

***CAPACITY
FOR
DEVELOPMENT***

8

***NEW SOLUTIONS
TO OLD PROBLEMS***

EARTHSCAN



PART 3: Knowledge

“Scan globally, reinvent locally” (Joseph E. Stiglitz)

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foreword

Developing capacity has been a fundamental component of international development assistance since the Marshall Plan. The huge success of that far-sighted programme, however, inadvertently generated an overly simplistic and optimistic view of what worked: Simply transfer capital and know-how to other countries, the thinking went, and swift economic growth will follow.

There have been some notable successes in trying to make these principles work in practice but overall progress has so far been uneven.

If capacity development initiatives are to have a pivotal role in helping developing countries meet the challenge of the 21st century, in particular the Millennium

Development Goals, we now need to take this process a step further, looking more closely at the underlying assumptions about:

- the nature of development as a process of societal transformation, and the fundamental importance of indigenous capacity for this transformation;
- the nature of capacity and capacity development, including individual skills, institutions and societal capacities;
- the nature of knowledge, where it is located and how it can or cannot be transferred and shared; and
- the nature of the aid-donor-recipient relationship, which has profound consequences for success and failure in developing lasting capacities.

The United Nations system was a pioneer in the field of technical cooperation, and capacity development is its central mandate. UNDP has long played an important leadership role, both as a source of technical cooperation funds and advisory services, and as the home of innovative intellectual research and analysis on these questions. This book, which is part of a broader research effort that UNDP is carrying out with the support of the Government of the Netherlands, is aimed squarely at helping stimulate discussion around this important issue. As such it should be seen as the beginning of a process of debate and dialogue around the broader issue of improving effective capacity development.

The book contains a range of views from practitioners, academics and policy-makers about what has gone right with technical cooperation in recent years, what has gone wrong, and how to do it better and perhaps very differently. In so doing, it focuses on the questions of indigenous capacity, ownership, civic engagement and new possibilities for knowledge-sharing, for which the revolution in information and communications technologies offers ample opportunities. The book draws from the operational experience, policy analysis and intellectual work of UNDP, brought to bear through the three lead authors from the Evaluation Office, the Bureau for Development Policy and the Human Development Report Office.

Not everything in the book is new. Taken together, however, its conclusions may help point the way to a genuinely new vision of capacity development that is firmly founded on genuine ownership by the ultimate beneficiaries of development efforts: the governments and citizens of developing countries.



MARK MALLOCH BROWN
Administrator
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3.4 DEVELOPMENTS IN PRIVATE SECTOR KNOWLEDGE-BASED ENTREPRENEURSHIP IN THE SOUTH

SUNIL CHACKO

Introduction

In recent years, financial investment has started to flow into human capital, owners of intellectual property, and producers of knowledge- and research-based goods and services in the global South. The role of the private sector in developing technological excellence is not marginal by any means. This is a distinct departure from the past, when the main investment in the South, committed by partners of both the South and the North, went to sectors that depleted natural resources and left environmental hazards for people who already carried the heaviest burden of diseases and other social inequities. Today, such factors as technological advances, availability of efficient network media, ethnic diasporas and others have contributed to a positive path. Some countries have yet to capitalize on these benefits. Nevertheless, knowledge- and research-based development has been quietly but steadily transforming the future of the South.

The research enterprise, while often locally specific, is inherently global in today's communication and digital technology era. Whether it is in India, Brazil or in sub-Saharan Africa, technology is one unifying principle drawing on the strength of emerging knowledge-based private sector development in the South. Poverty reduction is linked to job opportunities and technological excellence, overwhelmingly generated in the private sector, particularly in new value-added areas where intellectual production of knowledge raises technological standards and capacity.

Central to this development are new paths that offer greater opportunities and faster progress to better living standards. Even as the United Nations Development Programme (UNDP) has been spearheading the new agenda for capacity-building of the South in the midst of communication technology advances, the network age enables these momentous opportunities to be shaped. Considerable experience in global cooperation in both public and private sectors has already been built over the past decades, and it is this experience and knowledge that creates confidence that new modes of technical cooperation are not just feasible, but essential for international development cooperation in the modern era of the knowledge-based economy. In the following chapter, individual entities are mentioned solely as example to illustrate growing trends.

The Role of the Private Sector in Developing Technological Excellence in the South

The Rise of Knowledge-Based Research and Development

There is little question today about the role of the private sector in catalysing technological advancement and bringing its benefits within people's reach. Many times, the basic sciences are incubated and fostered during the most risky early stages by public resources at public sector institutions. For instance, the Internet and the Human Genome Project are recent cases in point. Basic research on both projects was initiated with Government-led efforts in the United States. The private sector then went on to demonstrate its capacity to expand the technological advances through the "3Ds": discovery, development and distribution of goods and services to the marketplace, where people's demands interact with commercial opportunities. This basic role of the private sector manifests in the global South as well.

The pharmaceutical industry in the South used to be almost all concentrated on low-risk, low-cost, low-profit-margin generic drug production. Today, with technology and efficient instruments increasingly available in the world, the scenario of concentrating industrial capacity in low-risk, low-cost and low-return areas has been changing in many countries. An illustrative case is the recent rise of the pharmaceutical and biotechnology sectors in India, which have placed a heavy emphasis on research and development (R&D). Worldwide, high-revenue-generating companies spend enormous resources on R&D. Technology-oriented companies spend even more than what they earn, yet still are constantly funded because investors see the value of technology and the benefits of long-term research activities (see Table 3.4.1). Indian companies are rapidly moving in that direction. Compared to their spending on R&D of less than 1 per cent of revenue a decade ago, the current level of 4 to 6 per cent of revenue is a remarkable shift in priorities towards more knowledge-based investment.

India's pharmaceutical industry and public R&D institutions, for instance, together with the Government's new vision and the global reality of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) in 2005, are reallocating internal resources on R&D for novel product discovery, and diversifying their operations in order to move up the global value chain.

Further, the Government of India now allows, in effect, a tax credit by exempting 125 per cent of R&D spending when companies conduct R&D through subsidiary research foundations, and 150 per cent for biotechnology research and clinical trials. The new environment has given a tremendous boost to the morale of scientists in R&D-oriented pharmaceutical and biotechnology companies, as well as in public sector laboratories that are increasingly building partnerships with the private sector, a development actively encouraged by the Government.¹

Already, some Indian pharmaceutical and biotechnology R&D companies have identified global opportunities that can build on traditional skills required for generic

¹ As one means to create a resource base for research that would strengthen neglected areas, the Pharmaceutical Research and Development Fund was established by the Government of India with about US \$33 million.

TABLE 3.4.1: MOST RECENT ANNUAL R+D SPENDING AS A PERCENTAGE OF REVENUE

COMPANY	R+D IN US \$ MILLIONS	REVENUE IN US \$ MILLIONS	R&D AS A PERCENTAGE OF REVENUE
Genomics and Research-Oriented Companies in the North			
Celera Genomics	167.8	42.7	393%
Human Genome Sciences	225.5	22.1	1020%
Millennium Pharmaceuticals	268.7	196.3	137%
Vertex Pharmaceuticals	84.9	78.1	109%
Integrated Pharmaceutical and Biotechnology Companies in the North			
Boehringer Ingelheim	871	5,569	16%
GlaxoSmithKline	3,677	26,486	14%
Merck and Co.	2,344	40,363	6%
Pfizer	4,435	29,574	15%
Serono	263	1,240	21%
Indian Pharmaceutical Companies			
Cipla	9.1	241	4%
Dr. Reddy's Laboratories	9.2	223	4%
Ranbaxy	11.3	401	2%
Lupin	8	202	4%

Source: Annual Reports 2000.

drug production, particularly in chemistry, process/reverse engineering and manufacturing (Chacko, 2002). Under the process patent system, combined with other factors, home-grown innovations for the discovery of novel therapeutics did not flourish much in the past. However, current development in the private sector indicates that those skills needed for generic drug production have become the technology foundation for the next level of innovation.

Twenty Indian companies have secured international accreditation from the US Food and Drug Administration (FDA), the UK Medicines Control Agency (MCA) and other regulatory agencies in the North for specific medicines, enabling them to export.² Research on drug delivery systems, improved versions of existing drugs with fewer side effects, and derivatives of existing medicines have been identified by the Indian Government and the private sector as high-value areas to pursue and develop during this transition period, without much exposure to attrition or cost risks.

A company in Hyderabad, Dr. Reddy's Laboratories, has a considerable number of patents of which three anti-diabetes molecules are licensed to the global pharmaceutical giants Novo Nordisk of Denmark and Novartis of Switzerland. Dr. Reddy's expects to garner US \$60-70 million in revenues if progress through the development pipeline continues. On the biotechnology front, recombinant technology has already been in use for some time in India. Multiple domestic companies now compete for market

² The UK Government's Trade Partners Programme.

share of the hepatitis B vaccine (along with Korean and Cuban companies, and large multinationals). In the past, recombinant technology was seen as too sophisticated for developing countries to master, and was the exclusive expertise of global technology leaders such as Chiron, Merck and SmithKline Beecham (now GlaxoSmithKline). Another Hyderabad-based company, Shantha Biotech, is a new entrepreneurial biotechnology company, and produced India's first hepatitis B vaccine with much lower costs, addressing the local public health needs by utilizing recombinant DNA protein production technology. Other therapeutic products resulting from biotechnology are in the company's pipeline.

This trend is not only confined to large and growing economies of the South and the North with an acknowledged technological and scientific base. Individual institutions in Africa are also moving towards upgrading their research output for new social and economic value creation. For instance, in Bamako, the US Government's National Institutes of Health (NIH), in collaboration with the University of Mali, has established a malaria research facility for the development of vaccines. In Cinzana, the agricultural research station maintained by the Syngenta (formerly Ciba-Geigy) Foundation and Mali's Institut d'Economie Rurale works on millet and sorghum improvement. Further, the Netherlands' African Studies Centre in Leiden promotes and undertakes social science and humanities research in Africa in cooperation with ten Dutch universities and African colleagues. These and numerous other cases throughout the South illustrate that research-based value generation has been undertaken even amid the intractable problems posed by low GDP per capita.

Value-Added Research and Production of Intellectual Property

The cost associated with pursuit of high-value, knowledge-intensive research is certainly high. Return on investment has to be above the cost of capital, so the issue of fostering the innovation and its research by safeguarding the legal entitlement for further development becomes critical. The clear title for ownership and intellectual property rights (IPRs) is the integral component for the knowledge- and research-based 3Ds noted above. The Indian health science research community, for instance, has been scoring quite good success in this new endeavour, along with researchers in a couple of other countries in the South.

A number of patents for proprietary new drug delivery systems, as well as improved versions and derivatives of existing medicines, have been filed in the United States, India and other countries. Many of them have already been granted patent protection. Indian patent holders in the private sector have successfully negotiated alliances with forthcoming global pharmaceutical giants to co-develop them further. For instance, Ranbaxy of India has licensed its new drug delivery system to Bayer of Germany. The system enables a once-daily dosage of Bayer's now world-famous anti-infective ciprofloxacin; it is now progressing through clinical trials in the United States.

Medicine utilizing traditional knowledge, abundant in the South, is also expanding the potential for value-added research and production of intellectual property to

boost technological excellence in the South. After a battery of tests to identify active ingredients and numerous clinical trials to prove efficacy under controlled conditions, a traditional Chinese cure used by a traditional healer was approved by the FDA in September 2000. It is used to treat patients with leukemia whose disease has recurred or who fail to respond to standard chemotherapy. Arsenic trioxide is the active ingredient, and the concoction is today distributed under the brand name Trisenox™ by the US company Cell Therapeutics for use in the most prominent American cancer hospitals, such as Memorial Sloan-Kettering in New York and the Dana-Farber Cancer Institute in Boston (Waxman et al., 2001) The work of this US company and Chinese partners is adding value to the traditional knowledge of Chinese medicine by taking the drug through clinical trials, carrying out the data management and regulatory filings, and securing approvals from regulatory authorities, thereby making it available in the industrialized countries as well the place of its origin.

There are numerous similar cases of discovery of great drugs that originated from biological substances native to the South. However, many doubt whether these commercial successes are bringing the proper share of benefits to indigenous peoples and to the South, where the substances have been tested and used over centuries. Hernando de Soto (2000) calls for the underprivileged to have a formal stake in the economic system by means of acquiring clear legal title to their assets. This, needless to say, helps to lift up the entrepreneurial aspirations among millions of people in the world who live in poverty.

Another great path-breaker who has veered from the conventional thinking of the past in the South is Dr. R. A. Mashelkar.³ He also forcefully advocates the importance of the knowledge-based ownership of goods and services in the world intellectual property system, for social, cultural, and, particularly, economic development. Dr. Mashelkar spearheaded the Pharmaceutical Research and Development Committee Report (December 1999) in India, which became a blueprint for a new focus on more research-based goods and services in order to move up the global value chain. The report stresses the value of R&D-based pharmaceutical, vaccine and biotechnology capacity development for industry and public sector R&D institutions. In addition, Dr. Mashelkar has a unique programme to foster and protect traditional knowledge and encourage innovation for its further development in India by linking age-old tradition with the modern medical science system. Medicinal property derived from nature is being catalogued—in particular, some 15,000 herbs, about 800 of which are commonly used as ingredients in the 5,000 year old practice of ayurveda and other traditional medical systems. For instance, clinical trials of active principles in *Curcuma longa* (turmeric, family Zingiberaceae) or curcumin; *Boswellia serrata* (family Burseraceae); and *Capsicum annum* have revealed value in treating arthritis (Majeed et al., 1997).

³ Dr. Mashelkar is the Director General of the Council of Scientific and Industrial Research, and the Secretary of the Department of Scientific and Industrial Research of India.

Notable Factors in the Private Sector for Facilitating Technological Excellence

Where Computing and Biological Systems Coalesce

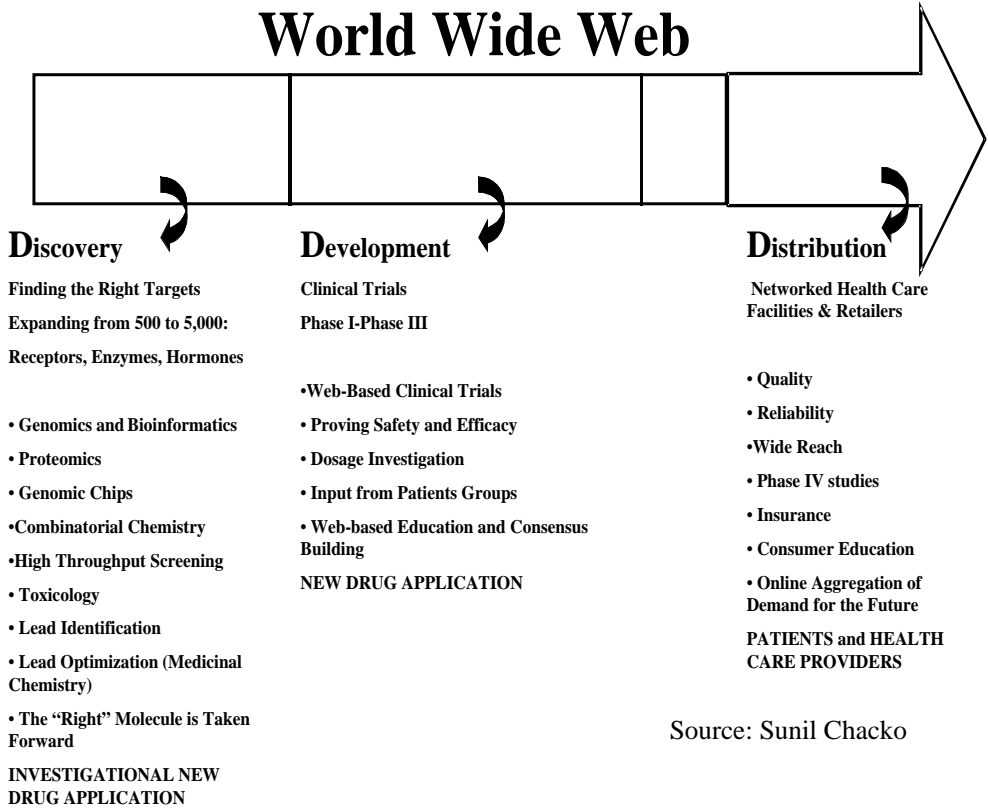
As UNDP's *Human Development Report 2001* points out, the Internet certainly has broken down the communication and geographical barrier for the global South, although challenges still remain. The Internet is helping to energize spirits across the world, forging links to the new technologies and new sources of funding. In the context of health science, digital and network technologies' contributions to such areas as the emerging fields of genomics, bioinformatics and proteomics, as well as clinical trials in both the North and South, have manifested a paradigm shift for the research community.

Figure 3.4.1 illustrates how the World Wide Web underlies each step in the 3Ds. The web has promoted access to online databases on genomic information. Further, online clinical trials software is particularly useful in standardized data collection, reporting and analysis. And this enrichment of clinical research is a critically important component for value-added research, particularly for the South.

Bioinformatics is a promising field, where computing capacity is required to process and manage the immense deluge of biological data generated by digitalgenomics. It involves the use of computers and associated software to gather, organize, store, analyse and integrate biological and genetic information, which can then be applied to new genomics-based rational and even personalized drug discovery and development. The increasing need for bioinformatics capability is directly related to the explosion of genomic information from the Human Genome Project, and from new technology related to combinatorial chemistry, rational drug design, high-throughput screening, microarrays and other advances in the biosciences. Further, both in-house and outside databases need to be integrated to maintain cutting-edge status. In all of this, the collection, warehousing, integration, annotation and analysis of biological information using code, software applications and databases are central. Gene sequences, protein expression, protein structure, protein-protein interactions, assay results and other information on drug development are stored and then need to be retrieved, analysed and cross-checked. Bioinformatics enables the pulling together of all the data for the study of biology as a functioning system. The changed world of new-medicines discovery treats bioinformatics as integral to almost every piece of medical and pharmaceutical research.

The same design skills for databases that store information in large corporations—for instance, on 100,000 employees, including their payroll, health care, other social needs, work-related accomplishments for bonuses, etc.—have to be utilized for medical benefits and potent medicine discoveries. Bioinformatics meets such demand, and it is becoming a crucial tool for building databases for genes, their sequence, functions, the proteins they code for, and the systemic and streaming interactions between them. Well beyond the monitoring capacity of notebooks and pencils and word-processing software, these essential research steps require giant, sophisticated,

Figure 3.4.1: NETWORKED 3 Ds—DRUG DISCOVERY, DEVELOPMENT AND DISTRIBUTION



scalable databases. Indeed, the largest database programmes, such as Oracle and Microsoft SQL, had to be customized for biological research information—so large are the billions of data points that are being generated. Statistical tests are employed to determine the significance of patterns matching against nucleotide and amino acid sequences.

This also demands a great number of programmers, database designers, developers and administrators, for which a core competence of the South can be effectively deployed. This painstaking, labour-intensive, somewhat cumbersome work is manna for many dedicated programmers from the South. They thrived on the laborious precision needed for fixing the COBOL code during the Y2K days, and are gearing up for this much larger challenge. The ratio of scientists to bioinformatics software professionals is so highly skewed, sometimes 700 to 5, and that presents outsourcing opportunities for the software industry.

Indeed, because of the fast pace of scientific developments and the need to constantly access that information, web-enabled research applications are the most logical, and perhaps the only way, to go forward. Millions of new sequences of micro-organisms are stored in databases somewhere in the world. Unless accessing this information is enabled, obsolescence will result. By the time such data are downloaded onto CD-ROMs and then sent over to the researcher, new sequences or other information may have been added to the original database, thereby already making days-old information out of date. This is also the case for diverse knowledge disciplines and endeavours. Hence, broadband-enabled international database access is critical for the South, and the only way actively to enhance value in the intellectual capital era.

Several companies offer this technological excellence and make use of genomic information through partnerships with academia and public institutions of the North as well as the South. Incyte Genomics, based in California, has academic collaboration programmes and special pricing for access to its databases for public and nonprofit entities. Having access to cutting-edge bioinformatics knowledge databases is in the interest of many scientists in the global North and South. At the same time, it is in the company's interest as well to discover wider application of the data and further validate its knowledge-based services. Hence, Incyte found synergy where its interests as a private sector company and those of the larger research community came together (Chacko, 1999). Affymetrix, another California-based company, builds genomic chips for research; it too offers reduced prices for public and nonprofit entities.

In addition to customized solutions from numerous other companies, the public sector also provides data from the Human Genome Project and other ongoing research on public sites, including those of NIH and the Wellcome Trust. Researchers have a choice, and that is why it is essential, in achieving targeted access, to both study terms and special arrangements on a case-by-case basis, and negotiate specifically for the needs of research programmes in developing country institutions. This has been accomplished by some research entities in Africa, Latin America and Asia, which have already been making use of these knowledge-based products and services. In the networked environment, the availability and quality of information has become drastically different for researchers in the South today, and will be even more so in the future.

Application of Computing Power in Downstream Research

Information technology is not only revolutionizing upstream research. Clinical research also comprises an important R&D component in the overall drug discovery and development process, and requires 30-40 per cent (or sometimes higher) of the commonly estimated average expenditure per drug: \$500-800 million. Today, computer technology makes it possible to organize patients and their data-monitoring system in clinical trials, managed with specialized software linked to the Internet. The digitized system prevents the high variability in non-standardized methods at the investigational site. Further, specialized training and available software for statistics and database management—such as Oracle Clinical Suite™, Clinsoft's (now a part of Phase Forward) Clintrial™ or Quad One's CliniOn™ for online clinical trials—have

been developed. They are designed to reduce the error rate, thereby helping to manage data quality, validation of trials and even to detect new effects.

Quad One Technologies is a company based in Hyderabad that created a proprietary, customizable, web-based software programme, CliniOn™, for online multicentric Phase I-IV clinical research. Dr. Reddy's Laboratories has begun to use this web solution, which incorporates the flexibility and stability of Java applications with the far-reaching strengths of the Internet. The dynamics of the software combined with the web application allows data capture to be stored locally or on the Internet, and enables effective monitoring and more rapid analysis. It even caters to the typical settings of the South: The client server configuration is designed to work both in offline and online situations because many locations in India do not have continuous Internet access due to frequent lapses in electricity and for other reasons. These computer-aided approaches to the apparent problems facing many developing countries are more likely to improve the acknowledged shortcomings of clinical research capacity in the South.

A study also shows that medical practitioners in Japan attest to the importance of Internet resources. Doctors surf the Internet to examine clinical data for a new drug or comparative studies on similar drugs. They often find that the Internet provides better, or sometimes overwhelmingly better, information for clinical research and practice than the information provided by a medical representative of a company that produces the new drug.⁴ Having roughly a 20 per cent share of the world drug market, Japan has a well-developed clinical research capacity. Each year, the national regulatory agency approves about 30 to 40 new drugs on average, with more than half of them having originated in domestic R&D entities. Coupled with the clinical trial requirement for the remaining new drug applications from abroad, the level of clinical research becomes significant.

While there is consensus that the North has extensive capacity, its quest is nonetheless relentless for new technology to maintain its competitive edge. Can the South, with its acknowledged capacity challenge, therefore afford to be complacent? In order to raise research output, it is very important to invest in new equipment and tools. We all personally witnessed the dramatic increase of productivity at each stage of progress on our own desktops, from the word processor to the personal computer, from sharing the computer at the office and the school lab to owning one's own at home, from Pentium I to Pentium 4. The cost savings have also grown enormously. The US-based data service company, Giga Information Group, has provided a startling comparison, noting for instance, the enormous savings of web-based self-help, which costs about one twentieth of what a conventional call center requires. In terms of health science research, microarrays, combinatorial chemistry and powerful sequencing machines are all revolutionizing output and saving vast amounts of time and cost in the North, particularly in the United States.

These technologies and forms of equipment are also embraced and recognized as a key for research capacity-building by scientists and researchers in the South. In Brazil, the nonprofit Ludwig Institute for Cancer Research has teamed up with local

⁴ Hidetoshi Naito, Shakai Joho Services, 1998.

government institutions⁵ to utilize high-throughput sequencing to discover genes associated with stomach and breast cancers in São Paulo, where cancers comprise a leading cause of death. This follows on the successful work by the same team on sequencing *Xyllela fastidiosa*, the first plant pathogen to be sequenced and the cause of severe damage to citrus trees, which are central to the local economy. It was also the first bacterial genome to be sequenced outside the United States, United Kingdom or Japan. Further, the International Livestock Research Center, based in Kenya and Ethiopia, is an illustrative case from the African region in capitalizing on new digitalgenomics technology. It collaborates with The Institute for Genomic Research (TIGR), based in the United States, on sequencing *Theileria parva*, the causative organism of (African) east coast fever, a deadly cattle disease.⁶

Diaspora Connection for Financing and Transfer of Technical Know-How

Another major factor to facilitate the private sector playing a crucial role for research- and knowledge-based development is the ethnic diaspora connection, which transfers technical know-how and financing, mostly in the private sector. Remittances to developing countries from workers residing abroad total some US \$60 billion (Martin, 2001), surpassing all foreign aid, which now amounts to about \$53 billion (Brown, 2001).

The Israeli diaspora in America, for instance, has been an active catalyst in developing high-value industry and the country's capacity through various means. In the research field, cooperation between the United States and Israel is supported by the Binational Science Foundation, which has an endowment of US \$100 million; the US-Israel Binational Industrial Research and Development Foundation (BIRD Foundation); and the US-Israel Science and Technology Foundation, which disburses grants jointly financed by the US and Israeli Governments. All these entities have as their goal the building of research and commercialization partnerships with private corporations in order to make the fruits of research available to the public.

Further, in the Israeli pharmaceutical sector, there are many milestone achievements tapping into the great talent of the diaspora. An Israeli pharmaceutical company, Teva, has been exporting generic medicines to the United States for 20 years. Founded in Jerusalem in 1901, the company gained momentum with the arrival of European scientists, chemists and technicians in the 1930s. Over time, its financial strength enabled it to create joint ventures in the United States in the 1980s, and acquisitions in the United States and Europe in the 1990s. Today, with revenues of US \$1.75 billion, mainly from manufacturing and selling high-quality generics medicines, Teva is among the top 50 pharmaceutical companies in the world, with a marketing or manufacturing presence on all continents. It has been investing significantly in R&D and took a novel molecule, glatiramer acetate (Copaxone), through clinical trials and on to use in patients with relapsing-remitting multiple sclerosis, a debilitating autoimmune neurological disease that affects over a million people worldwide. Glatiramer was discovered at the Weizmann Institute of Science at Rehovot, a major public

⁵ Over 200 Brazilian scientists are linked via networked infrastructure financed by the São Paulo State Research Foundation (FAPESP).

⁶ Financing for the project includes the donation by Dr. Craig Venter, TIGR's Chairperson, of the \$200,000 he received from the King Faisal Science Award.

research institution.⁷ The institute is well known for its extensive links with US and European premier R&D institutions, and is well-supported financially and technologically by the diaspora. Teva was able to take glatiramer through clinical trials and license it for use in 22 countries, including the United States, Brazil, Switzerland and Poland, indicating that the company is well poised to make use of public-private partnerships for the benefit of patients needing new treatments.

The Chinese diaspora also has been well known for contributing to the impressive technological development in Asia Pacific countries. Members of the Society of Chinese Bioscientists in America, for instance, have been active in enhancing the health science research capacity, and are attracting great interest from both the public and private sectors of Asia Pacific countries. They cooperate actively in terms of developing technological excellence as well as in setting up systems for professional operation of the peer review system for research, which has been actively debated and modeled on the US system through the diaspora connection, and which helps the positive progress of research capacity. There are numerous systems in Asia Pacific countries that are modeled on the NIH and its crucial role as a public sector institution undertaking risky and costly but high-value basic research that can be eventually applied to fulfil social needs and encourage wealth creation by the private sector.

Numbering some 50 million people, the Chinese diaspora throughout the world generates an estimated annual US \$700 billion in economic activity. Its liquid wealth may run as high as \$2.5 trillion (Burstein et al., 1998). Chinese investors, in addition to manufacturing garments, toys and other consumer goods, have generally favoured investments in information technology, especially computer components and hardware, but they are gradually warming to other high-technology sectors, such as biotechnology, as well.

African-Americans have been particularly passionate and active in promoting the development of African countries in recent years. The African Growth and Opportunity Act (AGOA) was sponsored in part by members of the Congressional Black Caucus and enacted by the US Congress in 2000. The act addresses how African countries and the United States, through public sector incentives, can tap the power of the markets to improve the lives of citizens. It also allows African countries and companies to export goods duty-free to the US \$1.2 trillion import market of the United States. US Congressional Black Caucus members have actively encouraged US financial institutions, such as the Export-Import Bank, to collaborate with African countries in providing loans, guarantees and insurance to upgrade health care access, technology and productivity. So far, in a short period of time, essential business networks have been built under the aegis of the act, and it is a major cornerstone achievement by concerned members of the African-American community for development in the African region.

Similarly, African-Americans, including the Congressional Black Caucus and church groups, have intensely lobbied and supported an increasing role for major donors in AIDS programmes and research. The Joint United Nations Programme on HIV/AIDS (UNAIDS) estimates that about 1,600 children become HIV positive every

⁷ Glatiramer, believed to function as a decoy, was discovered by Drs. Michael Sela, Ruth Arnon and Dvora Teitelbaum after 27 years of work on synthetic molecules capable of provoking an immune response.

day. Research done in Uganda by a team of African and US researchers showed that giving a single oral dose of nevirapine (a non-nucleoside reverse transcriptase inhibitor) to an infected mother at the onset of labour, and a single oral dose to the newborn within 72 hours of birth, significantly reduces mother-to-child transmission. This research has led to programmatic efforts in Cameroon, Congo, Kenya, Malawi, Rwanda, Senegal, Tanzania, Thailand, Uganda, Zambia, Zimbabwe and other countries, along with a donation programme from the drug's manufacturer, Boehringer Ingelheim of Germany.⁸ This sort of research elicits value-added, knowledge-based practice in tackling major public health threats.

Indian computer engineers and software programmers are also a networked world resource for development. The Indian diaspora, numbering somewhere around 20 million worldwide, is believed to generate economic activity totalling about US \$400 billion annually.⁹ Well-known personalities include Vinod Khosla, a founder of Sun Microsystems and now a venture capitalist; Purnendu Chatterjee, an investment fund manager for George Soros's Quantum Fund, who is now financing scholarships at a public research institution in New Delhi through collaboration with his India-based R&D pharmaceutical and biotechnology company; Vijay Vashee, a long-term, high-ranking manager of Microsoft; and Sabeer Bhatia, a founder of hotmail.com, the web-based e-mail system that was sold to Microsoft for nearly US \$400 million in 1998. They have been busy fostering nonprofit and for-profit activities that constitute a powerful force in developing technological excellence in India, and facilitating the transfer of knowledge, capital and human connections—the spirit capital of entrepreneurs—that encourages the aspirations of many.

Further, on the heels of the impending Y2K computer glitch challenges, diaspora information technology entrepreneurs such as Satish Sanan of IMR Global (now merged into Canada's CGI Group), Bharat Desai of Syntel and others created a firm collaborative link between India's programmers and global Fortune 1000 firms. Correcting the year number of 00 to the 2000 stored in mainframe computers and associated software built between the 1960s and 1980s required COBOL software programming knowledge. Otherwise, mainframe computers and software would recognize the number 00 as the year 1900, thereby making major errors in computerized calculations and systems related to insurance, bonds and other financial services for which the period of time is central. COBOL, a programme that had long been semi-abandoned in favor of the newer, more powerful software programming codes, such as C, C++ and Java, was still being used by programmers in South Asia.

Information technology entrepreneurs working overseas knew this fact first-hand, and they established subsidiaries of their US companies in India to enable thousands of programmers to contribute to this task. Once chief information officers were able to see how effectively they could work offshore using 64-kilobits-per-second satellite-based connections (even before the Internet became the mainstay of communications), this led to further programming work as well as prospects in the post-Y2K era. Now, T1, T3 and other broadband, high-speed links form the pathway through which these

⁸ Programme implementation is supported by the Elizabeth Glaser Pediatric AIDS Foundation and the Bill and Melinda Gates Foundation.

⁹ IndiaWatch Foundation.

collaborations work today. These entrepreneurs have brought together capital, knowledge of global information technology supply and demand resources, and the trust that generated employment in developing countries in order to create opportunities for trained knowledge workers.

This development sparked a social transformation as well. In the minds of the population, software training became synonymous with higher future income, leading to changes in the target educational courses for young people and corresponding shifts in the dreams of their parents. Unlike most other professional courses, basic software programming can be taught in many new institutions, with certification examinations being conducted by major corporations. Proving one's worth takes place through the objective means of mastering written software code that can be examined and analysed. In many ways, this revolution in thinking about work and value was inspired by the story of Microsoft Chairperson Bill Gates, who is the world's wealthiest programmer, despite having no postgraduate degree in programming.

These ethnic diaspora groups, together with numerous other diaspora communities, are disbursed all over the world. Today, the World Wide Web connects these communities not on the basis of geographical boundaries but on their common interests. This channel is a great resource for technical cooperation and, by networked on-line means, this rich resource can be effectively utilized in reaching the focused goals of raising living standard and enhancing country capacity-building.

Multinational Corporations and Companies

Transnational companies play a notable role in private sector technological development in the South. Outsourcing, subcontracting, original equipment manufacturer (OEM) contract manufacturing, licensing both from the North and from the South, and regulatory compliance are precious channels for the private sector in the South to earn hard currency, gain technological excellence and access large-scale markets. Although there are some negative experiences in the South in which multinational corporations suppressed local industry or caused more harm than good, it is also true on the other hand that the presence of foreign companies and cooperation with overseas companies have contributed much to raising technological and industrial standards.

Swedish-Anglo pharmaceutical giant AstraZeneca's research foundation, Astra Research Foundation, is one example. It has undertaken infectious disease research in Bangalore, utilizing the latest discovery technology. Its anti-tuberculosis (TB) drug discovery programmes include novel targets based on the knowledge of the already sequenced TB genome, with 4,000 genes and 4.4 million base pairs. This digital information is linked to studies by microarrays and genomic chips—a new digitalgenomic research technology developed in the past few years in Silicon Valley in the United States. AstraZeneca has invested substantially in genomics and maintains a global network of R&D facilities, including genomics and anti-infective research centers in Boston and in Cheshire in the United Kingdom. The proposed collaboration with local scientists and academic institutions in India is expected to provide India's researchers with good exposure to the latest scientific knowledge and the use of digitalgenomics equipment.

Pfizer provides another example. Recognizing the research quality of a local Indian biotechnology company, Pfizer is offering the valuable transfer of know-how on quality control as a part of their strategic alliance for product distribution in the Indian market. This strategic alliance has provided a much more cost-effective solution to the identified research challenge.

There is also a handful of scientists in India who have worked at the local R&D facilities of global pharmaceutical giants, including Hoechst (now Aventis) and Ciba-Geigy (now Novartis). Both have long maintained R&D activities in India, even during the time when India's patent protection environment and market conditions were not conducive to fostering novel research.¹⁰ These Indian scientists have now joined India's blue-chip pharmaceutical companies. Together with highly qualified public sector scientists, they have been laying the ground for new knowledge- and research-based development of health science in the country, and contributing to the successful discovery of new chemical entities for novel therapeutics.

South-North Industry Collaborations

Availability of Global Resources for the South

In the network age, money, human capital, specialized services, technology, tools and equipment can be sourced wherever they are most efficiently available. Collaborations between the South and the North to facilitate development are increasing as more resources and expertise are globalized. For drug discovery R&D, the challenge in biological screening and pharmacological testing are increasingly tackled by the availability of combinatorial chemistry and microarray technologies. Traditionally, toxicology and safety testing in India have been almost impossible, and today, many top companies still go abroad to North America and Europe to contract these studies to specialized service providers. The clinical research capacity in India has been another area that has lacked quality control and therefore suffers from a negative reputation. For this, too, there has been no choice but to rely on software aid and foreign contract research organizations abroad.

A form of strategic alliance and joint research with research organizations and companies in the North provides another route to achieve research and technological excellence. The joint research between the Indian pharmaceutical company Zydus Cadila and the Danish company Pantheco is a quintessential case in this regard. The Indian side can benefit from the know-how in areas in which critical expertise is lacking. Zydus Cadila aims to gain in preclinical and clinical development expertise, especially in Europe, and through getting patented drugs developed internationally. Pantheco, in return, will gain access to the core competence of the Indian researchers. The Indian company will undertake chemistry, preliminary screening and initial characterization of compounds with antibacterial activity. In this sort of alliance, the cost and profit sharing are integral parts of the deal.

¹⁰ Dr. Noel deSouza, Director of R&D, Wockhardt Pharmaceuticals, India.

Knowledge Transfer from the South to the North

Expertise and technology transfer from the South to the North are indeed occurring globally across a broad spectrum of industries and markets. Pharmaceutical product manufacturing, particularly generic drugs, is one area where the South has accumulated know-how, and transfer of knowledge from the South to the North can be seen at the level of the individual enterprise. Technology and capital are highly mobile in various directions in the private sector.

In the field of the generic drug industry, in which Indian companies have also accumulated solid know-how, Sun Pharmaceuticals of India provided a small US-based generic drug company, Caraco Pharmaceutical Laboratories, with a much-needed cash infusion and expertise to secure FDA regulatory approval. Sun Pharmaceuticals has considerable experience in working with the FDA to obtain certifications for bulk actives and production facilities in India. Its Ahmednagar plant for active pharmaceutical ingredients is FDA approved, and its Ankleshwar plant, dedicated to producing cephalexin, is FDA certified for 7-aminodecephalosporanic acid.¹¹ Prior to Sun Pharmaceutical's equity participation, Caraco was struggling with serious management problems and unable to raise further cash. In August 1997, Sun Pharmaceuticals officially reorganized the company under new management. As a result, Caraco successfully secured FDA approval for production of two drugs in the US market, clonazepam and flurbiprofen, and has seven additional abbreviated new drug applications (ANDAs) pending at this time.

The FDA's approval process for generic drugs is not by any means simple. It can take between three to four years to satisfy the requirements before the approval is granted on an ANDA. The documentation required and the associated inspections cover sourcing of raw materials; formulation; scale-up batch; testing the identity, strength, quality and purity of raw materials; stability; and, most importantly, bioequivalence. In obtaining certifications from regulatory agencies in countries of the North, validation of the manufacturing process through in-process and postmanufacturing testing in consecutive production batches is a long and cumbersome procedure. At the same time, certification is a well-recognized means to enhance the value of products. The Good Manufacturing Practice certification is not only important for patients, but also constitutes knowledge-based value creation for producers.

A similar example comes from the industrial development process Japanese auto makers experienced during the 1970s. Prior to establishing the brand recognition achieved today, many Japanese auto companies started investing heavily in US manufacturers in the 1970s, and transferred production-related technology and manufacturing practices that led to the establishment of extensive production and distribution channels.

For technology capacity development and for market access, many private sector companies in the South are very committed and forthcoming. They invest in a joint venture, plants, distribution rights or the buyout of businesses to create a base in the

¹¹ In addition, Sun Pharmaceutical's Panoli active pharmaceutical ingredient (API) plant currently holds a European Certificate of Suitability (CoS) for pentoxifylline, indicated in intermittent claudication and peripheral arterial disease. Sun subsidiary MJ Pharma's plant holds UK MCA and South African Medicines Control Council approval.

North and gain technological excellence. Following the success of many private sector companies from middle-income countries, particularly from East Asia, India's pharmaceutical companies have been actively investing. Ranbaxy Laboratories has had a manufacturing base in the United States since 1995, having acquired a small generic drug manufacturer, and upgraded the technology and management expertise there. Ranbaxy also formed several strategic alliances with other companies in the United States, and today it is the eleventh largest generic drug company there. Antibiotics sold under prescription, analgesics and anti-inflammatories such as ibuprofen, antacids, and the nasal decongestant pseudoephedrine are some of the many over-the-counter products manufactured for the US market. Dr. Reddy's Laboratories is another upcoming and formidable international player from the South. The company has invested in subsidiaries in the United States, France and the Netherlands for generic drug production and distribution, including the anti-ulcer drug ranitidine, as well as for therapeutics discovery R&D. Having multiple revenue-generating products, both generic and novel discovery products, Dr Reddy's Laboratories successfully raised substantial funding from the international equity market by making its debut on the New York Stock Exchange in April 2001. These are a handful of examples of the larger trend in the private sector in the South.

Harnessing the Incentives and Resources of the Private Sector for Technical Cooperation

Capital Accumulation for Acquiring Crucial Technology

Flexibility in financing and mobilizing capital in the private sector are necessary resources and incentives for developing technological excellence. Private placements, public offerings on the financial markets, mergers and acquisitions and joint ventures are all means for entrepreneurs to raise necessary resources for high-value, knowledge-based operations. There are now such financial flows into the South, though still limited, and there are notable cases where this private investment led to great bio-science success. Foreign direct investment (FDI) of US \$1 million is credited with sparking the creation of the first locally manufactured hepatitis B vaccine in India.¹² Domestic and other foreign investment followed. The growth of FDI flows into India has been substantial, from an average of \$500 million in the years 1985-1995 to the current \$2.3 billion. Nevertheless, there are wide disparities in the per-capita FDI between countries. China, excluding Hong Kong, attracted \$41 billion. The bulk of the world's \$1.3 trillion in total FDI pours into the United States, at \$281 billion, and the European Union countries, at \$617 billion (UNCTAD, 2001).

Capital formation is another incentive, allowing acquisition of crucial technology that is vital in raising research capacity. The early 1990s saw major economic reforms enacted in India that had a direct impact on software services and exports. Infosys is a major information-technology software company based in India, and its Chairperson, Narayana Murthy, described the reforms as having changed the Indian business context from one of state-centred control orientation to that of free, open market

¹² Chairperson Varaprasad Reddy, Shantha Biotech, Hyderabad, India.

orientation, at least for high-tech companies (Murthy, 2001). Job creation, export opportunities, wealth creation and capital formation translate well into economic development. Indian software exports have reached about US \$8 billion per year, and have experienced a growth rate of about 30 per cent per year despite the recessionary world environment. Indeed, companies are moving up the value chain from upgrading legacy systems and maintenance to packaged software integration, network infrastructure integration and outsourced software R&D. Further, business process outsourcing is growing at 70 per cent per year.¹³ All this growth is having a tremendous impact on investment in the next level of technology, as companies recognize the value of enhancing computerized operations. Efficiency gains that create job opportunities that benefit the poorest are a feature of these changes.

Forming Alliances with the Life Science Sector in the North

Two questions are very relevant for technical cooperation in the network age:

- How can multilateral institutions and governments collaborate with the private sector in the South to encourage its development; and
- What tools can multilateral institutions and governments use to accelerate the development of the private sector in the South.

Fostering knowledge- and research-based development between multilateral institutions, governments and the private sector in the South demands well-defined alliances, and an understanding of finance, scientific and technological aspects, and organizational and management issues. In the private sector, these assessments form the foundation for creating alliances in the pharmaceutical, biotechnology and genomic sectors, where strategic alliances are actively pursued to enhance core competence and value creation for a mutually shared mission.

For drug development, a collaborative deal is an intermediary step for fostering progress, as alliances of numerous pharmaceutical and biotechnology companies are leading to great success (of course failure, too) in the North. Understanding the technology specifics and market value, and gaining insight into recent partnership deals between the South and North enables us effectively to define the terms for potential new alliances between multilateral institutions, governments and the private sector.

A few analytical methodologies for private sector entities are very important tools. The methods have to be modified for the specifics of the public sector, and to make them applicable to multilateral institutions, governments and the private sector in the South. The following are a few of the tools that can be used to quantify the intangible assets—value—in the best possible way:

- Comparable analysis
- Discounted earnings analysis
- Milestone analysis

¹³ National Association of Software and Service Companies, India.

These methodologies are also frequently used for R&D-intensive companies, since they often do not show a profit, but that does not mean that there is no value in the company. The size of the loss-making can reflect the extent of R&D investment. In Table 3.4.2, examples are drawn from some of the most successful genomic companies in the United States. The technology is the core component of their value, which makes valuation and quantification of health science sectors—pharmaceutical, biotechnology and genomics—quite unique and unlike other industry analysis.

Comparable analysis is used to estimate financial worth by examining similar companies or institutions. It can help in situations where the local stock market is illiquid, the company is privately held, or it is a nonprofit entity. Discounted earnings analysis makes use of earnings projections that are then discounted back using discount rates appropriate for the risk taken. Milestone analysis is much more straightforward, in that it estimates or measures those milestone achievements in R&D and payments that have been made or are anticipated from often larger companies for licensing technology, or outsourcing products or raw materials. Within strategic alliances, rational decisions on ownership, strategy, financing needs, projects to be pursued or discarded, etc. require careful assessment of what each partner is bringing to the joint endeavour, and the internal and external progress of the entity they create.

Specialized Analysis

Technical cooperation has been and will be a very vital input for countries' capacity development. Today, the private sector is increasingly involved and committed to newer forms of cooperation. Harnessing incentives and resources of the private sector for technical cooperation requires market intelligence, rigorous analysis of both the benefits as well as shortcomings of the private sector, and identification of the real needs for technical cooperation organized and sponsored by multilateral organizations. This need for private sector intelligence and related services seems to be growing for various important projects led by multilateral organizations. Comprehensive studies are useful in presenting opportunities to investors, donors and the managers of organizations. For instance:

- developing the methodology to quantify the demand for particular services and products that are important for the South;
- identifying and characterizing the very new or neglected market segments that are vital for the underprivileged;
- comparative financial analysis for prioritizing the agenda for management;
- information technology applications for setting new directions in health, social and development policies; and
- cost studies and output monitoring that pinpoint hidden costs due to cumbersome procedures.

TABLE 3.4.2: LOSS-MAKING COMPANIES CAN HAVE LARGE VALUATION BECAUSE OF THEIR PATH-BREAKING TECHNOLOGIES OR SERVICES

NAME OF COMPANY	REVENUE IN LATEST THREE MONTHS REPORTED	LOSS IN LATEST THREE MONTHS REPORTED	VALUATION
Affymetrix	\$55.4 million	\$4.8 million	\$2.3 billion
Celera Genomics	\$27.0 million	\$15.6 million	\$1.8 billion
Human Genome Sciences	\$1.6 million	\$24.9 million	\$4.6 billion
Incyte Genomics	\$57.3 million	\$17.8 million	\$1.3 billion
Millennium Pharmaceuticals	\$82.0 million	\$25.0 million	\$5.6 billion
Myriad Genetics	\$13.2 million	\$1.2 million	\$1.3 billion

Source: Company filings with the Securities and Exchange Commission. Valuation as of 28 December 2001.

The great common denominator in creating the field of mutual interest and cooperation for R&D partnerships is often missed or neglected. Catering to scientists in the South, the intermediary entities have to analyse the technology and identify the joint research area, particularly for new sciences. It is also true that there is a huge gap in information about the health science sector, R&D capacity and market data analysis in the South among mainstream players in the North.

Further, the relevant issue is that partners do not necessarily have to be giant corporations. Today, technology-intensive companies, often lean and nimble, and academic research institutions comprise the real engine of innovation in the case of the pharmaceutical and biotechnology sectors. In the United States alone, there are about 1,300 biotechnology companies, of which 300 are listed on stock markets; the rest are privately held. The industry is fast growing, with revenues rising from US \$8 billion in 1993 to \$22.3 billion in 2000, and it spent \$10.7 billion on R&D in 2000.¹⁴ Moreover, in Europe there are about 1,600 biotechnology companies. In China, India, Brazil, Taiwan, Singapore, Thailand and South Africa, all members of the World Trade Organization, the academic and business segments focused on new drugs, vaccines and generic medicines are also growing.

Therefore, strategic alliances are often created to build synergy. Large corporations identify various technologies and their owner entities to form alliances. Accordingly, financial and industry analysts on Wall Street attach a value so that investors commit more resources. For smaller companies or institutions, strategic alliances with large corporations are one form of incentive and an engine of growth—their R&D is continuously financed or rewarded via equity participation and other arrangements. Total sales within the global pharmaceutical market were US \$317 billion in the year 2000 and growing—thereby generating considerable amounts of resources to fuel research alliances.¹⁵

¹⁴ Biotechnology Industry Organization.

¹⁵ IMS Health.

As for harnessing the incentives and resources of the private sector for technical cooperation, specialized analysis becomes the first necessary tool to generate neutral assessments to define the goal. Private companies function under a host of constraints, and high-social but low-financial-return projects are often left out in decision-making on prioritization, particularly in big corporations. For instance, the antimalarials discovery and development unit at pharmaceutical giant Hoffman La-Roche was eliminated some years ago because of the declining prospect of a financial rate of return on investment. Recognizing the importance and social value of continued research, a study was conducted to establish synergy among different actors—multilateral organizations, donor foundations, governments, corporations and academic institutions (Chacko, 1999). Subsequently, the vacuum left in antimalaria product discovery research was partly filled by the World Health Organization (WHO) joining hands with the Rockefeller Foundation and the Bill and Melinda Gates Foundation in creating a public-private partnership, the Geneva-based Medicines for Malaria Venture (MMV). Under MMV, research has been carried out in multiple locations at academic institutions that partner with pharmaceutical giants. The industry offers screening for drug discovery, in addition to development and distribution expertise that requires substantial economies of scale in reaching patients today.

The Role of Multilateral Institutions and Governments in Technical Cooperation and Private Sector Development

Demand-Side Initiatives

Solid identification of demand for technical cooperation in the South has to be carried out with concrete means. Today in the network age, the Internet helps scientists and entrepreneurs in the South greatly in identifying what is available to help build research capacity, and in comparing their needs to market and social realities. A chief executive officer of a health science company in the South, for instance, surfs the Internet and learns a great deal about the availability of various technologies. She reads online scientific papers that refer to these technologies, which are used in experiments featured in the papers. She identifies specific needs, and hopefully multilateral organizations and governments can identify larger trends from these needs that are prevalent in the South. Identifying the availability of technologies and determining realistic needs in that context has become widely practiced thanks to the Internet. The key is to crystallize the real and realistic demands of researchers and entrepreneurs in the South.

Various Approaches to Collaborations

For the long term, the challenge for the public sector may be how to maintain a proper stake in terms of investing public resources and the outcome of the investments. For instance, there are many important drugs—including the cancer drugs tamoxifen and paclitaxel; the AIDS drugs zidovudine, lamivudine, nevirapine and stavudine; the antihypertensive captopril; and the antidepressant fluoxetine—that were discovered and/or developed with significant public sector financial and technical support in the

United States.¹⁶ These drugs certainly broke the treatment barrier for patients, and now the challenge will be how this benefit can be brought to uninsured patients or those who are barely able to pay increasing insurance premiums. Leveraging the public sector's stake for the larger public good has been an argument for some time now.

Government entities sometimes distribute money through various vehicles to private research companies, such as government agencies for small business development or venture capital funding in economically depressed regions. With the constraints on governments, however, it is unrealistic, and indeed rare, for them to be able to influence the public stake even though it is for the benefit of the underprivileged. An example was the government contract for screening medical compounds that a US Government research agency gave to an American developmental-stage R&D company. There were encouraging hits against a particular disease that has high social value, especially for the South, but it was practically impossible to generate interest in further development. It is highly doubtful if companies in the private sector who reviewed this result will ever take it further for product discovery of the drug, since the disease is known as a neglected one, and perceived to have marginal commercial value with high risk.

One avenue to address this challenge is by forming collaborations. Chiron Corporation (a middle-sized biotechnology company with strong R&D activities in the United States), PathoGenesis (now a part of Chiron), and the Global Alliance for Tuberculosis Drug Development (a New York-based nonprofit partnership entity for medicine discovery) are cooperating on tuberculosis R&D with financing from the Rockefeller Foundation and the Bill and Melinda Gates Foundation. Similarly, major networking company Cisco Systems has partnered with UNDP in its Least-Developed Countries initiative in support of 27 African and other countries for enhancing Internet connectivity. Another notable collaboration is the UNDP/World Bank/WHO special programme for research and training in tropical diseases, including for therapeutic and diagnostics development. There is also the American International Group/World Bank International Finance Corporation Fund for investment in Africa. These examples may present models for multilateral institutions, governments and private sector entities working for a very specific purpose in international development. Moreover, the South-oriented electronic network-based venture is something of a unique initiative, in the context of collaboration platforms.

Peer-to-Peer Computing in the Social or Business Enterprise

In the network age, the third-party intermediary for private sector and multilateral organizations and governments to cooperate and share knowledge can well be an electronic knowledge repository for information exchange in addressing an identified mission, for instance, public health issues of the South. The health challenge of infectious diseases in the South is vastly neglected in global drug discovery. Reflecting this reality, new strategies have to be formulated. An electronic interface could be a platform for information exchange and knowledge transmission to benefit patients, scientists, entrepreneurs and industry all over the world, along with partners from international and bilateral agencies, and committed donor foundations. Figure 3.4.2 represents a

¹⁶ Three sources include Oxfam, the Consumer Project on Technology and the Joint Economic Committee of the US Congress.

system involving specialized databases, facilities for online communications and analytical tools. Via such means, researchers in the South could participate more fully and have an increased stake in product development against communicable and chronic diseases that affect large populations.

Unlike the well-known client-server computer networks, where information sharing occurs through central server hubs, peer-to-peer (P2P) is information sharing at the edges of networks. In many ways, e-mail is one form of P2P that has become the primary means of communications in international development. In addition, file transfer protocol (ftp), hyper-text transfer protocol (http), instant messaging and usenet news groups are other widely used means of P2P. On the technological side, an advantage of P2P is that it does not take up big bandwidth on servers; P2P networking, along with the necessary caching stations and routers, enables efficient bandwidth usage. As computing and the storage power of “client” computers follow a variation of Moore’s Law, it is becoming possible for “central server” programmes to function on “client” machines in this networked era. Simultaneously, the spread of broadband is enabling videoconferencing through the web, another emerging P2P application central to cost-reduction in capacity development.

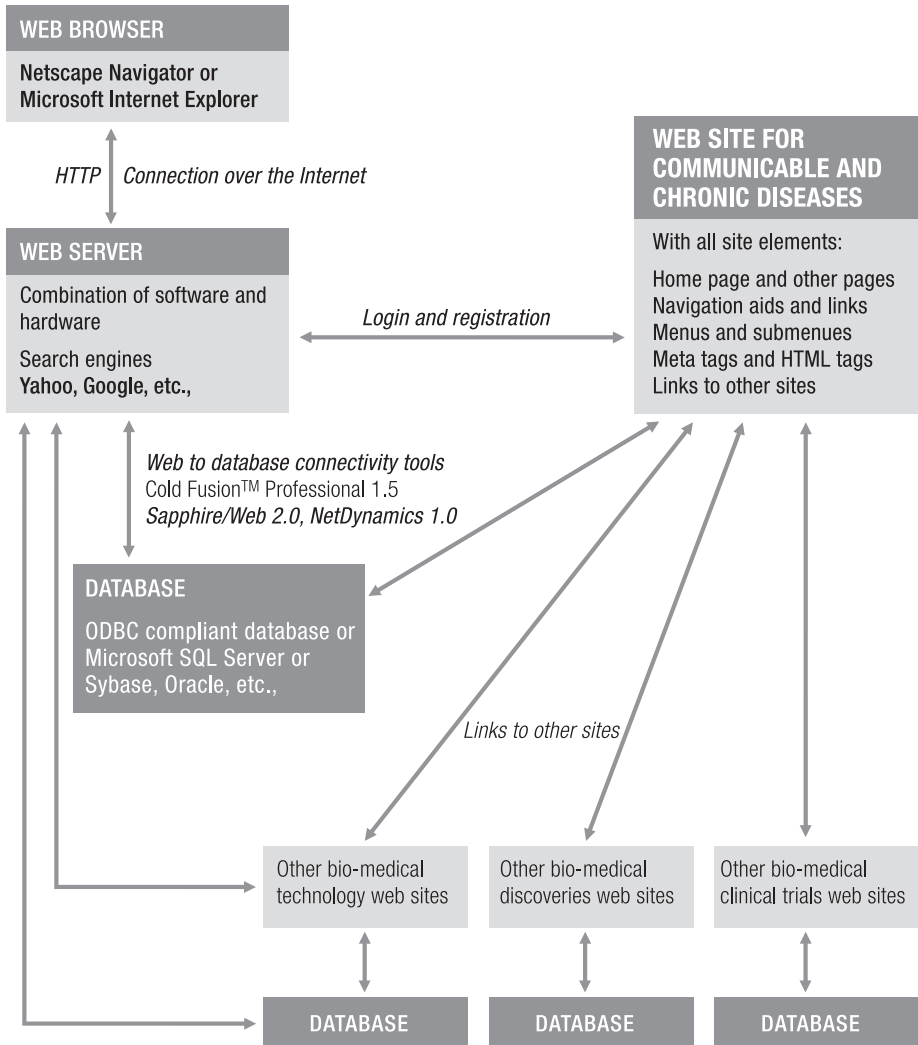
With communication and information technology, the means of global cooperation has become ever more democratized, with a much lower cost-burden and with high efficiency. Clients and providers both have a choice on where to present their needs and where to source their solutions, and this opportunity is increasing as more connectivity becomes available every day. Sub-Saharan African countries are certainly embracing this change. Internet-based initiatives and entrepreneurship, such as MaliNet, have started sprouting from the region to reach global resources.

Conclusion

Nations have boundaries and, at the same time, technology has no finite limit. In the quest for advanced optical broadband networking capabilities and universal outreach, it is not just the North and middle-income developing countries with a relative technological base in high-tech computing or biological systems who will benefit from the network era. Today, hard-working entrepreneurs and scientists in, say, Mali, Niger or Ghana have improved access to technology on the individual and institutional level, and this is utilized to enhance their goods, services and talents in global knowledge endeavours. Through the information communication medium that directly connects them to more than 3 billion web documents, a range of options exists, from virtual distance education to data management to equipment purchase in business-to-business marketplaces. In addition, software and the Internet make it possible for researchers located in sub-Saharan Africa to manage and supply weekly real-time data in a unified format with partners in the Netherlands and North America. This is the essence of value creation that upgrades the output of the intellectual production work of the South in the knowledge-based global economy. We have all witnessed how technology can level the playing field in many cases, particularly for the world’s majority that is

FIGURE 3.4.2: AN ELECTRONIC KNOWLEDGE REPOSITORY AND INTERFACE FOR INFORMATION EXCHANGE
HIGH-LEVEL DEFINITION DIAGRAM

© Sunil Chacko



outside “the major league.” Those groups and individuals willing to grasp a stake in the rising tide presented by the network era will empower the development process.

Nine hundred million people live in developed market economies in comparison with over 5 billion people in developing countries. In these demographics of horrendous inequity, international development organizations are uniquely and distinctly positioned as partners in addressing the needs of the underprivileged, for which overburdened governments are struggling to find solutions. Using their far-reaching global operations and associated prestige, multilateral organizations are effective in setting the agenda for pressing issues. They must, therefore, be constantly responsive to a changing world that is driven by technological advances, in order to be loud advocates for knowledge- and research-based development in adequately defined collaborations with the private sector. Undoubtedly, in the networked era of technical cooperation, the ingenuity in Bamako, New York, Beijing and all over will generate tangible development from the world’s intellectual and knowledge capital far into the future.

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