with global partners.

Public demand has dramatically altered the knowledge landscape. Specialized institutions and elites no longer have a monopoly on wisdom. The spread of knowledge (not just Western science) has led to the opening up of more global and national debates on issues

[11] See the National Science Board (2004).

surrounding risk, choice, culture, the environment and the quality of life. This demand, manifested through new groups, advocacy organizations and NGOs (all of whom have ironically mastered the new information technologies), is a driver of change – sometimes to positive effect, but not always for the better or to the good of society.[12] There are signs that research or knowledge producers are also changing their ways. No longer insular, protective or arrogant about the implications of the implementation of new knowledge, they have gradually come to adopt new strategies to work with the public at large, and eventually have become more adept at communicating and consulting on the results of research and the implications for the future human condition.

Advocacy groups such as the Action Group on Erosion, Technology and Concentration (ETC) and Greenpeace have both engaged in the debate on the introduction of nanotechnology, and have argued that lessons need to be learned from the public controversies that have surrounded biotechnology and its social and environmental impacts.[13] South Africa's Public Understanding of Biotechnology programme argues for the public to inform itself with the best knowledge available and then decide for itself ('Biotechnology and you: read about it, talk about it, think about it ... and decide for yourself').[14] Taking a page from this, the IDRC has mounted an exercise to assess the landscape for changing receptivity to genetically modified organisms (GMOs) and biotechnology issues in the South, and is looking carefully at how to engage a multi-stakeholder dialogue on this controversial subject. The World Bank has been the leader in urging a global assessment of agricultural science, knowledge and technology that can improve rural livelihoods and address poverty in low-income countries. Similarly, the UK government launched elaborate public engagement processes for the future development of both the research and the policy associated with biotechnology and nanotechnology.[15]

But it will take more than a change of strategy from knowledge producers to have an impact on policy outcomes. After all, as Yankelovich has argued, 'most public policy decisions must rely on ways of knowing – including judgement, insight, experience, history, scholarship, and analogies – that do not meet the gold standard of scientific verification'.[16] Decision makers will have to be more creative in integrating and learning from various sources of advice. Multiple networks of knowledge are growing in complexity (not just those associated with government), making it difficult to isolate the causes and effects of policy outcomes. Governance and risk management here take on a much more meaningful public policy function. One of the key forms that this advice takes place is through science advice. Increasingly, attention is being paid to this dimension of knowledge production within most states. The reason is that decision making increasingly has taken on a social and public value function, along with the usual

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12 Ausubel (1999), for example, argues that the greatest threat to future well-being is the rejection of science.

13 ETC (2003).

14 Visit www.pub.ac.za/. There are signs that these knowledge producers are taking heed of the hard lessons learned from the GMO debacle in the emerging technology arena, nanotechnology (see Willis and Wilsdon, 2003).

15 See www.ost.gov.uk

16 Yankelovich (2003).

examination of economic investment framework. Indeed, the debate in many societies has shifted from a narrow focus of competitiveness and prosperity to more complex, yet socially inclusive innovation and knowledge trends.[17]

As a result of the growing nexus between science, citizen and state, many countries and organizations are reshaping their formal (and informal) science advisory mechanisms, while keeping an eye on how others do it. This latter point is critical since much of what is being discussed as 'changes in knowledge' and its 'impact on society' is not limited to domestic sources, but has become globalized.[18] The SARS epidemics, mad cow disease, HIV/AIDS, disaster mitigation and food safety scares are but some examples of issues that require transboundary advisory structures and channels. But science advice must go hand in hand with other forms of governance – it needs to be embedded in the full machinery of government. As Tony Blair bluntly put it: 'Bad science didn't cause the spread of BSE; it was bad agriculture and poor government'.[19]

The attempt by the UN to re-examine its own structures of science advice is a good example of recent recognition of the importance of this issue. In the 2002 report of the National Academy of Sciences, *Knowledge and Diplomacy*, the authors argue for a series of changes. First they recommend that the governing bodies of the UN that have substantial responsibilities for implementing sustainable development programmes should each create an Office of the Science Adviser or equivalent facility.[20] They further advise that each such facility should adopt an appropriate set of general procedures based on best practice and procedures of science advice, that the UN should help member states to strengthen their own scientific advisory capabilities,[21] and that assemblies and other deliberative bodies should make greater use of scientific assessment mechanisms that have transparency and credibility. Some of this advice was further elaborated for the UN World Summit in September 2005.

One should be circumspect about science advice – it is after all, only advice. It can be acted on but may also be (and often is) ignored. It is only one part of the policy equation. If science advisers are not used (or studies requested), their relevance quickly becomes an issue. In Canada, for example, the Advisory Council on Science and Technology, which (on paper) advises the Prime Minister on issues of national importance affecting S&T, was largely ignored by the past two ministers responsible for its work. Today, it has undergone a transformation and has been given a new remit to better address urgent

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17 See Bozeman and Sarewitz (2002).

18 See Fukuyama and Wagner (2002).

19 Tony Blair, 'Science matters', speech to the Royal Society, London, 10 April 2002.

20 Similarly, the UK government through its Office of Science and Technology, has suggested that each ministry or science-based department should have their own chief scientific advisers (UK Department of Trade and Industry, 2003), who would meet on a regular basis.

21 On a related note, the National Academies have been working with both the African Academy of Sciences and the Arab states to introduce effective science academies that could serve as advisers on significant science-based issues of public policy for those regions. In February 2004 the NAS announced an initiative, with funding of US$20 million from the Gates Foundation, to stimulate the emergence of effective national science academies in selected African countries. http://www4.nationalacademies.org/news.nsf/isbn/02092005?OpenDocument.

questions. In April 2004 the Canadian Prime Minister appointed a National Science Adviser to his office for the very first time. In a similar vein, in the UK, the Council for Science and Technology (CST) has just undergone a quinquennial review, to which the government responded by stating that it will ask the CST to organize its work on five broad themes: sustaining and developing science, engineering and technology (SET) in the UK and promoting international cooperation, SET and society, SET education, SET in government, and SET and innovation.

Given its very nature, science advice needs to address global as well as domestic issues. For this reason, science advice is increasingly seen as an integral part of foreign policy, international finance, trade, global ethics and sustainable development issues. A more global science advisory capacity is required. While there are clubs that meet periodically to discuss such questions in the European context and the G8,[22] quite often the developing world has little say in such structures, nor does it have a major presence. Groups like the InterAcademy Panel established by the National Academy of Sciences on international issues have established a creative structure – the InterAcademy Council (IAC) – to provide these links. The IAC brings together the advisory expertise and experience of a worldwide group of national academies, including those in Brazil, China, Mexico, South Africa, and the Third World Academy of Sciences. In 2004 the IAC issued a major report, *Inventing a Better Future*, on ways to promote worldwide science and technology capacities for the 21st century. In 2005 the UN Commission on Science and Technology for Development published a report on the application of S&T to meet the Millennium Development Goals, which includes suggestions for enhanced science advisory bodies.[23] Leading up the G8 Summit in July 2005, the science academies of the G8 and some developing economies produced two public statements on science and technology for African development and on climate change.

Thus, science advice has undergone a much-needed renaissance, one that will look to using the knowledge assets and expertise of many states to resolve issues affecting sustainable development.

5 A failure to communicate

Knowledge networks of the future, especially those affecting the South, will be challenged by at least three key facts – that knowledge does not substitute for ethics, that new technologies require social and institutional innovation, and that geopolitical developments may hamper rather than strengthen international knowledge networks.

The first issue was succinctly raised by Prime Minister Tony Blair in 2002, when he stated that ‘Science is just knowledge. And knowledge can be used by evil people for evil ends. Science doesn’t replace moral judgement. It just extends the context of knowledge

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22 The Carnegie Group of Science Ministers for the G8 meets twice a year to discuss (off the record) issues of mutual concern amongst the G8 membership (see Bromley, 1996).

23 A good deal of this has been stimulated by the work of the Task Force on Science, Technology and Innovation; see UN Millennium Project (2005).

within which moral judgements are made. It allows us to do more, but it doesn't tell us whether doing more is right or wrong'.[24] For the advisory apparatus to be effective and politically attuned, it will need to pay attention to issues at the margins of (but not marginal to) knowledge development. A key concern surrounds ethical and legal issues affecting the introduction of new and emerging technologies in both developed and developing states alike. Most organizations, from the UN system through to Greenpeace, are taking up this challenge. Before September 11, 2001, the biggest debate facing the Bush Administration was in fact the ethical issues surrounding the use of embryonic stem cells for reproductive purposes. Other countries have followed suit and are now debating human cloning, xeno-transplantation and other medical issues associated with the revolutionary developments in the health sciences. A similar debate will emerge on nanotechnologies as countries like China, India, Korea, the Philippines, South Africa and Argentina adopt strategies for these new technologies. These issues are ripe not just for ethicists, religious leaders, philosophers and lawyers, but for concerned citizens as well. The mere mention of the need for biotechnology and GM crops is enough today to generate a raft of spins on the good, the bad and the ugly of this issue.

The media (including various Internet applications) will need to be engaged in such future debates. They play a strong role in shaping debates, and can influence public policy in significant ways. The adage that politicians are scientifically illiterate and scientists are politically clueless is not far off the mark. Add to this the often made observation that scientific communities tend to be insular or even arrogant, and combine this with the notion that governments are prone to spinning information to suit their needs, and you have a deadly fuel that can ignite quickly. Linking science journalists, communicators and practitioners of research and knowledge is a key element of a successful knowledge strategy. In the UK and Canada, efforts have been made to strengthen the communication of science to the general public, and guidelines have been produced to assist this process. In Canada, for example, these guidelines are intended to help shape communications as an integral part of the government's S&T policy. A recent report argues that federal science departments should embrace the concept of participatory communication, whereby audiences engage in dialogue, deliberation and decision making; adopt communications by integrating this element in the early planning phases of S&T programming; develop comprehensive communications strategies to complement and support the conduct of S&T; and invest in S&T communications planning, training and delivery.[25] Governments everywhere are realizing that in order for the public to both understand, become active in, and be informed of decisions that will affect public policy, they need to be part of the process, not separate, or worse, separated from it.[26]

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24 Tony Blair, 'Science matters', *ibid*.

25 CSTA (2003).

26 At the global level, similar challenges are being addressed. For instance, the SciDev website www.scidev.net provides reliable information on issues related to science and science-based technology that impact on social and economic development. The service, funded in part by donor agencies and supported by the journals *Science* and *Nature*, is a valuable tool in assisting decision makers from the developing world and other professionals interested in the interaction between science and development. The site offers news and dossiers on issues such as the brain drain, GM crops, biodiversity, climate change, ethics of research, and most recently on R&D. Its geographic spread is

If the research and knowledge communities are to build more powerful alliances with states and other sectors they will need to consider building on the changing dynamics of the science–society interface and develop newer tools that are more representative of the issues involving global civil society itself. Educating people is not the answer, as this implies a one-way flow of knowledge from the expert to the layperson. Rather, the issue is about involving the key stakeholders in all societies in the decision-making process, not just meting out information (which almost always has some spin on it).[27]

The second issue that will challenge knowledge networks, especially those in the South, relates to the fact that new technologies also require social and institutional innovation. Anticipating change will be one of the most important dimensions of this challenge. New technologies will never achieve their full potential unless they are accompanied by social and political innovation that alters the framework within which economic choices are made.[28]

So how can societies anticipate change and scan the horizon, and how do they put into place new mechanisms to do this? This will be a major challenge for societies bent on using reliable knowledge to make choices. Here, the issue is how to engage in a dialogue that will potentially alter visions of the future. Private sector firms engage in this type of exercise, Shell International being probably the most well known. But increasingly, governments are now experimenting with different forms of foresight exercises. UNIDO has recently produced a summary of these national exercises to highlight some of the common themes that are emerging with respect to economic and social change.[29]

Of course, this all sounds well and good, but as the adage goes, if you can't forecast well, forecast often. The UK, Germany and Japan have years of experience in this type of methodology, producing biennial versions, but gradually the list has expanded.[30] Foresight activities also require sound data collection and analysis. The data issue is problematic in many respects as several countries do not have the institutional capacity to collect the necessary data and analyze it in a way that can be helpful for decision makers. The UNESCO Institute for Statistics has launched a strategy that will elaborate

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increasing, with regional networks in sub-Saharan Africa, Latin America, Asia and China. As of May 2004, 54% of the site's 10,000 registrants were from developing countries, the top five being India, Brazil, China, Argentina, South Africa and Mexico.

27 For an interesting comparison of how the private sector and NGOs communicate complex S&T issues, see Einsiedel (2003).

28 Willis and Wilsdon (2003).

29 Among these common themes are: technological development will be the key agent of change; life cycles of products will be shorter; demands on education will increase; in developing countries, ICTs and biotechnology will dramatically influence the possibilities of growth; globalization will become even more accentuated with free flows of information, investment capital, ideas, products and services between countries; the proportion of women in the workforce will increase and a series of new systems and models for childcare and housing services will emerge (see UNIDO, 2003).

30 The International Council for Science (ICSU), for example, recently published a review of these reports and suggested areas that have an international or global scope for further assessment (Teixeira *et al.*, 2002).

requirements for S&T data and indicators in developing countries.[31] Creating demand for such information and linking data needs will be a challenge in this area. But this is one of a complex series of questions that needs to be addressed if communication of knowledge processes is to be adequately addressed. There are some bigger issues on the horizon though.

Are there brakes to local innovation and global knowledge production? As the public debate becomes more heated and engaged in the coming years over the development of knowledge, there will be more calls for ensuring a sound social function to this knowledge. To borrow from Auguste Comte's dictum: 'savoir pour prévoir, prévoir pour agir' ('knowing to foresee, foreseeing to act'). Those societies that have invested heavily in knowledge over the past 40 years are beginning to understand the hidden costs of such investments. True, knowledge has provided many gifts, but there are limits: limits in terms of costs, limits regarding choices and priorities, limits with respect to technical tolerance and risk, limits to ethical standards, etc. Above all, there are society's transactions costs. The bar has been raised. More will be expected of investments in this knowledge – more accounting, more transparency, more translation of the benefits and costs – some of which will fall on the shoulders of the research communities, some on the public, and some on the state.

The third issue that will challenge knowledge networks in the South relates to geopolitical developments. Ironically, at the very time the West has called for greater investment in knowledge (10 countries are responsible for over 80% of the world's total expenditures on S&T) in the developing world, and at the very moment that technologies have increasingly become more 'open-sourced' and freely available, geopolitical and security issues threaten to stall the potential for a new knowledge renaissance. Trade issues are blocking the ability of the South to develop intellectual property regimes that are relevant to their respective economies, including concerns over bioprospecting, and access to generic drugs for health care. Subsidy regimes for agriculture in the West are hampering the development of export markets for the South, not to mention their research infrastructure for agriculture. The development of global research organizations to address social and economic gaps has been short-circuited as funds are slow in coming. National policies designed to address a strengthened innovation and research effort are poorly integrated into national policies designed to assist developing countries; quite often, these policies conflict. Also, the knowledge community will be challenged to address its responsibilities as the landscape shifts with many more players than before. The media will play an increasing role in this; the public will become a more diverse stakeholder in these debates.

The geopolitics of security and the moral compunction of aid will have counteracting effects on the potential for a truly open knowledge system. The debates over whether the research community should refrain from publishing certain reports because of concerns about national security or the international spread of 'dangerous' technologies, will grow. The restrictions on movements of skilled personnel in certain fields, and from certain states, will clearly impact on creativity and entrepreneurship. Paradoxically, the

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[31] UNESCO Institute for Statistics (2003).

knowledge community will be drawn into the security and defence fields as the demands in these areas grow, and the higher education community will feel the impact of this on enrolments and faculties. Already, visa restrictions are limiting movements of researchers, and foreign students are being watched. Certain key technologies in IT, biotechnology and nanotechnology will be contained because of security concerns. At the very time that the university community is becoming internationalized – with more and more players having a role in knowledge production – there is public pressure for them to be more responsive to a risk environment. New structures for knowledge production will emerge that respond to such limits.[32]

6 Linking up and linking out

Constructing knowledge networks around such impediments will be tricky. But a key will be continuous learning and investment in training and education. Paying attention to grey matter will be a major issue for developing societies. It is not for nothing that the number one Millennium Development Goal is universal primary education, or that the World Bank has focused on tertiary education systems, or that the G8 research councils have examined science education as a key element of development. All societies have their own rich pools of talent – entrepreneurs, skilled crafts persons and knowledge producers. Providing the right incentives and institutional capacity to attract such development is what often distinguishes the richer societies from the poorer ones. A healthy mix of investing in national educational policies for growth, and establishing strong linkages with the diaspora abroad will be critical investments to consider.[33] The development of national or regional centres of excellence will help keep talent at home, along of course with strong professional recognition of the knowledge producers and adequate support through wages and infrastructure.[34] Investing in teachers and rewarding them is also essential. Some countries have tried to develop teachers' awards to provide incentives in this direction. Encouraging diplomatic corps to use their networks for increased linkages to the diaspora and to new opportunities for investment in ideas and innovation from their respective host countries is another strategy in the knowledge toolkit. Countries like Argentina, China, Colombia, Eritrea and South Africa have all introduced strong incentives and mechanisms to tap into their talent pool living abroad.

In the end, specific attention must be devoted to a suite of measures that will maintain a healthy national knowledge system linked to the global environment. The rhetoric of investing in knowledge has to be followed up with the reality of long-term (not on and off) support for skills and people. Institutions and integrated policies that complement,

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32 The US Department of Homeland Security has an entire budget and sub-structure devoted to technology that subsumes the research activities of several existing agencies. As a consequence, it has become the biggest single recipient of funding for research in the US government. In Canada, a new programme for research and technology production in defence-related areas is now the biggest single recipient of new funding for a government laboratory.

33 See Gaillard (2003).

34 Of course, such investments are not limited to the South. In Canada, one of the principal reasons for the creation of 2000 well-paid chairs in research centres and universities was the need to address the brain drain of talent to the US.

rather than contradict each other need to be viewed as assets, along with attention to the specific cultural, economic and social fabric of the society one is trying to improve. Capacity to learn has to be built in – not just to blindly copy other models, but to study and analyze carefully the good practices that can be gleaned from such exercises (including examining the right countries for comparison). Also, an advisory and communications capability is needed that is able to interact appropriately with various stakeholders in society to ensure adequate and effective decision making about future knowledge strategies. Finally, the careful monitoring and analysis of global developments will be a *sine qua non* for positioning the society and economy in a well-rounded approach to development.

In this last context, more attention needs to be paid to the strategic use of and learning from regional and global clubs. All countries belong to clubs of one form or another (some belong to too many, making it difficult to provide adequate funding or inputs).[35] The use of such forums, whether the UN system, APEC, the Commonwealth, the African Union, the Organization of American States (OAS), la Francophonie, or NATO, etc., offers countries rare opportunities to leverage funding and talent. It is rare that states pay much attention to evaluating the benefits or impacts of their membership in these clubs. In fact, most states often join clubs because they see a political advantage to such adherence, not necessarily because the membership offers substantial intellectual rewards. Canada, for example, as a member of the G8, takes it as a given that it will have to continue to belong to many clubs simply because of the cachet such membership brings. Nevertheless, because of their limited resources, developing countries in particular should be paying more attention to how they can benefit from selected knowledge forums. The recent case of the government of Tanzania requesting its ambassadors in 14 countries to monitor and report on the GMO debate perhaps offers an example of how developing countries could deploy their trade and foreign policy assets to monitor S&T issues.

An assessment of existing and potentially new memberships should be developed in such instances. In addition, regular, careful examinations of bilateral and multilateral S&T and related agreements should be introduced into decision-making systems in order to ensure that national and international objectives can be met.

7 Renaissance of development research

There is another side to this equation. International organizations must themselves become more attuned to their clientele. It is axiomatic that international organizations are experimental and learning institutions. Nevertheless, they must be attuned to changes in the landscape. The Canadian action group ETC has radically transformed itself over the past few years to focus its efforts on emerging technologies that may have significant impacts on society. As part of its new long-range plan, the Swedish International Foundation for Science has substantially increased its work in support of young scholars

[35] It stands to reason that as more countries are created, more clubs will emerge, and that as knowledge becomes more specialized, the number of forums to discuss specific issues will also increase.

from low- and lower middle-income countries. USAID is exploring a new approach to supporting science and technology in specific regions of the world.[36] The Global Research Alliance of technology organizations has been established to create a network designed to build on opportunities for technology exchange and joint ventures – in short, to fill a perceived gap. NEPAD has established a new African Forum on Science and Technology for Development. The UNDP Human Development Report 2003 argued for a series of international forums to help establish research priorities required to meet the technological needs of the developing world. The list goes on.

What is behind this renaissance of institutional experimentation in development research for knowledge and capacity building? The World Bank, the Rockefeller Foundation and IDRC are positing that there is a renewed attention within the donor community to the important role played by knowledge, and research for development. Why has there been a sudden resurgence of the role of knowledge for development? Donor agencies are retooling as they address the new challenges of knowledge production in the South. But what is being done to integrate knowledge into the mainstream of public policy decision making and governance issues? The ability of governments to join up policy streams from various areas will become critical over the next decades as the advance of knowledge outpaces the ability to respond and be proactive. To some extent this is already happening in the development and aid policies of some countries. For instance, the International Assessment of Agricultural Science and Technology for Development, led by the World Bank, is intended to bring together a range of stakeholders involved in the agricultural sector to share their views and reach a common understanding and vision for the future. This effort to develop partnerships and provide robust information to policy makers represents a new generation of such research for action models. On another front, Canada is experimenting with a new approach to development assistance, one that will devote no less than 5% of its total domestic R&D to a knowledge-based approach to help address the most pressing problems of developing countries. It may also be time to consider some form of 'grand challenge' among like-minded donor agencies that can provide larger-scale institutional and governance capacities in the South devoted to the intersection of research and public policy.

Knowledge will continue to expand. Institutions designed to advance this knowledge will also increase. Donor agencies have a significant role to play in coordinating their efforts across the spectrum of knowledge issues that have emerged. The developing countries have an opportunity to position themselves well in this new arena if they pay attention to the lessons of the past, and help shape and dictate the direction of this new frontier of knowledge.

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[36] USAID has been the subject of a review by the NAS to examine its science and technology to support health care, sustainability and other aspects of development assistance. DfID has also been the subject of testimony before the UK House of Commons Science and Technology Committee.

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