CHAPTER 2

New technologies and the global race for knowledge

The recent great strides in technology present tremendous opportunities for human development—but achieving that potential depends on how technology is used. What is technology's impact on globalization—and globalization's impact on technology?

The race for knowledge

With the knowledge economy at the forefront of global interaction, much attention has become focused on new technologies: on information and communications technologies and on biotechnology. Why do these stand out?

For both, there have been fundamental leaps in innovation—not just better ways of doing old things but radically new ways of doing previously unimagined things. The fusion of computing and communications—especially through the Internet—has broken the bounds of cost, time and distance, launching an era of global information networking. In biotechnology the ability to identify and move genetic materials across species types has broken the bounds of nature, creating totally new organisms with enormous but unknown implications.

Both technologies are fuelling globalization, opening new markets and giving rise to new actors. Communications change economic competition, empowerment and culture, inspiring global conversation. Genetic engineering leads to complex links between farmers and indigenous people in biorich countries and the multinational pharmaceutical and agricultural industries.

And both technologies are being shaped by globalization. Writing computer programmes and revealing genetic codes have replaced the search for gold, the conquest of land and the command of machinery as the path to economic power. Knowledge is the new asset: more than half of the GDP in the major OECD countries is now knowledge-based. With such importance placed on these technologies, the new rules of globalization—liberalization, privatization and tighter intellectual property rights—are shaping their control and use, with many consequences for human development.

Globalization's rules have set off a race to lay claim to knowledge. A global map for the new technologies is being drawn up faster than most people are able to understand the implications—let alone respond to them—and faster than anyone's certainty of the ethical and developmental impacts. The global gap between haves and have-nots, between know and know-nots, is widening:

- In private research agendas money talks louder than need.
- Tightened intellectual property rights keep developing countries out of the knowledge sector.
- Patent laws do not recognize traditional knowledge and systems of ownership.
- The rush and push of commercial interests protect profits, not people, despite the risks in the new technologies.

The global gap between haves and have-nots, between know and know-nots, is widening

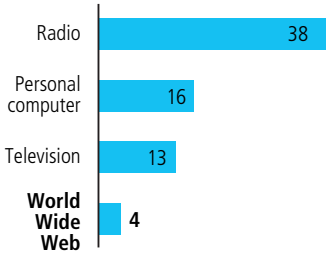
The new technologies—drivers of globalization

Communications technology sets this era of globalization apart from any other. The Internet, mobile phones and satellite networks have shrunk space and time. Bringing together computers and communications unleashed an unprecedented explosion of ways to communicate at the start of the 1990s. Since then tremendous productivity gains, ever-falling costs and rapidly growing networks of computers have

transformed the computing and communications sector. If the automobile industry had the same productivity growth, a car today would cost $3.

In the early 1990s the Internet shifted from a specialized tool of the scientific community to a more user-friendly network transforming social interaction (box 2.1). The number of Internet hosts—computers with a direct connection—rose from less than 100,000 in 1988 to more than 36 million in 1998. More than 143 million people were estimated to be Internet users in mid-1998—and by 2001 that number is expected to be more than 700 million. The Internet is the fastest-growing tool of communication ever (figure 2.1).

FIGURE 2.1
How long before new technologies gain widespread acceptance?
(years from inception to 50 million users)



Source: Economist 1998b.

Its speed and cost advantages are clear. A 40-page document can be sent from Madagascar to Côte d'Ivoire, for example, by five-day courier for $75, by 30-minute fax for $45 or by two-minute email for less than 20 cents—and the email can go to hundreds of people at no extra cost. The choice is easy, if the choice is there.

As the communications revolution turns digital, it promises far-reaching change, globally, nationally and locally. Network communications connect everything to everything else, creating a network society that forces complex and contradictory shifts:

- *Decentralization versus recentralization.* Old economic boundaries around nations have given way to new centres of power in the private sector. Multinational corporations have spread their activities around the world thanks to fast and cheap communications, computer-aided design and the standardization of tasks—yet they can still coordinate and control their worldwide operations as a unit. They operate in an arena beyond the jurisdiction and accountability of any one country, in a global context that does not yet have an adequate framework for regulating them. At the same time network communications have been a tremendous levelling force for small businesses, enabling them to compete—and succeed—in lucrative niches of the global market.
- *Fragmentation versus integration.* Cutting across the tradition of national communities is the rise of on-line communities, drawn together by politics, ethnicity, interests, gender, work or social cause. Using the network, they fire up debates and rally instant responses, bringing a new lobbying power to previously silent voices on the global stage. At the same time network communications can forge closer local communities, providing community information and making local government more transparent.
- *Homogenization versus diversity.* The global entertainment and media industry—spreading opinion, culture and politics—is dominated by a handful of major companies. They control both distribution networks and the programming, including news and films, sent by cable and satellite television into households across the world. At the same time the declining costs of technology have allowed a diversity of voices and cultures to be aired. Multilingual Internet sites and radio programming in local languages reach out to minority groups. Programmes on satellite television bring news and culture from home to many diasporas around the world, including Chinese, Indian and Korean communities.

These changes are still in flux. But information and communications technology can be a tremendous force for human development for all those connected—by providing information, enabling empowerment and raising productivity.

BOX 2.1

What is the Internet?

The Internet—a centreless web of computer networks—was funded by the US Department of Defence in the late 1960s as a strategy for communicating during a nuclear attack. Soon it was used to link technically skilled science and university communities. In the early 1990s user-friendly innovations—the creation of the World Wide Web, the distribution of free browsers—turned the arcana of computer language into the simple point and click of a mouse, making the Internet more widely accessible.

At the same time computers became much cheaper, and the network took off. Even people in the industry did not foresee the revolution. In 1977 a computer industry executive said "there is no reason why anyone would want a computer in their home". Today more than 50 million households in the United States and almost 50 million in Europe have at least one computer at home—and many have two.

The Web began as a free-for-all, an unregulated domain, with a spirit of exploration and spontaneity. Now that it is of commercial interest, laws and regulations are needed in areas of privacy, liability, censorship, taxation and intellectual property.

Source: Security Distributing and Marketing 1998; CNBC 1998; Human Development Report Office.

PROVIDING INFORMATION

Developing countries suffer many of the world's most virulent and infectious diseases, yet often have the least access to information

for combating them. A US medical library subscribes to around 5,000 journals, but the Nairobi University Medical School Library, long regarded as a flagship centre in East Africa, now receives just 20 journals, compared with 300 a decade ago. In Brazzaville, Congo, the university has only 40 medical books and a dozen journals, all from before 1993. Worse, the library in a large district hospital consists of a single bookshelf filled mostly with novels.

Distance learning, through teleconferencing and, increasingly, the Internet, can bring critical knowledge to information-poor hospitals and schools in developing countries (box 2.2). The potential is great—but technology alone is not a solution. Three cautions:

- Information-poor schools and hospitals are often poorly connected. In South Africa, the best-connected African country, many hospitals and about 75% of schools have no telephone line. Even at the university level, where there is connection, up to 1,000 people can depend on just one terminal. A single computer is not enough: an entire telecommunications infrastructure is needed.
- Equipment is a necessity, but to be part of a solution distance learning requires institutions, skills and good management. Distance learning technology is of little use without relevant course content and strong staff support. Zambia saw an exodus of 7,000 teachers between 1986 and 1990, largely due to a shrinking education budget. Technology cannot work where there are no support staff to help pupils get the best from the network.
- Information is only one of many needs. Email is no substitute for vaccines, and satellites cannot provide clean water. High-profile technology projects risk overshadowing basic priorities. As one health worker in Kathmandu said, "Our priorities are hygiene, sanitation, safe drinking water . . . how is access to the Internet going to change that?" The main constraint is inadequate resources for health and education systems as a whole.

Enabling empowerment

Communications technology opens new opportunities for small players to enter the global marketplace and political arena.

Giving voice to NGOs. The heat of the moment will not wait for a letter to travel halfway around the world: people's movements must respond fast to have an impact. Instant network communications have brought this power to NGOs, creating a tremendously important countervailing force out of previously silent voices in the global arena.

The rise of these new actors is felt across the board (box 2.3). Socially excluded and minority groups have created cybercommunities to find strength in on-line unity and fight the silence on abuses of their rights. In India DATPERS, the Dalit and Tribal People Electronic Resource Site, exposes the exclusion of 250 million low-caste people, coordinating international human rights campaigns and keeping the community in touch. During the Indonesian riots of 1998 the ethnic Chinese minority used the Web to draw the attention of the world to their plight.

Women have been innovative in using global communications for their needs. In Mexico City an NGO called Mujer a Mujer—Woman to Woman—emailed contacts in California for assistance when plans for a new textile factory were announced in their community. The women went to meet the management with a bulky portfolio detailing the company's practices, profits and ownership—

BOX 2.2

HealthNet for better patient care

HealthNet is a networked information service supporting health care workers in more than 30 developing countries, including 22 in Africa. It uses radio- and telephone-based computer networks and a low-earth-orbit satellite. Slower than the Internet, it is also cheaper, and accessible in areas with no telecommunications infrastructure.

The network provides summaries of the latest medical research, email connectivity and access to medical libraries. Doctors in Central Africa used it to share information on the 1995 outbreak of the Ebola virus. Burn surgeons in Mozambique, Tanzania and Uganda use it to consult one another on reconstructive surgery techniques. Malaria researchers at a remote site in northern Ghana use the system to communicate daily with the London School of Hygiene and Tropical Medicine.

HealthNet's communications system also supports ProMED mail, created by the Program for Monitoring Emerging Diseases. A moderated, free email list started in 1994, it now has more than 11,000 direct subscribers in more than 135 countries—and thousands more over the Web—who report, discuss and request assistance for outbreaks of emerging infectious diseases. The aim of ProMED is fast reporting—of cholera in the Philippines, E. coli in Japan, Delta hepatitis in the upper Amazon, dengue fever in Malaysia, yellow fever in Switzerland and Ebola in Gabon. The speed of communication—often faster than official channels, yet just as reliable—translates into faster assistance, earlier warnings to neighbouring countries and greater awareness among health workers.

Source: SatelLife 1998.

information impossible to find in Mexico City, and even on the Web, but available in the United States for a small database access fee. And one inspired group used the Internet to build community across the lines in war-torn former Yugoslavia in 1994, creating the Electronic Witches to link women from different ethnic groups. Gathering at Internet-linked computers around the country, often in universities, groups of women sent messages to one another, sharing their concerns, their grief over the bombing of the city of Tuzla and their survival strategies. One message advised that burning just one running shoe would be enough to bake a loaf of bread.

Creating commerce for small businesses. Telephone, email and the Internet give small businesses access to markets and bring much-needed savings in cost and time. A study in Ghana found that workers in small-scale industries without telecommunications can waste up to half their work time travelling from place to place.

Starting from a small base, electronic commerce is booming. The market was valued at $2.6 billion in 1996, and by 2002 it is expected to be more than $300 billion, promising to transform the way business is done around the world. The potential is not limited to companies with sophisticated Websites, or to customers with credit cards and electronic banking. There are many ways of using the Internet to do business—from making contacts and checking prices to displaying goods and entering into contracts. Small businesses everywhere are exploiting the opportunities.

PEOPLink is a fair trade organization selling crafts over the Internet, linking the work of more than 130,000 artisans across 14 countries of Africa, Asia and Latin America. By recording their work with a digital camera, the trading partners can display their products on the Internet and receive orders from around the world.

Tropical Whole Foods, a UK company selling fairly traded dried fruit from cooperatives and small businesses in Burkina Faso, South Africa, Uganda and Zambia, has transformed communications with email. Daily messages are exchanged to pass on business advice and share accounts and production figures, preventing stockpiles and shortages and keeping all partners informed of the current state of trade. In the past such tight coordination would have been possible only for multinational corporations with integrated data networks. Now innovative small businesses can find their niche and compete alongside giants.

Empowering governments of poor countries. In 1990 more than 90% of data on Africa were stored and managed in the United States and Europe, inaccessible to African policy-makers and academics. The Internet is bringing the data back home. Policy-makers can also gain access to international expertise and ongoing debates, strengthening their negotiating positions for a much-needed greater presence in international forums. The Small Islands Developing States Network, SIDSNet, is a forum for its 42 member nations—from Malta and Mauritius to Cuba and Comoros—to share data and experience on common concerns: energy options, sustainable tourism, coastal and marine resources and biodiversity.

BOX 2.3

Defending Gorbachev, defeating the Multilateral Agreement on Investment—how the Internet made a difference

Leaflets and banners are out. Email and Websites are in—as the new tool of protest movements in this global era. Click, connect and the campaign begins.

- In August 1991 an attempted coup against President Mikhail Gorbachev of the Soviet Union was defeated—a part in this was played by a small but determined network society. Coup leaders seized control of television and radio stations, the traditional communications, to block the sounds of dissent, but they did not think to shut down the telephone network. Russia's fledgling and little-known computer network set to work, supplying information to computer nodes and fax machines across the Soviet Union, broadcasting Boris Yeltsin's declaration of defiance and providing a link between Moscow and the rest of the world. The supply of information galvanized people's resistance and helped prevent the coup from gaining momentum.
- In 1997 the leading countries of the OECD began negotiating an agreement behind closed doors to set up a global framework of rules on investment. The Multilateral Agreement on Investment aimed to prevent governments from favouring domestic investors and to remove restrictions on multinational corporations investing in developing countries—highly sensitive issues. When the proposal was posted on the Internet, a coalition of NGOs—environmental organizations, consumer groups, trade unions and church groups—united forces to question the direction of the debate, gain the attention of the press and expose the agreement's shortcomings. By the end of 1998 there were campaigns against the agreement in more than half the OECD countries participating in the discussions and many more in developing countries. With public pressure putting negotiators in an uncomfortable position, and with disagreement among the players, the negotiations broke down.

Source: Rohozinski 1998; Kobrin 1998.

Informing remote specialists. Isolated academics and scientists can take part in Internet conferences, keeping up to date on discussions and developments in their fields. Contacts made can become technical support groups, which are of tremendous value to remote specialists. By allowing participants to share and discuss papers on-line, Internet conferences can easily involve more than 1,000 people worldwide, without any of the costs of travel.

Raising productivity

With the knowledge sector at the forefront of global economic opportunity, getting into knowledge production can be a fast track to growth. By creating a basic capacity to operate imported technology, countries can progress, climbing the rungs of the ladder, by learning to duplicate, to adapt to their own needs and, finally, to innovate. The Eastern Caribbean has seized the opportunity to step onto the first rung, using its low-cost, semi-skilled labour to export data processing services (box 2.4). In Sweden, too, remote communities have specialized in data processing, airline ticketing and hotel reservations, creating productive employment to keep young people from heading for the cities. India has forged ahead, specializing in software programming for export (figure 2.2). Japan and the first tier of newly industrializing countries have climbed the furthest—they focused their industrial strategies on creating knowledge-intensive industries and have built up strong national capacities in research and development. Indeed, Japan is perhaps the ultimate proof that comparative advantage is not a fixed given, but can be created in the information economy.

Addressing censorship

Many governments recognize the tremendous potential of the Internet and use it to provide public information: from the Indian Ministry of Finance to the Malaysian Ministry of Agriculture, government agencies are using Websites to increase the transparency of their operations. Several countries, however, have attempted to censor and control this popular empowerment. Some monitor Web searches and have blocked access to sites providing foreign news or airing political criticism. Others have even made use of the Internet a punishable crime.

But censoring the Internet is difficult, ultimately impossible, since it was designed by the US Department of Defence to operate even if under nuclear attack and to hunt for ways around obstacles when access is blocked. Web discussion groups write the equivalent of thousands of broadsheet newspapers every day—an impossible volume to oversee. The Global Internet Liberty Campaign brings together civil liberties groups, journalists and NGOs to persuade national governments not to restrict access to the Internet because of its tremendous potential for human development. Compared with most traditional tools for development, information and communications technologies can reach many more people, go geographically deeper, work faster and at lower cost.

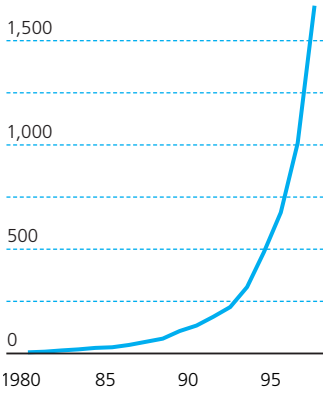
Access to the network society—who is in the loop and on the map?

The power and importance of communications technology are clear. But is it leading to globalization or polarization in communications?

The information revolution has only just begun on a worldwide scale, and its networks are spreading wider every day. But they are heavily concentrated in a very few countries.

In Cambodia in 1996, there was less than 1 telephone for every 100 people. In Monaco, by

FIGURE 2.2
Software exports from India
US$ millions



Source: Heeks 1998.

BOX 2.4

Trading places—the rise of data processing

As early as 1980 electronic data entry services were being exported: bulky paper slips were sent by air freight to countries with good computing skills and low wages. The industry was hampered, however, by the unreliability of freight delivery and the costs of volume, time and distance. Electronic commerce has removed those constraints. Claims processing, electronic publishing, secretarial work, airline ticketing and customer support have migrated overseas through the Internet.

The Eastern Caribbean seized this opportunity. Combining excellent telecommunications with low wages for semi-skilled computer work, the islands have attracted many US companies. In 1994 hourly wages for data entry in the United States were $7–8. Compare that with less than $1.50 in Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent.

The appeal is heating up the competition among offshore teleports, and the cost of overseas calls is often a determining factor—compare Jamaica's 22 cents a minute with Saint Lucia's $1.85 in 1994. That is why developing countries need to move into high-tech, low-cost digital communications technology to be competitive in the global knowledge sector.

Source: Schware and Hume 1994.

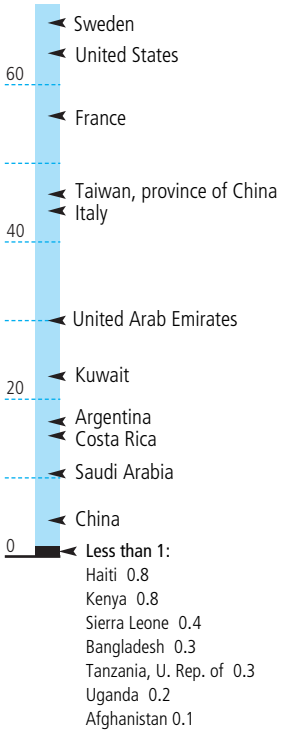
contrast, there were 99 telephones for every 100 people. A widely accepted measure of basic access to telecommunications is having 1 telephone for every 100 people—a teledensity of 1. Yet as we enter the next century, a quarter of countries still have not achieved even this basic level. Many of those countries are in Sub-Saharan Africa and among the least developed countries (figure 2.3). At the present average speed of telecommunications spread, Côte d'Ivoire and Bhutan would take until 2050 to achieve the teledensity that Germany and Singapore have today.

Beyond basic landline connections, the disparities are even more stark. In mid-1998 industrial countries—home to less than 15% of people—had 88% of Internet users. North America alone—with less than 5% of all people—had more than 50% of Internet users. By contrast, South Asia is home to over 20% of all people but had less than 1% of the world's Internet users (figure 2.4).

Thailand has more cellular phones than the whole of Africa. There are more Internet hosts in Bulgaria than in Sub-Saharan Africa (excluding South Africa). The United States has more computers than the rest of the world combined, and more computers per capita than any other country. Just 55 countries account for 99% of global spending on information technology. Most telephones in developing countries are in the capital city, although most people live in rural areas. Connections are often poor in the rainy season, and the costs of calls are very high. In several African countries average monthly Internet connection and use costs run as high as $100—compared with $10 in the United States.

Yet even if telecommunications systems are installed and accessible, without literacy and basic computer skills people will have little access to the network society. In 1995 adult literacy was less than 40% in 16 countries, and primary school enrolments less than 80% in 24 countries. In Benin, for example, more than 60% of the population is illiterate, so the possibilities of expanding access beyond today's 2,000 Internet users are heavily constrained. Even for the newest and most advanced technologies, the most basic and long-standing policy lies at the heart of the solution: investment in education.

FIGURE 2.3
Teledensity
Telephone mainlines per 100 people



Source: ITU 1998.

Welcome to the network high society

Within each region it is only the tip of each society that has stepped into the global loop—worldwide, just 2% of all people. What sets these people apart from the rest? Current access to the Internet runs along the fault lines of national societies, dividing educated from illiterate, men from women, rich from poor, young from old, urban from rural. National Internet surveys in 1998 and 1999 revealed that:

- *Income buys access.* The average South African user had an income seven times the national average, and 90% of users in Latin America came from upper-income groups. More than 30% of users in the United Kingdom had salaries above $60,000. Buying a computer would cost the average Bangladeshi more than eight years' income, compared with just one month's wage for the average American.
- *Education is a ticket to the network high society.* Globally, 30% of users have at least one university degree—in the United Kingdom it is 50%, in China almost 60%, in Mexico 67% and in Ireland almost 70%.
- *Men dominate.* Women accounted for 38% of users in the United States, 25% in Brazil, 17% in Japan and South Africa, 16% in Russia, only 7% in China and a mere 4% in the Arab States. The trend starts early: in the United States five times as many boys as girls use computers at home, and parents spend twice as much on technology products for their sons as they do for their daughters.
- *Youth dominate too.* The average age of users in the United States was 36; in China and the United Kingdom, under 30.
- *Ethnicity counts.* In the United States the difference in use by ethnic groups widened between 1995 and 1998. Disparity exists even among US university students. More than 80% attending elite private colleges used the Internet regularly, compared with just over 40% attending public institutions, where African-American students are more likely to enrol.
- *English talks.* English is used in almost 80% of Websites and in the common user interfaces—the graphics and instructions. Yet less than 1 in 10 people worldwide speaks the language.

Geographic barriers may have fallen for communications, but a new barrier has emerged, an invisible barrier that, true to its name, is like a world wide web, embracing the connected and silently—almost imperceptibly—excluding the rest. The typical Internet user worldwide is male, under 35 years old, with a college education and high income, urban-based and English-speaking—a member of a very elite minority worldwide. The consequence? The network society is creating parallel communications systems: one for those with income, education and—literally—connections, giving plentiful information at low cost and high speed; the other for those without connections, blocked by high barriers of time, cost and uncertainty and dependent on outdated information. With people in these two systems living and competing side by side, the advantages of connection are overpowering. The voices and concerns of people already living in human poverty—lacking incomes, education and access to public institutions—are being increasingly marginalized. Determined efforts are needed to bring developing countries—and poor people everywhere—into the global conversation.

Making global communications truly global

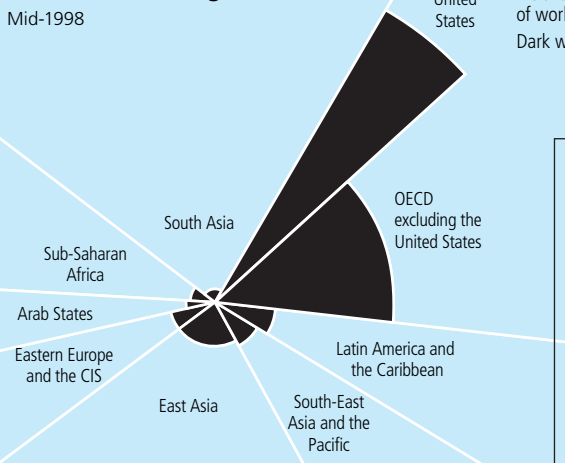
The past decade has proven the tremendous potential of global communications to provide information, enable empowerment and raise productivity. But it has also exposed the risks of dividing and polarizing societies, threatening greater marginalization of those left out and left behind.

What lies in between is proactive policy. The greatest danger is the complacent belief that a profitable and growing industry will solve the problem by itself. But the market alone will make global citizens only of those who can afford it. Fulfilling the potential of global communications for development demands relentless effort in reaching out to extend and enhance the loop. Seven goals on the road to an information society:

- *Connectivity*—setting up telecommunications and computer networks.
- *Community*—focusing on group access, not individual ownership.
- *Capacity*—building human skills for the knowledge society.
- *Content*—putting local views, news, culture and commerce on the Web.
- *Creativity*—adapting technology to local needs and constraints.
- *Collaboration*—devising Internet governance for diverse needs around the world.
- *Cash*—finding innovative ways to fund the knowledge society.

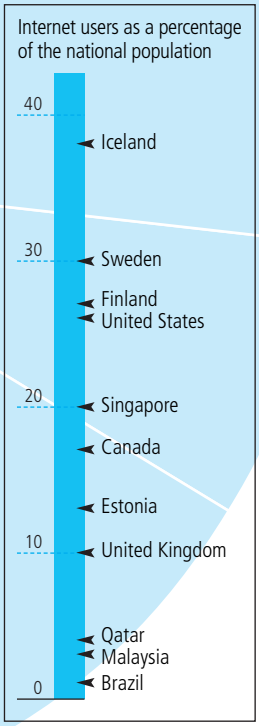
Connectivity. A telecommunications infrastructure is needed, but the infrastructure costs are immense, and many governments are turning to the private sector. Opening telecommunications and Internet provider services to the market can massively increase connectivity. But schemes are needed to ensure that the market does not focus only on lucrative urban customers. When Senegal privatized telephone services, operators were required under licence to install public telephones in 50% of the rural villages containing

FIGURE 2.4
Internet users—a global enclave
Mid-1998



Large circle represents world population.
Pie slices show regional shares of world population.
Dark wedges show Internet users.

	Regional population (as a percentage of world population)	Internet users (as a percentage of regional population)
United States	4.7	26.3
OECD (excl. United States)	14.1	6.9
Latin America and the Caribbean	6.8	0.8
South-East Asia and the Pacific	8.6	0.5
East Asia	22.2	0.4
Eastern Europe and the CIS	5.8	0.4
Arab States	4.5	0.2
Sub-Saharan Africa	9.7	0.1
South Asia	23.5	0.04
World	**100**	**2.4**



Note: The Czech Republic, Hungary, Mexico, Poland, the Republic of Korea and Turkey are included in the OECD and not in the regional aggregates.

Source: Based on data supplied by Nua 1999, Network Wizards 1998 and IDC 1999.

more than 3,000 people by 2000. In the Philippines new mobile phone operators—usually serving an elite market—are also required to install 400,000 landlines—serving poor communities—within five years. Computing hardware and software are needed to transform telephone lines into Internet connections, and policies are needed to promote this. To encourage computer ownership, the governments of Bangladesh and Mauritius, for example, eliminated tariffs and taxes on personal computers.

The satellite revolution promises greater connectivity, since every point on the globe can be reached instantly without a need for expensive land-based infrastructure. User costs are still very high, but with several major satellite networks due to be launched before 2001, competition could bring rapidly falling prices in the future.

Competition is hard to ensure in the telecommunications industry—especially for local calls, as even the most developed countries have seen. Strong regulation and antitrust laws, well implemented, are needed to ensure that private markets are competitive markets and that public needs are met. This will be a challenge for all countries.

Community access. To bring connectivity to people, community access is key, not individual ownership. The concept of one household, one phone is unrealistic in many developing countries, especially in rural areas and among poor communities everywhere. A

BOX 2.5

Innovating with the Internet

The Internet is an evolving tool and can be creatively used in many ways. Some countries are at the forefront of innovating to make this technology work for their needs.

Egypt—enriching telecentres

At the end of 1998 there was less than one Internet user for every 1,600 people in Egypt. Connections are increasing daily, but mainly among the wealthy and well educated in urban areas. To reach out to people in poor and remote areas, UNDP has launched three pilot Technology Access Community Centres (TACCs) in the governorate of Sharkeya.

Each TACC telecentre, equipped with Internet connection and many computers, is located in a public building or a local chamber of commerce to ensure that it is accessible to all—individuals, civil society groups, small businesses, low-income communities. But the centres provide far more than walk-in access. They offer training in computer literacy, email and Web searches, Webpage creation, desktop publishing, computer maintenance and technical support. These skills can be used for distance learning, telemedicine, networking and electronic commerce. Future plans include integrating women's health centres into the TACCs. Internet access is initially free to encourage people to explore the potential. Later, low fees will be supplemented by charges on other services: fax, photocopies and training programmes. This is the way forward for telecentres.

Estonia—raising the roof

Estonia, among the first of Eastern Europe's transition economies expected to enter the European Union, is wasting no time catching up. Along with economic reform, the country has made great efforts to promote access to the Internet for its 1.4 million citizens. Small countries, often disadvantaged by their size in other areas, can be among the first to create an information society. As President Lennart Meri of Estonia has said, "The Internet is the roof of the world for a small nation."

Public Internet access points are provided throughout the country, even on remote islands in the Baltic Sea. In schools the Tiger Leap Programme, launched in 1996, provides information-based learning systems for all pupils, rapidly modernizing education and creating strong conditions for an open learning environment. Its scope has widened, aiming to create an open and democratic society by providing access to modern communications for all, not just school pupils, city dwellers and the well-off. With few natural resources, Estonia has realized that its wealth is its people and is investing in them for the 21st century.

The country has indeed tiger-leaped ahead of other transition economies in integrating into the information society. More than one in 10 Estonians are now on-line—using the Internet—and Estonia ranks among the top 15 countries in Europe in computers per capita, ahead of France and Italy. Surveys of users show that they use the World Wide Web mainly to find information for work, for school and for leisure—spending little time playing games or watching videos. Clearly, in Estonia the Internet is becoming a learning tool, not an entertainment centre.

India—reaching the villages

Some of the remotest villages in the world have modern communication. Ironically, it usually brings only satellite television full of images of distant lives, irrelevant to local issues.

The M.S. Swaminathan Research Foundation in South India is trying to change this—to tackle local problems. The Village Information Project in Pondicherry began with an in-depth study of village needs—and only when this was complete did it turn to technology. Reconditioned second-hand computers were donated by Byte by Byte, a Tokyo-based organization that collects discarded equipment from companies such as Reuters and Ford Motors and sends them off for second lives around the world.

Even in villages without telephones, the Village Information Project brings people the knowledge they need. Free-standing, solar-powered computers are updated daily with information relayed through radio handsets and cell phones from a regional centre with direct Internet access. The village computer acts as a bulletin board for the availability of medicine in health centres and credit in microfinance schemes, for market prices, transport services and input costs, for warnings of pest, weather and water risks and for educational materials for schoolchildren.

Source: M.S. Swaminathan Research Foundation 1998; Mehta 1999; UNDP 1998b; BMF Gallup Media 1999.

more appropriate approach is to create multimedia community centres—or "telecentres"—in places accessible to those often blocked out of institutions: poor people and communities, women and youth. From Peru to Kazakhstan, basic telecentres have been set up in post offices, community centres, libraries, video shops, police stations and health clinics, providing local community access to telephone and fax services, email and the World Wide Web. But providing access takes more than providing computers. Telecentres need to become hubs for skills training and capacity building. Egypt is leading the way in this approach (box 2.5).

Capacity. Building people's capacity to use the Internet starts in schools. The Costa Rican government has installed computers in rural schools across the country to give all pupils a chance to learn the new skills. In Hungary the ambitious Sulinet (Schoolnet) has enabled students in more than two-thirds of secondary schools to browse the Net from their classrooms. The annual NetDay initiative in the United States has used volunteers to connect more than 140,000 schools at a fraction of the commercial cost. Beyond classroom connections, support staff are essential for on-line learning, and teachers need training. In Finland teachers receive more than a month of training in how to use information technology in the classroom. In Lesotho the Technical Enhanced Learning Institutes in Southern Africa (TELISA) were launched in 1998 to renew regional education with professional development for teachers.

Content. The information highway cannot be a one-way street. Websites need to be created locally, adding new voices to the global conversation and making content relevant to communities. The first step is language and culture. The government of Tamil Nadu, India, is promoting keyboard standardization, software interfaces and Websites in Tamil, spoken by 75 million people worldwide. In Estonia the highly effective Tiger Leap Programme is developing educational software to teach the Estonian language and the history of the country (see box 2.5). The Vietnamese community in California's Silicon Valley uses email to keep culture strong for the worldwide diaspora. As one user said of the discussion group, "Vietnet brought everybody closer. Many ideas, feelings, poems and opinions were exchanged. . . . Many people from faraway states and different continents came to visit."

Local content can enhance community participation and institutional transparency. In India the state government of Andhra Pradesh is setting up a network to connect telecentre access points with government services and offices. The Infoville Project in Villena, Spain, has created a "virtual" town hall by subsidizing access to a community intranet with local information, government services, banking, retail, schools and health services on-line.

To bring connectivity to people, community access is key, not individual ownership

Creativity. The context for communications varies greatly around the world, yet solutions have focused on industrial countries. Creativity is needed to adapt the possibilities of technology to the needs of poor countries and poor people. In rural Bolivia most farmers have never seen a computer, but they already have access to the Internet. How? Farmers with crop concerns can give questions to a community leader, who relays the inquiry to the radio station, where it is sent to UNDP's communications centre. The question is then posted on the Internet and answers received are emailed back to the radio station and broadcast. In South India, too, creativity has tailored computer technology to local community needs (see box 2.5).

Collaboration. The Internet has rapidly become not only a global communications tool but a great source of economic potential. Its evolution, at first ad hoc, is being shaped into a system of governance—with rules on domain names, taxation, privacy and protection of intellectual property rights. But governance should not be framed by the United States, the European Union or the OECD alone. Commercial interests may be at stake—but so is the right of access to communications for all people. Internet and telecommunications need global governance framed by global interests.

BOX 2.6

Preparing for the information age—set the wheels in motion

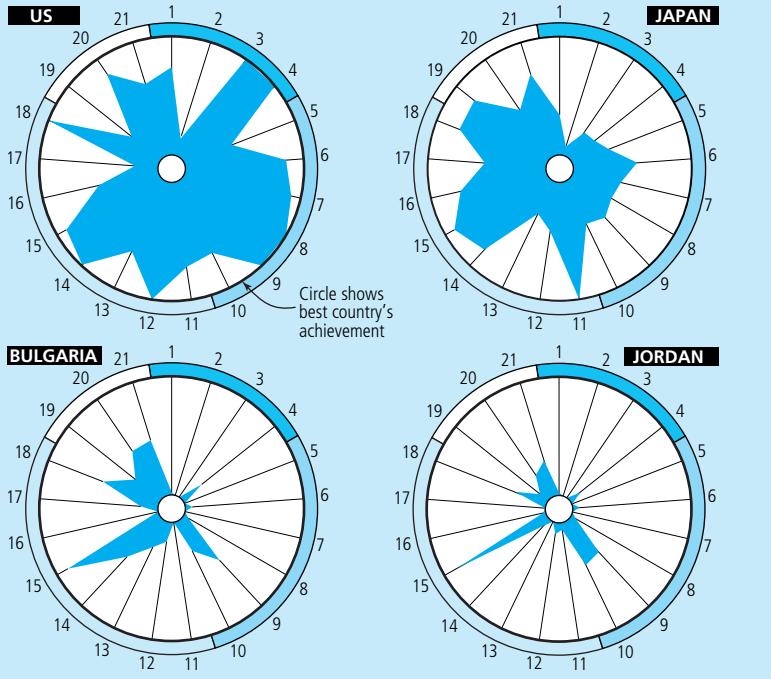
The importance of building an information society is clear. The question for governments faced with scarce resources is not whether to invest—but how much and where. What are the areas that strengthen a nation's capacity to make the most of information and communications technology? The Information Society Index, prepared by the World Times and the International Data Corporation, gives one way of measuring a country's preparedness, across four types of infrastructure:

- *Information*—creating the capacity to send and receive information by telephone, television, radio and fax.
- *Computer*—extending access to computers in schools, workplaces and homes, building networks and using software.
- *Internet*—expanding the use of the Internet in schools, workplaces and homes and enabling electronic commerce.
- *Social*—building people's capacity to use information through education, freedom of the press and civil liberty.

For each indicator, the closer a country is to the outside of the wheel, the closer it is to the best performance yet achieved. A complete wheel would mean the smoothest ride in the information age.

The index has been calculated for the 55 countries, which account for 99% of global information technology spending. This puts the focus on indicators most relevant to industrial countries. An interesting future challenge would be to adapt the index to include indicators more relevant to progress in developing countries. Even in this group of 55 there is great disparity, shown in the range of wheels below.

The United States is the most prepared information economy, but small countries can be early adopters and leaders of the information revolution. Finland, the Netherlands and Singapore have all surpassed many of the traditional industrial economies in coverage and preparedness. The wheels show that there are many dimensions to being prepared for the information age, and each country must tackle its weaknesses.



INTERNET
1 Business Internet use
2 Education Internet use
3 Home Internet use
4 E-commerce spending

COMPUTERS
5 Personal computers for education use
6 PCs for government and commercial use
7 PCs for home use
8 PCs installed
9 Networked PCs
10 Software spending

INFORMATION
11 Fax ownership
12 Radio ownership
13 Cable TV subscription
14 TV ownership
15 Cost of phone call
16 Cellular phone ownership
17 Telephone line error rate
18 Telephone lines installed

SOCIAL
19 Newspaper readership
20 Tertiary enrolment
21 Secondary enrolment

Source: World Times and IDC 1999.

Cash. There is an urgent need to find the resources to fund the global communications revolution—to ensure that it is truly global. One proposal is a "bit tax"—a very small tax on the amount of data sent through the Internet. The costs for users would be negligible: sending 100 emails a day, each containing a 10-kilobyte document (a very long one), would raise a tax of just 1 cent. Yet with email booming worldwide, the total would be substantial. In Belgium in 1998, such a tax would have yielded $10 billion. Globally in 1996, it would have yielded $70 billion—more than total official development assistance that year.

How quickly are different countries preparing for global communications? Many factors are involved, and the race to join the information society has set off at a fast pace. It will determine many of the winners and losers in the globalized world (box 2.6).

The new rules of globalization—shaping the path of technology

New technologies promise many advances for human development. Gene therapy could tackle diseases such as cystic fibrosis and cancer. Genetically altered crops could reduce the need to use polluting herbicides and pesticides. The information and communications industry could provide entry points for developing countries into producing for the knowledge-intensive economy. Yet the path of technology is not predetermined—many avenues of research could be pursued, but only a few are followed.

Technology may be globalizing communications, but globalization—and its new rules—is also shaping the path of new technologies. Over the past 20 years increasing privatization of research and development, ever-growing liberalization of markets and the tightening of intellectual property rights have set off a race to lay claim to knowledge, and this has changed technology's path. The risk is that poor people's and poor countries' interests are being left on the sidelines.

Privatization of research

The knowledge sector is a fast-growing area of the global economy: between 1980 and 1994

the share of high-technology products in international trade doubled, from 12% to 24%. Yet in the 1990s, with many governments facing a squeeze on budgets, the proportion of public funding for research and development in science and technology has fallen around the world, to be replaced by private industry. Research and development has also shifted away from developing countries. Their share in the global total dropped from 6% in the mid-1980s to 4% in the mid-1990s.

The trend has been particularly strong in agriculture and biotechnology. In the early 1980s most crop and seed development in the United States was under public research. Patents were rarely sought and rarely enforced; saving and trading of seed was commonplace. This changed when new legislation encouraged closer cooperation with the private sector, enabling companies to profit from products developed largely with public funds. The intellectual property of public and university research was increasingly passed over to private industry: the portion of public sector patents in biotechnology sold under exclusive licence to the private sector rose from just 6% in 1981 to more than 40% by 1990.

With increasing privatization of research and rising costs for risky innovations, the 1990s have seen a boom in the number and value of mergers and acquisitions. The biggest year ever was 1998, especially for biotechnology, telecommunications and computing industries (figure 2.5). As a result economic power has consolidated among a very few players. By 1995 the world's top 20 information and communications corporations had combined revenue of more than $1 trillion—equivalent to the GDP of the United Kingdom.

In biotechnology genetic engineering underlies the new direction of pharmaceuticals, food, chemicals, cosmetics, energy and seeds. This is blurring the boundaries between the sectors, creating mega "life sciences" corporations. Indeed, across all knowledge-intensive industries, a select group of corporations controls ever-growing shares of the global market. In 1998, how much of the global market did the top 10 corporations in each industry control? In commercial seed, 32% of a $23 billion industry; in pharmaceuticals, 35% of $297 billion; in veterinary medicine, 60% of $17 billion; in computers, almost 70% of $334 billion; in pesticides, 85% of $31 billion; and in telecommunications, more than 86% of $262 billion. The lesson is clear: privatization does not automatically lead to competition.

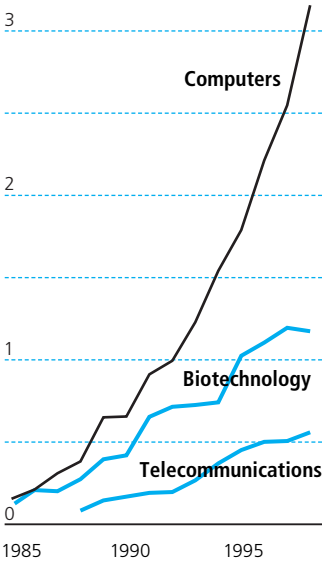
Tighter intellectual property rights

At the creation of the World Trade Organization in 1994, the most far-reaching multilateral agreement on intellectual property was drawn up: Trade-Related Aspects of Intellectual Property Rights, or TRIPS (box 2.7).

The past two decades have seen a huge rise in patent claims. The World Intellectual Property Organization's Patent Cooperation Treaty accepts a single international application valid in many countries. The number of applications made annually soared from less than 3,000 in 1979 to more than 54,000 in 1997—and those applications in 1997 were equivalent to nearly 3.5 million individual national applications (figure 2.6). According to the director of research and development at one of the largest biotechnology corporations, "the most important publications for our researchers are not chemistry journals but patent office journals around the world."

Yet the claims to intellectual property are concentrated among very few countries.

FIGURE 2.5
Worldwide mergers and acquisitions
Deals annually (thousands)



Total value of mergers and acquisitions
US$ billions

Sector	1988	1998
Computers	21.4	246.7
Biotechnology	9.3	172.4
Telecommunications	6.8	265.8

Source: Securities Data Company 1999.

BOX 2.7

What is TRIPS?

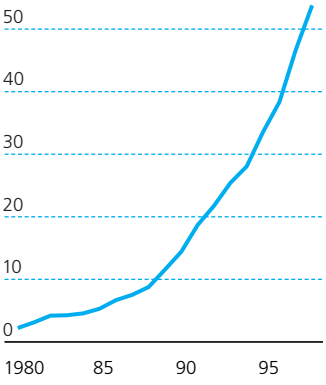
Intellectual property issues were first raised under the General Agreement on Tariffs and Trade in 1986 to clamp down on trade in counterfeit goods. With many industrial countries interested in tying negotiations on trade liberalization to tighter control over technology, this narrow focus was soon extended to include many other areas. The agreement on Trade-Related Aspects of Intellectual Property Rights, or TRIPS, came into effect in 1995 under the World Trade Organization (WTO). It affects such diverse areas as computer programming and circuit design, pharmaceuticals and transgenic crops.

Although each country implements intellectual property rights law at the national level, the TRIPS agreement imposes minimum standards on patents, copyright, trademarks and trade secrets. These standards are derived from the legislation of industrial countries, applying the form and level of protection of the industrial world to all WTO members. This is far tighter than existing legislation in most developing countries and often conflicts with their national interests and needs. Developing countries have been given until 2000 to adjust their laws, least developed countries until 2005.

The WTO's TRIPS agreement can be enforced through the integrated dispute settlement system. This effectively means that if a country does not fulfil its intellectual property rights obligations, trade sanctions can be applied against it—a serious threat.

Source: South Centre 1997.

FIGURE 2.6
The race for patents
Annual applications under World Intellectual Property Organization's Patent Cooperation Treaty (thousands)



Source: WIPO 1998.

Industrial countries hold 97% of all patents worldwide. In 1995 more than half of global royalties and licensing fees were paid to the United States, mostly from Japan, the United Kingdom, France, Germany and the Netherlands. Indeed, in 1993 just 10 countries accounted for 84% of global research and development, controlled 95% of the US patents of the past two decades and captured more than 90% of cross-border royalties and licensing fees—and 70% of global royalty and licensing fee payments were between parent and affiliate in multinational corporations. By contrast, the use of intellectual property rights is alien to many developing countries. More than 80% of the patents that have been granted in developing countries belong to residents of industrial countries.

Impacts on people

These new rules of globalization—privatization, liberalization and tighter intellectual property rights—are shaping the path of technology, creating new risks of marginalization and vulnerability:

- In defining research agendas, money talks louder than need—cosmetic drugs and slow-ripening tomatoes come higher on the list than a vaccine against malaria or drought-resistant crops for marginal lands. Tighter control of innovation in the hands of multinational corporations ignores the needs of millions. From new drugs to better seeds for food crops, the best of the new technologies are designed and priced for those who can pay. For poor people, the technological progress remains far out of reach.
- Tighter intellectual property rights raise the price of technology transfer, and risk blocking developing countries out of the dynamic knowledge sector in areas such as computer software and generic drugs.
- New patent laws pay scant attention to the knowledge of indigenous people, leaving it vulnerable to claim by others. These laws ignore cultural diversity in creating and sharing innovations—and diversity in views on what can and should be owned, from plant varieties to human life. The result is a silent theft of centuries of knowledge from developing to developed countries.
- Despite the risks of genetic engineering, the rush and push of commercial interests are putting profits before people.

Private research agendas—money talks louder than need

Genetic engineering is largely the product of private commercial research in industrial countries. The top five biotechnology firms, based in the United States and Europe, control more than 95% of gene transfer patents. It can take 10 years and $300 million to create a new commercial product—so, not surprisingly, companies want to protect their innovations and ensure that they reap profits. But this approach focuses research on high-income markets. In 1998, of the 27 million hectares of land under transgenic—genetically altered—crops, more than 95% was in North America and Europe. Research has focused on the wants of rich farmers and consumers: tomatoes with longer shelf lives or herbicide-resistant soyabeans and yellow maize to be used mainly for poultry feed. Seed varieties are engineered to be suitable for mechanized mass production with labour-saving techniques, designed for industrial and intensive farming conditions.

Far less time and money have been given to the needs of farmers in developing countries: increasing nutritional value, disease resistance and robustness. Similarly, research is lacking on water-saving plant varieties for smallholders. Instead, many major corporations are seeking patents for the innovation of linking genetic characteristics to chemical triggers. What for? One likely use is to create seeds that will germinate and bear fruit only when used with the company's brand of fertilizers or herbicides—increasing sales through dependency on inputs. With agrochemical, plant breeding and seed distribution companies merging into megacorporations, farming communities risk becoming caught in a chain of biological and licensing controls.

Local plant breeding is essential for adapting seeds to the ecosystem and maintaining biodiversity. The 1.4 billion rural people relying on farm-saved seed could see their interests marginalized. With increasing control and homogenization of the market by major agribusinesses,

the competitiveness of alternative varieties and the scope for producing alternative crops will most likely decline, depleting local genetic diversity.

In the pharmaceutical industry private interests cannot be expected to meet all public needs. Almost all research on diseases in developing countries has been done by international organizations or the military in industrial countries. Of the annual health-related research and development worldwide, only 0.2% goes for pneumonia, diarrhoeal diseases and tuberculosis—yet these account for 18% of the global disease burden. In the United States between 1981 and 1991, less than 5% of drugs introduced by the top 25 companies were therapeutic advances. Some 70% of drugs with therapeutic gain were produced with government involvement. Vaccines are the most cost-effective technologies known in health care, preventing illness in a one-time dose. But they generate smaller profits and have higher potential liabilities than treatments used repeatedly. As a result a consortium of US pharmaceutical companies has united to develop antiviral agents against HIV, but not to produce a vaccine against AIDS.

Tighter intellectual property rights are blocking developing countries from the knowledge sector

The costs of industrial catch-up for Japan and the first-tier newly industrializing economies in East Asia were greatly reduced by the weak enforcement of intellectual property rights in the region before the mid-1980s. Tighter control under the TRIPS agreement has closed off old opportunities and increased the costs of access to new technologies.

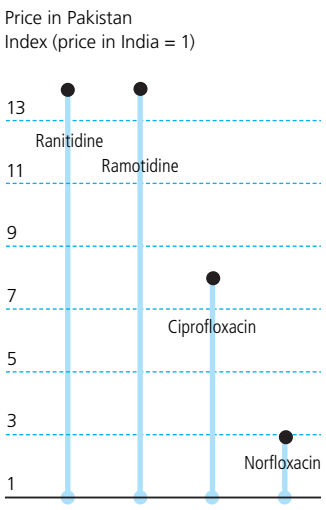
In the pharmaceutical industry, prior to the TRIPS agreement, countries such as China, Egypt and India allowed patents on pharmaceutical processes but not final products. This approach supported the development of domestic industries using different methods to produce mainly generic drugs, similar to but far cheaper than the original brand names. The difference is highlighted by contrasting drug prices in Pakistan, where there are patents, to India, where there are none (figure 2.7).

When Glaxo Wellcome launched AZT as an inhibitor of AIDS, it cost $10,000 per patient each year. As sales increased, the price fell to $3,000—still far out of reach for most people in developing countries. An Indian company then produced a generic—Zidovir 100—and exported it to Belgium, Tanzania and Uganda at less than half the price. The TRIPS agreement requires 20-year patents on both processes and products, so India and others must change national patent laws, making such opportunities impossible in the future. As gene therapy comes to dominate the pharmaceutical industry, this will significantly limit the industry's potential in developing countries.

Countries can choose to require patent holders to give licences to competitors—but the process is long and the fees may be prohibitive. Imposing price controls on industry, calculated as a mark-up on costs, is another option, but multinationals often avoid low prices by using loopholes in transfer pricing—artificially inflating the cost of inputs transferred from country to country within the multinational's domain. In India multinational companies have sometimes charged 2, 4 or even 10 times the prices they would charge for inputs in Europe and the United States in order to avoid controlled low prices. They have little interest in pricing drugs for the market in developing countries because they are maximizing global, not national, profits and do not want to set a low-price precedent.

In the computer industry, software is one of the fastest-growing areas and can be a way for new countries to get into producing for the knowledge sector. In 1994 the global market for final, packaged software was $79 billion, of which OECD countries accounted for 94%. With a small but growing number of developing countries entering the competition, it is not surprising that the battle over intellectual property rights for software is a fierce one. Protection is certainly needed: programmes are expensive to develop, while pirating them is cheap and easy. Even before Microsoft launched Windows 95 at $100, it was on sale on the streets of Beijing for $9. Many firms have lost billions of dollars of trade in this way. At the same time excessively tight intellectual property rights would eliminate competition and innovation in this industry

FIGURE 2.7
Drug prices and patent costs



Source: Lanjouw 1997.

underlying global communications. A careful balance needs to be struck.

The TRIPS agreement followed the United States in placing software, like music and novels, under copyright law, with strong and universal protection. The United States has started to grant patents on software in addition to copyright, creating stronger control over programme interfaces and tightening control over the industry. But there is leeway. The TRIPS agreement does not prohibit making copies for reverse engineering—a process of unravelling computer programmes to see how they work, generating ideas and innovation. With programmes such as Word and Excel becoming computing standards, reverse engineering is essential for smaller producers to create software that is compatible and competitive, and it must be protected in future reviews of the agreement. If it were forbidden, the development of competitive products would be drastically limited. And different computers around the world would not be able to interact with one another—defeating the aim of connecting the network society.

Developing countries are the source of an estimated 90% of the world's store of biological resources

Patent laws do not recognize traditional knowledge and systems of ownership

Biodiversity is of great importance to drug development, and developing countries are the source of an estimated 90% of the world's store of biological resources. More than half of the world's most frequently prescribed drugs are derived from plants or synthetic copies of plant chemicals—and this trend is growing. Plant-based drugs are part of standard medical treatment for heart conditions, childhood leukaemia, lymphatic cancer and glaucoma, with a global value over the counter of more than $40 billion a year.

In the same way that many Arab states benefited from industrialization's thirst for the petroleum that lay beneath their land, so now biorich countries could have the chance to benefit from biotechnology's demand for the rare germ plasm found on their land. Many indigenous communities have a further claim to biotechnology's bounty because they have been the cultivators, researchers and protectors of their plants—indeed, it is their long-acquired knowledge of nature's potential that is valuable to pharmaceutical companies today. Bioprospectors have for many years taken samples of plant material and documented their traditional medicinal uses. Without the consent of local people, this knowledge has been used to develop highly profitable drugs. In any other situation this would be called industrial espionage—theft of both the genetic materials and the long-acquired knowledge of using them to develop medicines.

The rosy periwinkle found in Madagascar, for example, contains anticancer properties, and drugs developed from it give $100 million in annual sales to a US-based multinational pharmaceutical company, Eli Lilly—but virtually nothing for Madagascar.

Plant material was once treated as common property, but a landmark US legal case in 1980 awarded a patent on a genetically altered organism, launching the first step in the race to patent life. Yet patent laws were drawn up in 19th-century Europe during the industrial revolution; their legal frameworks have been extended to cover global markets during the information revolution. Three fundamental concerns:

- The inventions born of genetic engineering bring radically new characteristics. Can a framework of property rights first designed to protect industrial machinery really cope fairly and effectively with the complexities of genetically manipulated organisms?
- Scientific research now takes place under a regime based on ownership and control. It rewards research according to short-term profitability, not according to the needs to protect biodiversity, ensure sustainable and ethical use of genetic resources or meet the essential needs of people.
- The attempt to create a global market in property rights imposes one conception of ownership and innovation on a culturally diverse reality, benefiting private industrial research but not public institutes or farming communities (table 2.1).

In 1995 two researchers at the University of Mississippi Medical Center were granted the US patent for using turmeric to heal wounds. But in India this was a long-standing art, common knowledge and practice for thousands of

years. To get the patent repealed, the claim had to be backed by written evidence—an ancient Sanskrit text was eventually presented as proof and the patent removed—but this only highlighted the absurd imposition of one culture's systems on another culture's traditions.

As a result of these problems, there has been increasing recognition of the need to protect the knowledge of indigenous people. The Convention on Biological Diversity of 1992 recognizes the need to protect property rights but also the need for companies to gain prior informed consent before conducting research—but this convention is not legally binding until countries translate it into national law, and indigenous communities have often received little attention or protection under national law.

In the absence of legislation, more and more strategic alliances are being struck between pharmaceutical firms and governments or indigenous groups in resource-rich countries. Merck Pharmaceuticals has an agreement with the non-profit National Institute of Biodiversity, INBio, in Costa Rica to pay $1.1 million for access to 10,000 plant and insect samples. If any leads to a successful drug, Costa Rica would receive a 2–3% royalty share, yielding a possible $20–30 million each year.

From Australia and Ecuador to Thailand and Uganda, bioprospectors have made agreements with local communities, taking out patents based on local knowledge in exchange for a share of profits. Royalties promised are commonly 1–2%, though sometimes as low as 0.1% and as high as 3–4%. Even if just a 2% royalty were charged on genetic resources that had been developed by local innovators in the South, it is estimated that the North would owe more than $300 million in unpaid royalties for farmers' crop seeds and more than $5 billion in unpaid royalties for medicinal plants. But this rate is low because negotiations are on an uneven footing. When one company wanted to bioprospect in Yellowstone National Park, the United States Park Service secured a 10% royalty share. Negotiating power is everything.

More strategic alliances are being struck between pharmaceutical firms and the governments or indigenous groups in resource-rich countries

The rush and push of commercial interests protect profits, not people—despite the risks in the new technologies

Genetically modified foods come from plants to which extra genes have been introduced to add qualities such as resistance to pests or frost. The genes are taken from other plants, animals or micro-organisms and are often introduced by attaching them to a virus. There are several risks in this process. Genes introduced to make plants tolerant to herbicides and insecticides could escape in pollen and create highly resilient weeds that displace other wild plants and change the balance of the ecosystem. Similarly, over time powerful new strains of insects

TABLE 2.1
Who has real access to intellectual property claims?

Issue	Multinational corporations	Public research institutes	Farming communities
Under intellectual property law the inventor must be named.	Employee contracts ensure that inventors surrender most or all rights to the company.	Employee contracts can ensure that inventors surrender most or all rights to the institute.	The concept of an individual inventor is alien to many communities and can cause conflict.
The criteria for patents include novelty and an inventive step.	Companies' focus on micro-improvements usually manages to meet the criteria.	Focused more on research, institutes often cannot meet the strict criteria.	Since these criteria have little to do with the process of community invention, they are hard to meet.
Legal advice from highly specialized patent lawyers is expensive.	Companies have in-house legal departments and ready access to expert consultants.	Institutes have little in-house capacity and limited access to expensive expertise.	Communities usually cannot afford or obtain either basic or expert advice.
Patent holders must defend their patents under civil law.	Companies employ aggressive tactics, using patent claims to stake out their market turf.	Institutes often lack strong patent defence and give in to political pressure not to challenge the private sector.	Communities find it almost impossible to monitor—let alone confront—patent infringements around the world.

Source: RAFI 1998.

and weeds resistant to herbicides and insecticides could develop. New toxins could have damaging effects in the food chain, and viruses could escape from virus-containing crops. The impacts could be particularly serious in developing countries where biodiversity is high and essential for sustainable agriculture. Yet it can take 10–15 years before environmental damage becomes evident. Despite the promised commercial gains, many developing countries are extremely concerned about the potential impact (box 2.8).

Policies are urgently needed to turn the advances in the new technologies into advances for all of humankind

The growing use of transgenic crops raises important issues—about the safety of transferring organisms into new environments, questions of liability for damage that are not covered under international law and the need for far more transparency in information. Responses to these issues have varied dramatically.

The United States, exporting $50 billion of agricultural products a year and planting transgenic varieties for 25–45% of its major crops, claims that strict safety rules will impede billions of dollars of global exports annually in seed, grains and even products like breakfast cereals and cotton clothing. But consumer movements and farmers have often reacted strongly to transgenic crops, pulling them out of fields and rejecting them in shops. Ten years ago the risk of humans being infected by bovine spongiform encephalopathy (BSE, or mad cow disease) was said to be negligible—but it happened. Once bitten, twice shy, European consumers especially are now questioning altered foods. Science is moving so fast and so little information has been shared, it is not surprising that people fear that technology is out of control.

With new technologies, profits should not come first—but nor should panic. Precaution is needed, and this was the motivation for the Biosafety Protocol under the Convention on Biological Diversity. The protocol would require exports of genetically manipulated organisms to be approved in advance by the importing country. The negotiations collapsed in February 1999 after the main exporting countries—the United States, Canada, Australia, Argentina, Uruguay and Chile—fell into open disagreement with the European Union and many developing countries. Biosafety is still critical—all the more so as transgenic crops become more widespread.

BOX 2.8

Ethics and technology—a luxury concern?

The ability to manipulate genetic resources is running far ahead of the understanding of where to place the ethical limits. Sheep, mice and human cells have already been cloned—all considered impossible only 10 years ago. The new technologies have sparked many debates about the limits of science and the ethics of tampering with the essence of life.

Some argue that ethical questions are a luxury for the wealthy and should not hinder technological change in the developing world, especially when the race is on to establish a competitive edge. But this is surely wrong. The pursuit of human development is the first priority, and all concerns—social, financial, ethical, environmental—need to be taken into account. This is especially true of the new technologies whose social and environmental implications are still unknown. To ask who gains and who loses, and what are the benefits and what are the costs, is precisely to ask the ethical questions.

Far from being able to ignore these issues, developing countries often find themselves at the centre. They are home to much of the world's biodiversity. And neglecting the ethical issues surrounding genetic engineering will lead to their continued neglect in economic forums. For developing countries the ethics of technology are far from a luxury—they are a basic.

Source: Shiva 1997.

THE NEED TO RESHAPE TECHNOLOGY'S PATH

Policies are urgently needed to turn the advances in the new technologies into advances for all of humankind—and to prevent the rules of globalization from blocking poor people and poor countries out of the knowledge economy.

THE NEED TO BROADEN GOVERNANCE

Intellectual property rights were first raised in GATT in 1986 to crack down on counterfeit goods. Their reach has gone far beyond that into the ownership of life itself. As trade and intellectual property law increasingly come to determine the path of nations—and the path of technology—questioning present arrangements is not just about economic flows. It is about preserving biodiversity, carefully considering the ethics of patents on life, ensuring access to health care, respecting other cultures' forms of ownership and preventing a widening of the technological gap between the knowledge-driven global economy and the rest trapped in its shadows.

At a time of such dramatic breakthroughs in new technologies, it is indefensible that human poverty should persist as it does. What is more startling is that the current path could be leading to greater marginalization and vulnerability

of poor people. The relentless march of intellectual property rights needs to be stopped and questioned. Developments in the new technologies are running far ahead of the ethical, legal, regulatory and policy frameworks needed to govern their use. More understanding is needed—in every country—of the economic and social consequences of the TRIPS agreement. Many people have started to question the relationship between knowledge ownership and innovation. Alternative approaches to innovation, based on sharing, open access and communal innovation, are flourishing, disproving the claim that innovation necessarily requires patents (box 2.9).

Broader governance is also needed in the communications industry. Governance of the Internet has until recently been ad hoc and largely biased towards the needs of high-tech countries. Debates over taxing electronic commerce, allocating domain names and creating privacy laws need to be opened up to include the needs and concerns of developing countries, which have an equal interest in the evolution of this tremendous tool.

Participation in the governance of technology must also be widened. Race car drivers would not be the best advisers on public transport, and scientists at the cutting edge of the technological revolution cannot alone decide its path. This calls for collaboration—in national and global forums—between industry, independent scientists and technicians, governments, regulators, civil society organizations and the mass media.

At a time of such dramatic breakthroughs in new technologies, it is indefensible that human poverty should persist

Public investment in technologies for development

The path of technology must be reshaped if developing countries are to see an advance in sustainable agriculture, wide access to global communications and improvements in the health of their populations. The new structure of science requires new initiatives. New technologies promise many advances for human

BOX 2.9

Questioning the ownership of knowledge

Innovation is one of the most important processes for human development. It pushes human capability forward and keeps cultures thriving. It is also at the heart of the human quest to expand knowledge. But are patents always the best way to promote innovation in new technologies? There are good reasons to question this common claim.

Experts question current trends

Some scientists are appalled by the scramble for patents for commercial gain, believing that it damages research openness about discoveries that should be shared for the common good. With the "stacking"—tactical purchase—of patents by corporations, the terrain of medical and agricultural research is quickly being carved up and fenced off. Ideas are no longer shared across the boundaries of different research groups.

History tells another story

Many of today's developed countries—ironically now the strongest advocates of tighter intellectual property rights—themselves had loose rules when they were setting up their national industries, changing their tune only after they became technology exporters. Canada and Italy had no trouble attracting foreign investors even when they lacked patent protection. In Switzerland in 1883, a leading textile manufacturer defended loose laws, saying "Swiss industrial development was fostered by the absence of patent protection. If [it] had been in effect, neither the textile industry nor the machine-building industry . . . would have flourished as they did."

Empirical evidence shows no clear link

Despite the fierce defence of the need for intellectual property rights in new technologies, there is no conclusive evidence to back it up. Do tighter intellectual property rights increase trade in knowledge-intensive goods? Unclear. A 1999 World Bank study examining the experience of more than 80 countries found that the effect of intellectual property rights on trade flows in high-tech goods was insignificant. Do tighter intellectual property rights increase foreign direct investment in high-tech goods? Studies say yes for pharmaceuticals—along with higher prices—but for other knowledge goods foreign direct investment usually depends on market size, technological infrastructure and macroeconomic policy. Do tighter intellectual property rights spur multinational corporations to carry out in-country research and development? Apparently not: studies have found that competitive markets are the biggest influence on research and development, not patents. All this evidence is inconclusive—but while the jury is still out, how can the judge decide?

There is living proof of successful alternatives

Alternative ways of innovating are alive—and doing very well. The Internet is testament to the power of cooperative, decentralized approaches to solving problems. Rejecting the tight control over software given by copyright, a reverse movement has been launched—"copyleft", turning standard practice on its head. Rather than guarding the source codes to programmes, software developers allow users to view, modify and innovate with them—as long as they keep the new codes open too. The result? Arguably the best software around. Apache, a Web server developed communally by programmers in their spare time, is one of the most reliable and up-to-date products available—and is installed on 50% of publicly accessible Web servers. Its no-secrets policy makes it an ideal tool for teaching and experimenting in programming.

Source: Gerster 1998; Fink and Braga 1999; Leonard 1997; GRAIN 1998; UNCTAD 1997.

development, but public institutions cannot afford them alone and private industry will not develop them alone. Jointly they can. Innovative policy is needed to ensure that much-needed solutions for human development are pursued. Incentives are needed to turn research towards the pressing needs of the world, not just of those who pay. One proposal is for the Consultative Group on International Agricultural Research (CGIAR) to reroute genetic research to wider needs (box 2.10).

Incentives are needed to turn research towards the pressing needs of the world, not just of those who pay

A representative group of independent scientists is needed to identify the critically important technological challenges—those that, if solved, would substantially improve the human development of the world's poorest people and address the global challenges to human security faced by all. Every five years the group could offer financial incentives and public recognition to researchers, public and private alike, for innovations that would be used for global public interests. What would be high on the list? In agriculture, sustainable, robust and biosafe crops. In medical research, vaccines for malaria and HIV. In communications technology, personal computers powered by solar strips and wind-up or dynamo drives, resistant to sand and humidity; software for touch screens; and prepaid chip card software for electronic commerce without credit cards. In environmental science, diverse sources of renewable energy. What would fund such initiatives? A levy on patents registered under the World Intellectual Property Organization is one possibility. A levy of just $100 on each patent would have raised $350 million in 1998 alone, equivalent to the annual budget of the world's largest international research organization in agriculture, the CGIAR. Alternatively, funding could be reallocated from the research subsidies, grants and tax breaks now given to industry.

BOX 2.10

Rerouting the genetic revolution—the CGIAR proposal

The Consultative Group on International Agricultural Research (CGIAR) proposes to redirect the path of modern biotechnology by providing public research to meet the needs of all humanity. Responsible for a major collection of crop species—numbering 600,000 accessions—it has called for an end to patenting genes drawn from gene banks. It has also banned the use of genetically sterile seeds—"terminator technology"—in its own research. The CGIAR's current budget for crop biotechnology is just $12 million a year—compare that with US private sector spending on biotechnology research: $9 billion in 1997 alone.

The CGIAR plans to rejuvenate a strong public research system to ensure that breakthroughs in science are translated into breakthroughs for people—reducing malnutrition, poverty and environmental degradation, keeping the findings as public property. Also needed are "rules of engagement" for the public and private sectors, based on the premise that access to the means of food production is as much a human right as access to food. The CGIAR could also lead the way in combining the search for solutions with precautions against risk—following the equity and biosafety protocols of the Convention on Biological Diversity.

Source: CGIAR 1998.

Pushing for change in multilateral agreements

The WTO is planning a review of the TRIPS agreement. But these discussions must not simply push into new issues. Intellectual property rights agreements were signed before most governments and people understood the social and economic implications of patents on life. They were also negotiated with far too little participation from many developing countries now feeling the impact of their conditions. There is a clear need for a full and broad review of existing legislation, not an additional, unsustainable burden of new conditions.

The choice is not between patents on everything or on nothing. Rather, the question is, how much should be patentable? How can the system be structured to take into account diverse interests and diverse needs?

The review needs to ensure that the room for manoeuvre granted in the TRIPS agreement is respected in practice. Interpretation of the agreement is obviously not a unilateral matter, and proposals by developing countries have often been rejected by G-7 countries keen to maintain their industrial interests. In the event of disagreement, dispute resolution mechanisms involve intense negotiating among lawyers—expensive and complex. The advantage in costs and expertise clearly does not lie with developing countries.

To strengthen their bargaining positions in pushing for change, countries need to present frameworks that provide alternatives to the provisions of the TRIPS agreement. Work is already well under way. Many countries are exploring possible sui generis legislation for plant varieties to protect farmers' rights. The difficulty is the need for legislation to meet many diverse interests within each country. One strong and coordinated international proposal is the Convention of Farmers and Breed-

ers (CoFaB). It offers developing countries an alternative to following European legislation by focusing legislation on needs to protect farmers' rights to save and reuse seed and to fulfil the food and nutritional security goals of their people.

For indigenous people's interests, too, open debate is needed across countries to bring together the most up-to-date thinking for use by negotiators and policy-makers. The framework needs to consider collective rights to knowledge and resources, the need for prior informed consent for use of materials and knowledge—not just the consent of the government but also of the indigenous groups concerned—and the need for transparency in the findings of research. Some initiatives have already been taken. Indigenous people's organizations around the world such as the Indigenous Peoples Biodiversity Network are seeking guidelines for legal recognition of their intellectual property. Thailand, the Philippines and Australian aboriginal groups have all taken steps to protect indigenous knowledge.

Developing countries facing similar challenges can benefit from consultation and co-operation to create model laws, collaborate in training public officials and devise strategies to help industries adversely affected by the new regime. Spreading awareness of the issues at stake is important in building coalitions among national interest groups, regional organizations and international civil society campaigns. Presenting counter-proposals as a united negotiating bloc would greatly strengthen the possibility for change. In March 1999 the International South Group Network drew together representatives from 17 southern and East African countries to discuss a joint position on the upcoming World Trade Organization round and the review of the TRIPS agreement, greatly strengthening the clarity and force of the message to be delivered from countries in the region.

The TRIPS agreement was drawn up with remarkably little analysis of its expected economic impacts. The costs of implementation—revising laws, training officers, testing and enforcing patents—are high, yet the benefits are unclear. If the agreement is to be reviewed, then let it be a review in everyone's interests. A transparent cost review mechanism should be established within the World Trade Organization, to track the costs of implementing the TRIPS agreement, the effects on consumer prices, the cost of anti-competitive effects and the impact on technology flows. And most important, it should examine the impact on biodiversity, on farming communities and on access to medical resources and scientific information.

Putting precaution before profits

The potentially great benefits of the new biotechnology come with risks attached: national and international guidelines are urgently needed as transgenic crop production grows. Each country needs to draw up biosafety measures, to monitor changes in biodiversity, demand transparency and labelling of products, consider the social, economic and ethical impacts and promote research into areas of national need. Regional coordination is needed for sharing data and experience, for sharing in the costs of training officials and for developing rules of trading.

Much greater attention must be given to understanding the potential environmental and health hazards of genetically altered crops—an especially important task in countries where the science base and media coverage are narrow and there is extensive fragmentation of the food chain into many smallholders, processors and traders.

Participation in the process must be widened. Knowledge is needed not only of the latest technologies but also of local ecosystems and food chains, local culture and systems of exchange, socio-economic conditions and political and market stability. This calls for broad collaboration. Some countries are already on this path with established and representative biotechnology advisory groups. France's government has adopted the precautionary principle, promising to survey the development of the genetic revolution and increase public transparency on findings. The European Parliament favours creating a registry of tested and accepted transgenic products, making a database available to the public.

To strengthen their bargaining positions in pushing for change, countries need to present frameworks that provide alternatives to the provisions of the TRIPS agreement

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Information and communications technologies and biotechnology hold great potential for human development. But strong policy action is needed nationally and internationally to ensure that the new rules of globalization are framed to turn the new technologies towards people's needs. Thus questions need to be asked on how it is used. Does the control, direction and use of technology:

- Promote innovation and sharing of knowledge?
- Restore social balance or concentrate power in the hands of a few?
- Favour profits or precaution?
- Bring benefits for the many or profits for the few?
- Respect diverse systems of property ownership?
- Empower or disempower people?
- Make technology accessible to those who need it?

Global governance of technology must respect and encompass diverse needs and cultures. Public investment—through new funding—is essential to develop products and systems for poor people and countries. Precaution is needed in exploring new applications, no matter how great their commercial promise. Only then will the rules of globalization allow technological breakthroughs to be steered to the needs of people, not just profits.