The Global Information Technology Report 2001–2002

Readiness for the Networked World

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The terms *country* and *nation* as used in this report do not in all cases refer to a territorial entity that is a state as understood by international law and practice. The term covers well-defined, geographically self-contained economic areas that may not be states but for which statistical data are maintained on a separate and independent basis.

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Preface

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Animated discussion of the economic miracle heralded by information and communication technologies (ICTs) was ubiquitous in the late 1990s. Yet as the dust settles upon the era of the "new economy," and as the wilder claims regarding the resurgent power of new technologies die down, it is nevertheless clear that ICTs have become one of the key factors in all modern economies.

Policymakers and business leaders increasingly recognize the need to create an enabling environment to support the development and adoption of technologies across all sectors. The importance of Networked Readiness, at the regional and national levels, has gained prominence on the public policy agenda alongside the realization that the tools provided by ICTs can help countries fulfill their national potential and enable a better quality of life for their citizens.

This report highlights the prospects for growth in countries that have proven themselves ready to take up new technologies, and importantly, reveals the obstacles to Networked Readiness. Through in-depth analysis of how multiple factors such as access to enabling infrastructure, local content development, and human capacity-building contribute to Networked Readiness, the report can serve as a guide to policymakers and regulators.

The World Economic Forum itself has responded to this issue since January 2000, when the Global Digital Divide Initiative was launched at our annual meeting in Davos, Switzerland. The meeting gathered together top ICT, media, communications, and entertainment sector executives. These executives initiated the formation of a task force to look at how to transform into an opportunity for growth the so-called digital divide between developed countries that had embraced Networked Readiness, and those countries that potentially would lag behind.

Since its inception, the task force has engaged a uniquely global, multisectoral, and diverse community of stakeholders from business, government, and civil society who meet to explore creative ways to engage stakeholders worldwide in dialogue and action to address the challenge of bridging the global digital divide.

At the invitation of the government of Japan, in its then-capacity as President of the G-8, the task force submitted a statement in July 2000 at the Kyushu-Okinawa Summit meeting. In this statement, the task force outlined policy actions and initiatives that each stakeholder group could undertake to transform the global digital divide into a opportunity. Since then, the task force has continued to contribute to the work of the G-8 Dot Force and the United Nations ICT task force.

Since November 2000, the task force has been engaged in its implementation phase, with steering committees working on the key issues of education, content, connectivity, and strategies and policies needed to create an entrepreneurial environment. At a policy level, the task force works with regional policymakers to provide them with new perspectives; the October 2001, joint consultative workshop on Networked Readiness held with the Southern Africa Development Community, is one such example. At the grassroots level, task force member companies channel resources and support to projects that promote education, training, and new enterprise building.

The Global Digital Divide Initiative continues to be the product of fruitful collaboration between members of a broad community of businesses, governments, and civil society. I would, however, wish to thank especially the 2001 cochairs of the task force, Joao Roberto Marinho, Cochairman, Organizaçoes Globo, Brazil; Jean Marie Messier, Chairman and Chief Executive Officer, Vivendi Universal, France; and Maureen O'Neil, President, International Research and Development Centre, Canada for their time and commitment to the work of the task force. In addition, I would like to thank the digital divide secretariat, Julianne Lee, Juliet Borton, and Julia Fisherman, for their continued hard work on the Global Digital Divide Initiative.

We extend our gratitude to all the committed business leaders that responded to our Survey. We would like to extend a special thank you to Geoffrey Kirkman, Managing Director of the Information Technologies Group at the Center for International Development at Harvard University, who has taken the lead role in creating this project, as well as his colleague, Professor Jeffrey Sachs, who also serves as the cochair of the Global Competitiveness Program. At the World Economic Forum, my appreciation goes to Dr. Peter K. Cornelius, who has been charged with heading the Global Competitiveness Program under which this Report is published. Finally, we extend very special thanks to our partner, the *info*Dev Program at the World Bank, led by Bruno Lanvin, Program Manager, for their support of this important study.

Foreword

Bruno Lanvin, *infoDev, The World Bank*

Information and communication technologies (ICT) have been a core driver of the phenomenon of "globalization." In this new environment, information has new value and generates new power. Information is changing the rules of competition and the very basis on which investors, producers, and consumers make their decisions.

As governments, businesses, and civil society devote increasing attention to ways in which globalization can be an efficient tool for more equitable international relations, they naturally come to the conclusion that this question is tightly linked to another one, namely: How can societies with different levels of development turn the ICT revolution into an instrument that reduces the risk of marginalization and alleviates poverty?

Taking action in this broad and complex area requires a clear assessment of how well, or how poorly, equipped a country is to face the challenges of an information-driven global economy, and how ready it is to benefit from potential "digital dividends."

For over six years, the Information for Development Program (*info*Dev; http://www.infodev.org) has been exploring these questions. A multidonor program administered by the World Bank, *info*Dev has been the grant mechanism through which a large number of "ICT for development" projects have been financed all over the world. The decision to fund a project is based on its originality, usefulness, scalability, replicability, and relevance; that is, on its potential to bridge the so-called digital divide. The *Global Information Technology Report 2001–2002* is a project that meets all the criteria necessary to receive *info*Dev's support.

Even more compelling than bridging the digital divide, however, was another reason why *info*Dev wanted to support this report. Throughout its existence, *info*Dev has been confronted with one of the most striking characteristics of the world of ICT: its potential to reduce poverty. While anecdotes abound about how particular ICT projects contributed to the fight against poverty, it remains remarkably difficult to convince many decision makers, private and public, that fighting the digital divide is a priority and an avenue by which to reduce the broader, more complex, and deeper development divides. How does one go from anecdotes (which can illustrate) to experience (which can be shared) to knowledge (which can be disseminated), and then to strategies and actions (which can make a difference in the lives of people)? This report is a major step in that direction. By offering state-of-the-art reflections on some of the key facets of the global information revolution, and by providing a set of comparable Networked Readiness indicators, the *Global Information Technology Report* provides a sound and comprehensible tool for action for those who want to go "from here to there."

To gear up for the challenges and opportunities of the Networked Economy, action will be required from governments (economic and regulatory reforms, for example); from the local private sector (which will have to upgrade its organization, equipment, labor force, and business practices); as well as from international investors, who will have to prove imaginative and daring enough to seize fresh opportunities. Such action will also require the involvement of civil society, because the world of information and knowledge needs more than a technological or economic vision: it calls for new kinds of social contracts.

After a year of shocks and increased awareness about the promises of information dividends and the dangers of information divides; after the production of various reports and plans of action (including those of the World Economic Forum's Global Digital Divide Initiative, the G-8 DOT Force and the United Nations ICT Task Force); and after major changes in the international economic landscape (including the entry of China into the World Trade Organization (WTO) and the launch of a common European currency); it is auspicious that 2002 should start with the publication of the first *Global Information Technology Report.* May it be of use in helping as many individuals, enterprises, and countries as possible to consider globalization an opportunity, poverty alleviation the challenge, and digital dividends a way to bind these elements in a virtuous circle of growth, fairness, and peace.

Executive Summary

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The Context

Amidst the political and economic volatility of the last eighteen months, many observers have dismissed or forgotten the promise that the Internet offers. Terrorism is on everyone's mind, thousands protest at every major global meeting, there is a global recession, and in the wake of the bursting of the 1990s dot-com bubble, information and communication technologies (ICTs) have fallen far down on the list of global priorities.

The *Global Information Technology Report 2001–2002: Readiness for the Networked World (GITR)* reminds us of the continued relevance and promise of ICTs, and helps bring some order and clarity to our collective thinking about the appropriate use of ICTs in the world. We are very excited to bring together such a diversity of expert voices and wealth of analysis in one volume.

Although much has recently been turned on its head, some things remain clear. Most importantly for the context of the *GITR*, the Internet and other ICTs have fundamentally changed the way the world works. The Networked World is here to stay, but the changes have happened so fast that we don't really understand our new surroundings. Most importantly, we still have a long way to go in figuring out how ICTs can help in the greatest challenge we face today—the enhancement of global well-being.

The analysis and findings in the *GITR* are relevant to the whole world, but we have crafted a particular focus on the issues of developing countries. ICTs have yet to be adopted or used by most of the world, but it is those people who have not yet used the Internet or spoken on a telephone who perhaps have the most to gain from the potential of ICTs.

The Report

In assembling this report, we wanted three basic elements to create a coherent message. First, we wanted *vision* to inspire and challenge us to think about technology, development, and their relationship, in new ways. Second, we wanted to better understand how people and organizations are translating vision into *action* on the ground. Third, and at the heart of the *GITR*, we sought to challenge conventional wisdom and standard operating procedures and find better ways to *analyze, understand, and measure* the results of action in order to establish benchmarks and decision-making capability for future success. These building blocks are central to all three sections of the *GITR*: the individually authored chapters, the country profiles, and the presentation of data.

The centerpieces: Networked Readiness Index and country profiles

At the core of the *GITR* is the Networked Readiness Index, a major comparative assessment of countries' capacity to exploit the opportunities offered by ICTs. The Networked Readiness Index provides a summary measure that ranks 75 countries on their relative ability to leverage their ICT networks. (See Table 1.) The Index and its major findings are presented in Chapter 2.

The Networked Readiness Index goes hand-in-hand with the 75 country profiles that are presented in the second part of the *GITR*. These profiles explore subnational ICT trends and ways in which ICTs are contributing to national, social, and economic development goals in the context of the framework of the Networked Readiness Index. The country profiles provide snapshots of both the quantitative and qualitative factors of Networked Readiness and reveal common themes, different strategies, and clear patterns in national and subnational approaches to Networked Readiness. The challenges of encouraging greater and more effective use of ICTs by small and medium sized enterprises, overcoming rural versus urban discrepancies in ICT adoption, designing policies to encourage Networked Readiness, and overcoming marked deficits in the numbers and skills of ICT workers are among the issues being confronted in countries all over the world.

The final section of the *GITR* contains a series of tables that show in detailed ranking format, both the hard and survey data that were used to build the Networked Readiness Index presented in Chapter 2 and to develop the country profiles. This collection of data pertaining to the Networked World provides a rich trove for analysis that we have only begun to explore within the *GITR*.

Expert voices on the Networked World

Our contributing authors include some of the leading thinkers, academics, business leaders, and analysts in the world, and each of their contributions is vital to enhancing our understanding of Networked Readiness. The essays in the first part of the *GITR* bring us an unrivaled balance of vision, action, and new ways of understanding the Networked World.

VISION

The rapidity of the advances in technological development too often leaves organizations, programs, and businesses struggling to keep up. This means that we are left with policies, programs, and business models that do not leverage the real potential of ICTs. Our authors contribute to our understanding of what changes ICTs can bring in the future and how we can maximize their benefit.

One-to-one, many-to-many, and a better world

We have yet to begin tapping into the power of the newest and next technologies. In Chapter 1, entitled, “Some Thoughts on How ICTs Could Really Change the World,” John Gage of Sun Microsystems shares his inspiring vision of how ICTs could revolutionize economic development worldwide. Gage challenges readers to link tomorrow’s technological change to real projects that can have a lasting, positive impact.

Finger paint and the computer

The assumption that computers by themselves will improve the learning process has become endemic among decision makers in education and other areas. One of the misconceptions of how computers can help learning stems from an insistence that the same skills that we have been taught for the past century remain the most important and relevant in today’s Networked World. In Chapter 3, Mitchel Resnick of the Massachusetts Institute of Technology (MIT) Media Lab in “Rethinking Learning in the Digital Age” emphasizes the need for radically different learning systems that tap into the potential that computers, in particular, offer. Drawing upon his experiences with the Computer Clubhouse and other projects, Resnick shows how computer-enhanced learning can create meaningful change in the lives of children, and points to the importance of the underlying philosophy of learning as key to instituting reform.

Table 1: **The Networked Readiness Index**

Country	NRI rank	Country	NRI rank
United States	1	Latvia	39
Iceland	2	South Africa	40
Finland	3	Turkey	41
Sweden	4	Lithuania	42
Norway	5	Thailand	43
Netherlands	6	Mexico	44
Denmark	7	Costa Rica	45
Singapore	8	Trinidad and Tobago	46
Austria	9	Dominican Republic	47
United Kingdom	10	Panama	48
New Zealand	11	Jordan	49
Canada	12	Venezuela	50
Hong Kong SAR	13	Mauritius	51
Australia	14	Peru	52
Taiwan	15	Bulgaria	53
Switzerland	16	India	54
Germany	17	El Salvador	55
Belgium	18	Jamaica	56
Ireland	19	Colombia	57
Korea	20	Philippines	58
Japan	21	Indonesia	59
Israel	22	Egypt	60
Estonia	23	Russian Federation	61
France	24	Sri Lanka	62
Italy	25	Paraguay	63
Spain	26	China	64
Portugal	27	Romania	65
Czech Republic	28	Ukraine	66
Slovenia	29	Bolivia	67
Hungary	30	Guatemala	68
Greece	31	Nicaragua	69
Argentina	32	Zimbabwe	70
Slovak Republic	33	Ecuador	71
Chile	34	Honduras	72
Poland	35	Bangladesh	73
Malaysia	36	Vietnam	74
Uruguay	37	Nigeria	75
Brazil	38		

Get on board, or get shut out

As the Internet continues to evolve, businesses need to evolve as well. In Chapter 5, “The X Internet: Leveling the Playing Field for Businesses in Developing Nations,” George Colony, Navi Radjou, and Eroica Howard of Forrester Research show us how the next generation of the Internet, one that is executable and extended, will fundamentally change business practices and the sources of competitive advantage. The authors stress the importance for companies, particularly in the developing world, to adapt to the coming technological realities.

ACTION

We can learn a lot from the on-the-ground experiences of projects, businesses, and endeavors that are using ICTs effectively. This is true in all areas, but especially important in education, business, and policy.

Moving beyond the blackboard

More often than not, computers are installed into schools around the world without sufficient thought given to how the computers will be used. In Chapter 4, "Ten Lessons for ICT and Education in the Developing World," Robert Hawkins from World Links, a program of the World Bank Institute, discusses his program's experience in connecting schools to the Internet, training teachers, and grappling with curriculum and education reform issues in developing countries. Hawkins distills the World Links story into ten cogent, practical lessons that policymakers and business and community leaders should bear in mind as they attempt to incorporate the Internet into the educational process.

The triumph of business fundamentals

The Internet can help create true excellence in business practice, but technology alone will do nothing if the appropriate managerial and organizational infrastructure and knowledge are not in place. In Chapter 6, "The Importance of Organizational Leadership for Creating Technology Excellence," Soumitra Dutta of INSEAD presents two compelling case studies that show the tremendous impact that leadership and organizational excellence can have in creating business success using ICTs in the developing world. Dutta effectively illustrates that managerial innovation is essential to creating environments where ICT-enabled business models can thrive.

Navigating the difficulties of policy reform

In recognition of the complexity involved with telecommunications regulation decisions, in Chapter 12, "The Elements of Successful Telecommunications Sector Reform," Scott Beardsley, Ingo Beyer von Morgenstern, Luis Enriquez, and Carsten Kipping of McKinsey & Co. present the policy reform levers that policymakers have at their disposal. The authors discuss the sequencing and tradeoffs of implementing telecommunications liberalization programs.

ANALYZING, UNDERSTANDING, AND MEASURING

We are still trying to understand the dynamics of the Networked World. There is a crucial need for measures that better capture its complexity.

Redefining the Networked World

In Chapter 2, "The Networked Readiness Index: Measuring the Preparedness of Nations for the Networked World," Geoffrey Kirkman, Carlos Osorio, and Jeffrey Sachs from the Center for International Development at Harvard University present the Networked Readiness Index and the major Networked Readiness findings from 75 countries. In their more detailed findings, the authors break new ground in analytical measurement of the factors that generate Networked Readiness, and suggest that much conventional wisdom about ICT policymaking may be fundamentally flawed.

Creating a digital provide

A shortcoming that has plagued the field of ICT and Development is its reliance on anecdotal accounts of how ICTs can help the ubiquitous poor farmer find out market prices. Descriptions pointing to why the Internet is relevant in the economic development process are filled with stories of online sales of Ethiopian sheep and Indonesian goats, but there has been little analytical evidence of the true microeconomic impact of ICTs. In Chapter 7, "Information and Communication Technologies, Markets, and Economic Development," Karen Eggleston of Tufts University and Robert Jensen and Richard Zeckhauser of Harvard University present a compelling analysis of the impact of ICTs on income in the context of rural villages in China. The construction of their economic model fills an important gap in our knowledge of how ICTs affect income, and paves the way for more analytical research in this area.

Making rural markets work

Most of the world has still had no contact with the Internet or any other modern ICTs, and bringing the opportunities of connectivity to the rural areas of the globe remains a major development challenge. In Chapter 8, "Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle," Michael Best of the MIT Media Lab and Colin Maclay of the Center for International Development at Harvard University discuss the major challenges to extending the benefits of ICTs to rural areas. Drawing largely upon their experience in southern India, Best and Maclay show that market forces and entrepreneurship are of paramount importance in meeting rural ICT needs effectively, and that perceptions of rural areas as nonviable markets are flawed.

Putting e-commerce and trade strategies together

The challenges of making e-commerce truly global are wide-ranging, especially when policymakers lack the analytical tools to identify opportunity and craft policy accordingly. In Chapter 9, "Electronic Commerce, Networked Readiness, and Trade Competitiveness," Catherine Mann of the Institute for International Economics builds upon existing models of trade and e-commerce analysis to devise new analytical tools for policymakers as they focus on improving the policy environment for the development of e-commerce. In particular, Mann shows the importance in developing countries of aligning e-commerce and trade strategies around principles of competitive advantage and industry fit.

Tracking the flows of trade

International trade can play a major role in extending the diffusion of ICTs around the world. In Chapter 10, "Trade in ICT Products: The Global Framework and Empirical Evidence," Peter K. Cornelius and Fiona Paua of the World Economic Forum and Friedrich von Kirchbach and Nicolai Sëmine of the International Trade Centre look at trends in the international trade of ICT products, with particular attention to improving the adoption of ICTs in the developing world.

Mastering the minutiae of regulation

Telecommunications deregulation is one of the key areas of policymaking that affects Networked Readiness, because it affects the price, quality, and diffusion of the Internet. In Chapter 11, "Telecommunications Sector Reform—A Prerequisite for Networked Readiness," Scott Beardsley, Ingo Beyer von Morgenstern, Luis Enriquez, and Carsten Kipping of McKinsey & Co. examine the evidence of telecommunications liberalization to date, and through rigorous cross-country comparison and data analysis, present a solid look at the global experience. Their analysis provides a firm base for their discussion of the levers of policy reform in Chapter 12.

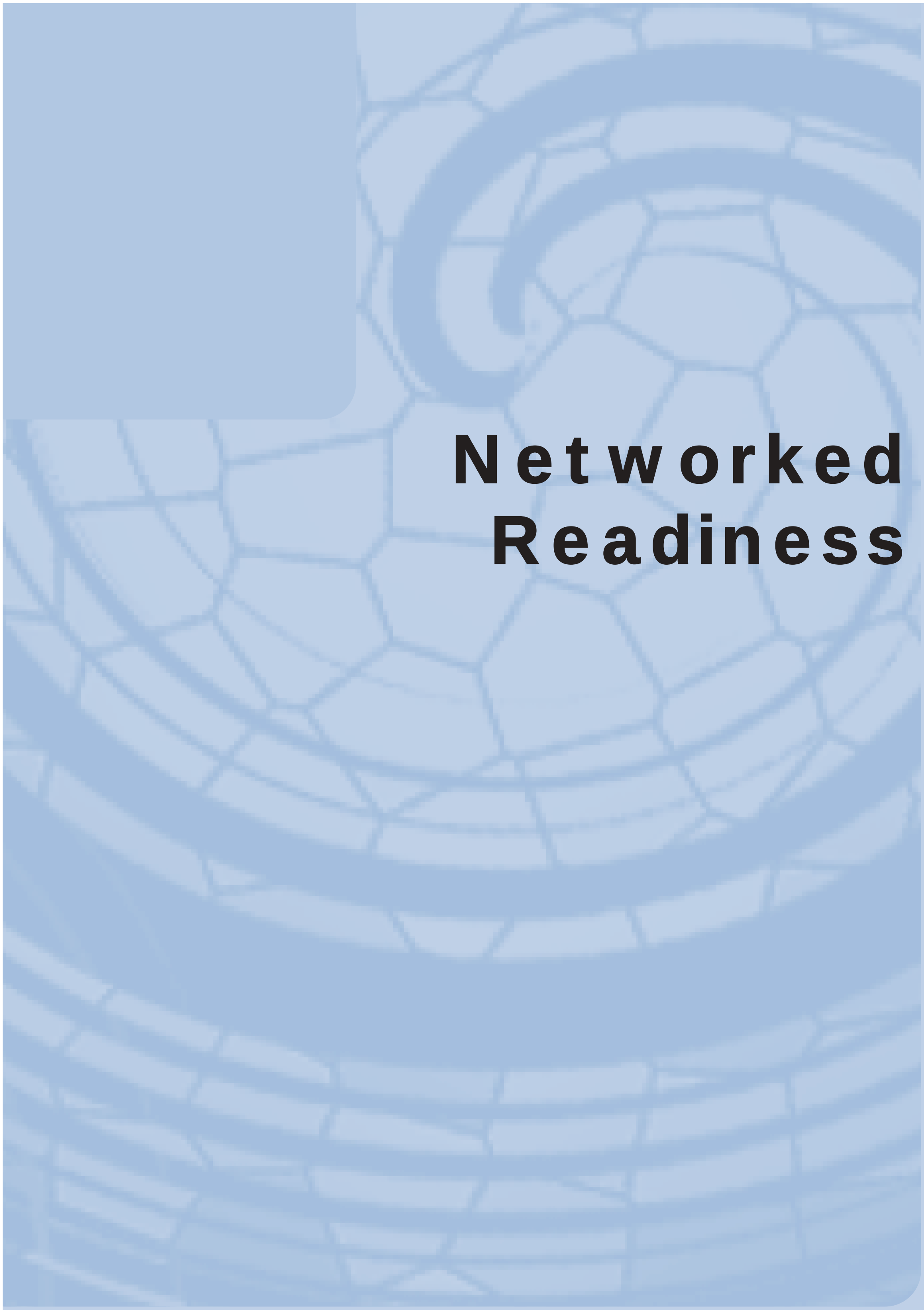
Toward the Future

This inaugural *Global Information Technology Report: Readiness for the Networked World* is the first volume of its kind to explore such a wide range of issues, capture the current realities, and challenge us all to improve how ICTs are used throughout the world. We look forward to continuing to build on the vision, action, and tools for understanding that can be found throughout the Report. Above all, we hope that the *GITR* will contribute to the overarching goal of making the world a better place through the thoughtful and appropriate use of information and communication technologies.

Chapters

Chapters

Chapters



Networked Readiness

CHAPTER 1

Some Thoughts on How ICTs Could Really Change the World

John Gage

Sun Microsystems

As network and transportation technologies link the world, they change it. United Nations Secretary General Kofi Annan reminded us of this as he accepted the 2001 Nobel Peace prize:

> *Today's real borders are not between nations, but between powerful and powerless, free and fettered, privileged and humiliated. Today, no walls can separate humanitarian or human rights crises in one part of the world from national security crises in another…New threats make no distinction between races, nations, or regions. A new insecurity has entered every mind, regardless of wealth or status. A deeper awareness of the bonds that bind us all—in pain as in prosperity—has gripped young and old.*
>
> *…We must focus, as never before, on improving the conditions of the individual men and women who give the state or nation its richness and character. We must begin with the young Afghan girl, recognizing that saving one life is to save humanity itself.*
>
> *Oslo, 10 December 2001*

The Networked World: Bonding Us One to One, One to All, and Many to Many

The Secretary General challenges us: Can we apply information and communication technologies to improve the condition of each individual? Can today's information communication technologies (ICTs), designed for one-to-one links in telephone networks, or for one-to-many links in radio and television networks, serve to bond us all? And how can new forms of ICTs—peer-to-peer, edge-to-edge, many-to-many networks—change the relationship between each one of us and all of us?

The Networked World: Today's ICTs and Development

Three fundamental technical changes in ICTs are responsible for the explosion in their use to promote economic development: plummeting cost, expanding access to the network, and more powerful human-to-machine interfaces.

The plummeting cost of devices allows many people and applications that could not afford to communicate in the past, to link. Expanding access to the network allows new services to reach more people. Intuitive interface metaphors allow new users to understand how to use these services without manuals, instruction, or translation.

These three changes will continue and accelerate. As a result, ICTs will permeate the poorest regions of the world over the next twenty years. Their use will provide new tools for economic development: to make markets more efficient, as discussed by Eggleston, Jensen, and Zeckhauser in Chapter 7 of this report; to change education, as discussed by Resnick and Hawkins in Chapters 3 and 4; and to change government and business institutional forms.

But institutional change takes time. Governments and businesses are only now experimenting with ICT tools that have been available for twenty years. For technology to be used, we must match technology with need. We must carefully choose our focus. And we must measure what we are accomplishing.

Remember the first law of technical change: Technology is easy. People are hard.

The Networked World: Tomorrow's ICTs and Development

New technical capabilities are now emerging; their uses must be matched to needs. Four technical advances, in particular, promise to aid development—peer-to-peer (i.e., device-to-device) networks, precise local spatial data systems, sensor fusion, and unique identity systems—developments whose role in economic development demands new understanding and innovation. These advances are built from the innovations of the past, but provide new tools for change.

First, peer-to-peer or device-to-device networks turn today's networks on their head. Instead of centralized portals bringing data from big servers to users, the devices at the edges of the network share resources with each other, form self-organized groups, and migrate data and programs among themselves as needed. The aggregate of resources at the edge of the network is much greater than that of the resources in central servers, and the disparity will grow larger forever. This inevitable change means that today's centers of information and resources become ever less important. A hundred million music lovers exchanging music files among themselves don't ask permission from broadcasters or music publishers.

Furthermore, existing applications must be replaced in this new, distributed world. Application developers who create distributed, peer-to-peer applications from scratch, unburdened by the need to work on legacy centralized systems, have an advantage. An example of how rapidly a new, distributed technology can replace or supplant existing centralized systems is the explosion of cellular telephony in countries that abandoned exclusive control by expensive centralized telephone monopolies.

Second, precise local spatial data embedded in every device and application creates new possibilities for engineering and market efficiencies. To know the location of every package, freight container, truck, cell phone, well, fruit tree, plow, irrigation pump, unexploded munitions, street, or building allows more efficient use of existing infrastructure, and more efficient designs of new systems of transportation, water and power distribution, shipping, and early flood warning. For example, linking a sensor in an automobile air filter to the network, when coupled with meter-accurate Global Position Satellite (GPS) data, can give a precise guide to sources of chemical, biological, radioactive, or particulate pollution in a city. Linking the windshield wipers gives an instant, precise weather map—if they're on, it's raining.

Third, sensor fusion—integration of devices that measure temperature, movement, pressure, acceleration, flow, electrical use, radioactivity, chemical composition—allows new forms of interaction between each device and its environment. For example, intelligent electrical motor control, aggregated across all air conditioners and refrigerators in a tropical city, can cut the peak load demand by 20 to 40 percent. Since electrical capacity is built for peak loads, significant investment can be saved through network-enabled efficiency.

Fourth, unique identity systems—that is, systems that identify any device, program or user; that establish the authenticity of an identity; that authorize actions depending on permissions—provide the basis for transactions, whether commercial or societal. All contract systems, all payment systems are based on establishing and trusting the identity of the participants. New technologies, ranging from DNA analysis to face recognition to pressure-sensitive fingerprint recognition to unique signatures, make it possible to create new systems of personal trust. Examples are locks that open only for one person, gun triggers that can only be pulled by the finger of the owner of the gun, money transfers between devices whose mutual trust is established by a permanent, undeniable audit trail, or microcredit loans among individuals whose identities are known only by a trusted third party. New institutions—bank and nonbank—will arise to use these capabilities.

How Will These New Capabilities Be Used?

By the end of 2005, more than two billion human beings will be linked by networked systems of mobile communications devices. Humans will talk. Humans will exchange messages. But something else will occur. The devices themselves will alter their own behavior by exchanging code with other devices on the network—machine-to-machine behavior modification. This is more than communication. This is a new foundation for systemic change. Innovation—creation of new applications or behavior—can be shared immediately with any authorized device on the network. The potential market for innovation is growing exponentially.

In the next five years the volume of machine-to-machine communications will surpass human-to-human communications. What will these machines be talking about? At first, just the basics: who they are, where they are, how much power they're using, how they might trust each other to form groups to do something more efficiently, how they might share secret data and programs, what their local sensors tell them about conditions and resources around them, and how they might cooperate to make more effective use of resources. In human terms: identity, trust, contracts, cooperation, and efficiencies. In development terms: bringing those with no voice today into tomorrow's conversation.

Today, a billion cellular telephones do some or all of these things. Soon, a billion new devices will join the conversation: credit cards, automobiles, shipping containers, power switches, motors, air conditioners, suitcases, light switches, envelopes, pacemakers, plows, water pumps, elevators—anything with electricity or an antenna.

These emerging machine conversations provide us with new tools to redesign well-known human institutions: money, contracts, markets, auctions, knowledge exchanges, agricultural cooperatives, audits, currencies, taxes, human rights monitoring, traffic and freight management, health assessment and measurement, power management grids, water distribution systems. We will use them to build new systems of management, new tools for efficient resource allocation, new forms of governance and control.

Our challenge is to design in the service of development. We can build new systems of credit—global mobile microcredit systems, for example—to create secure person-to-person transactions, bypassing today's government-to-government, multilateral-to-government, or business-to-business financial systems. We can create new forms of markets, new cooperatives, and new alliances. We can link sources of knowledge to those who need knowledge, nurse-to-patient, mother-to-mother.

The greatest challenge these new capabilities pose, however, is to balance control and freedom. Networked technologies of measurement, identity, location, and efficiency may enable a transformation of the economic system faced by the poor. The same technologies may also enable ubiquitous control.

Remember the second law of technical change: Expect unexpected effects.

The Networked World: Linking Creates Change

Small changes in ICTs trigger unexpectedly explosive changes in use. The adoption of TCP/IP brought common networking, and suddenly all computers could communicate—the Internet was launched. The adoption of html, http and e-mail unified document exchange, and suddenly anyone could publish—enter the World Wide Web. Radio devices and spectrum became cheap, and suddenly anyone, anywhere could communicate—the wireless and cellular explosion had begun.

The next explosions will come in the same way. Small changes in human-to-machine interfaces will trigger explosions in use. Here's a partial list of what we can see today, and deploy globally in the next five years:

- Speech recognition
- Handwriting recognition
- Gesture recognition
- Face recognition
- Emotion recognition
- Identity recognition
- Sensor fusion
- Location recognition

Clearly, each of these technical innovations has deep implications for human communication, and thus, for human development. In a world of six thousand languages and a thousand scripts, we are approaching the ability for any person to converse with any other person. To anticipate how these innovations will be used, we must use them ourselves. To form the empathetic bonds among ourselves that will make conversation meaningful, we must learn to see through another's eyes.

The Networked World: How We See Ourselves

Let me give an example. Until this year, only a few groups of people, gathered in expensive rooms with expensive equipment—military command centers, intelligence agency situation rooms, satellite and space station control centers, advanced university research centers—could see through the eyes of satellite cameras looking down on earth. Few of them could merge satellite imagery with submeter high-resolution aerial survey pictures, and fewer still could merge this image data with exact Global Positioning Satellite data (street maps, building locations, vehicle location, ship and airplane positions).

Today, a child—anywhere in the world, linked to the Internet—can reach across the network to access immense databases of images, bring them to the screen, and fly across the face of the earth, zooming down on streets and homes or up over mountain peaks and down river valleys. Today, a child can see planes on runways at San Francisco International Airport, visit the hospital inside the Imperial Palace in Tokyo, float above cars and trucks on the streets of Kabul, circle Mount Everest, or examine the bottom of the Grand Canyon. Real data, real pictures, real streets and buildings, real cars and trees and people.

In the next few years, pictures at any level of resolution will enter databases in real time, gathered by network-linked cameras and sensors deployed by the millions, with meter-accurate location data as part of the picture. By 2005, over twenty countries and private organizations will have independent sources of submeter satellite imagery, enabling anyone to watch as teak trees are cut down in Burma and floated across the Salween River to Thailand or watch freighters cross the Arabian Gulf to any destination.

The power of this way of seeing the earth—continuous in detail from continents to cars, continuous through time—transforms understanding. The combination of ICT components, in a new way, makes a thousand-year-old dream accessible to a child: a magic carpet now exists to explore the earth and the way we see ourselves.

Seeing from a distance becomes more powerful when joined with local data, data flowing up from the most decentralized sources, data never available before the arrival of ubiquitous access to the network. What may not be known or reported at a national level can be known and reported at a local level. Seeing the images of clear-cut logging in the center of the National Forest Preserve of Gabon takes on new meaning when local data is added that shows the names and companies of those doing the logging. Seeing deforestation in the uplands of Mozambique, Cambodia, or Liberia takes on new meaning when combined with local hydrologic data to show where the floods will go when the rains come.

Local reporting combined with global information allows us to see ourselves as individuals, to see our neighborhood in relation to other neighborhoods. Global action coupled with local assessment is more effective action.

Today, to understand human development, we rely upon aggregate data reported at a regional or national level. The statistical foundations of the United Nations Development Programme Human Development Report, the World Bank World Development Report, the United Nations Population Division reports—the fundamental guides we rely upon—are collected, estimated, and presented country by country. For lack of budget or for shortage of expertise or for political convenience, the data we rely upon for policy analysis and decision are aggregated, hiding local variation.

But action to change individual lives is local, not general. Disaggregated data—from a school, a clinic, a police station, a well, a store—let us see what a person sees. Local information lets us understand in an immediate way what might be done to change that person's life. This is one way to change the relationship between all of us and each one of us.

Tomorrow, using new ICTs of location and communication, we will be able to see how many children die in a village, or the life expectancy for a mother in a neighborhood, or whether there is clean water or sanitation for a school, a village, or a street. We will see who lives and who dies. We will see ourselves in ways we cannot today. And for the first time, all of us will be able to see.

Seeing what is shows us what to do.

The Networked World: From *Readiness* to *Global Information Technology Report*

Two years ago, with the publication of *Readiness for the Networked World: A Guide for Developing Countries* by the Center for International Development at Harvard University,[1] a conversation intensified among policy, business, and technology communities about the use of information and communication technologies in the service of human development. The remarkable expansion of the Internet since the early 1990s convinced millions that the vision of ubiquitous access by business and citizen to global stores of knowledge at ever-decreasing cost would soon be realized. The report sought to establish tools to determine just where the world was along the path to global interconnection.

To do this, the *Guide* provided a framework for diagnosis and evaluation of the level of information technology present in a community. This framework created a point of view; in each category—learning, economy, society, policy, access—measurement suggested action. Higher levels of readiness meant more bandwidth, more transparency, more standardized commercial instruments, more independent regulation, more competition, and more communication devices. The focus was upon the components of the Networked World.

This report, the *Global Information Technology Report,* focuses not on components, but on the interaction among *systems of components*. It focuses on the emerging patterns of use of information and communications technologies (ICTs) to create bonds—economic bonds, social bonds, generational bonds, educational bonds, cultural bonds—bonds in the large and in the small. Access by all to ICTs enables new bonds to form among individuals, communities, villages, regions, families and institutions; these emerging bonds are the substance of how ICTs affect development.

The emergent structure of this report reflects what we have learned, and what we need to learn, about the interaction of ICT systems with existing human systems of communication, commerce, health, education, and governance. But we need to disaggregate our focus, to move closer in our data and our understanding to the individual, the family, the young girl in Afghanistan. Today, our studies are at a national or city level. Tomorrow, they must be at the most local level, to enable us to understand emerging patterns of use. The most powerful consequence of global access to ICTs is to enable this understanding.

The distinction between systems and components in this report is critical. In technology, individual devices develop along a predictable trajectory. Systems of devices do not. Unpredictable interactions among systems create unexpected results, described and studied today as "emergent" or self-organizing behavior, following the language of biology. And ICTs, in the first decade of this century, are reaching a global threshold of scale and complexity, leading to new, emergent interactions and new uses.

Understanding this emerging global interaction of individual components is the foundation for change.

The Networked World: Complex Systems Built from Simple Components

Predicting what complex systems will do is hard. It's easy to understand what a simple machine will do—a wheel, a lever, a piston, a gear, a switch—but when they combine to become a system—a cart, a train, an automobile, a computer—simple machines interact in new ways. New systems emerge: the cart system changes the street system; automobile systems change streets, buildings, traffic control systems, court systems, training systems, energy systems, agricultural and urban systems, courtship and marriage systems.

As previously independent complex systems link, new systems emerge, often with unanticipated uses and behavior. We assume that technologies have a certain scope. Automobiles transform systems involving transport of material goods. Electrical and oil technologies transform systems involving energy. Chemical and materials technologies transform systems of atoms. Information technologies transform systems involving transactions, ideas, perceptions, memory, and control.

Today's ICTs have become involved in all these systems, and therefore offer new ways of transforming them all.

In the past thirty years of ICTs, we have built the Internet, an artificial construction that is approaching the complexity of cities or of biological systems. To predict how this most complex of human creations might change human economic, societal, and cultural systems usually leads us to focus on the individual components: the computers, the telephone wires and instruments, the radio spectrum, the wireless hand-set, the television; we count them, predict their declining cost, measure their penetration, forecast their message volume as they assist existing human uses of exchanging market information or sharing family news. We study technology, not systems.

Biologists, in analyzing life, emphasize the transmission of information in reproduction. Even a virus or prion, incapable of using energy to alter its surroundings, finds a way to reproduce information about itself, and thereby reproduce itself. Today's most advanced biological technologies are based on better understanding this transmission of information.

In human societies, we create educational systems to enable cultural transmission, but ICTs are changing the fundamental assumptions of cost and availability of information. New means of linking and transmitting human understanding are emerging as we begin to understand the new tools. As Mitchel Resnick points out in this collection of essays, we must learn how to reform educational reform to match the complex systems that have arisen through ICTs.

The Networked World: Where Are We Going?

How are we responding today to the Secretary General's challenge? Have ICTs been used to eradicate poverty, prevent conflict, and promote freedom?

The evidence is certainly against us, so far. As we invented and deployed communication technologies—telegraph, telephone, radio, television—the tools of ubiquitous one-to-one and mass communication—we created the deadliest century in human history. We developed the technical means to share with every human the most advanced knowledge in health and food production, the provision of clean water, healthy housing, and economic development. But these same technical means of communication enabled global warfare, international crime, and mass mobilization of hatred and prejudice. Today, they enable pinpoint targeting of conventional bombs, deployment of weapons of mass destruction, destruction of personal privacy, and ubiquitous surveillance.

This is not new. Powerful technologies will be used by the powerful to maintain and extend power. Access to knowledge does not mean it will be used to transform cultures and societies, or empower the powerless.

What is different today? We are crossing a threshold of access. What has been available only to the rich, only to the powerful, is becoming available to a majority of humans, human groups, and human organizations. The rhythm of change is accelerating. The capability to build new institutions that bond us all is arriving. We must seize the opportunity to create them.

It is technically possible today to enable a hundred million people living in rich countries to make person-to-person loans of US$100 each to a hundred million people living on a dollar a day. It is technically possible for tens of millions of migratory workers to remit their earnings to their distant families at almost no cost. But it cannot be guaranteed that these networked person-to-person money transfer institutions will not be used to finance the world drug trade or terrorist cells.

Still, we must try. In choosing to create institutions where technical change has the greatest impact on individuals, the creation of direct person-to-person financial links heads the list, followed closely by direct family links—exchanges as simple as sending baby pictures to a grandmother, or joining family members separated by war or migration.

The Networked World: What Should We Do Now?

Until now, it has been too expensive and too difficult for all of us to have a conversation. No longer. Today, anyone can tell the world about his or her local community.

Here are three immediate, measurable actions that can make this global conversation real.

First, complete the job of ubiquitous connectivity and access.

- Link the schools, cafés, churches, mosques, clinics, community centers—any place people gather in a community—to the Internet. As a core component of a national economic development policy, governments should provide free network connectivity to schools. Why schools? Because schools touch every family, every parent, every child, and every neighborhood; schools are a focal point everyone understands.
- Draw upon the employees of every telecommunications company, every computer company, every ICT company, every government, and every ministry of telecommunications and ministry of education in every country to design and implement network connectivity for their own children's schools. Each company or ministry should match the contribution of time by its employees with a contribution of equipment, money, or training. For every such school connected, they should adopt and connect a poor or rural school.
- Use the examples of existing programs as templates for school connectivity, curriculum creation, and teacher training. World Links, Schools OnLine, NetDay, Educar.org, Cisco Network Academies, Canada SchoolNet, ThinkQuest, and many others provide real examples in dozens of countries.
- Use local spatial data to create a map with a dot showing the location of every school, and color-code the school's dot to show if it is connected to the Internet. Do the same for health clinics, universities, cafés, neighborhood centers. Create competition to be connected. The map is the measurement of change.
- Create personal bonds among children in schools worldwide. Remember, every child in the world has an e-mail account today waiting for him or her, with Yahoo or Hotmail—all they need is access.

Second, ask each linked location to describe their local world.

- See through the eyes of children. Form a partnership between a major newspaper, magazine, or radio or television station and the local schools. In each country, each national newspaper with a website should initiate a nationwide project to see the country through the eyes of the children. Teachers in each school—elementary, middle, and secondary—select one or two students as the School Technology Reporters. Every week they write a story about their school and technology—what they study, what use they make of the Internet, what they dream of doing. Every week, the newspaper prints one of these stories in the paper, and puts all the other stories on the newspaper website. At the end of the year, fifty-two students have been in the paper; thousands of others have written for Web publication. All of them have possible new careers; all of them have helped the rest of the country, and the rest of the world, understand what their lives are like.
- Build networks of local information at the most decentralized level possible; ask local small businesses, farmers, merchants, teachers, and parents to share local news. Supplement today's systems of gathering statistics and assessment. Post local market prices. Support local auctions. Create local genealogies.

Third, form a local microcredit organization at the linked location.

- Use identity systems from local banks or telecommunication providers, or use international systems to allow every person in a dollar-a-day community to have an account, an identity. Transfer money into that account. See what institutional forms develop.
- Link poor people to a sponsor in a rich country. Form person-to-person bonds between the lender and the recipient. Call upon large organizations to create each-one-reach-one links to those whose names they can now know.
- Maintain frequent contact. Measure it—by organization, by individual. Reward it.

How Do We Measure Our Progress?

Our goal is to improve the conditions of every individual. Our focus is to choose technologies that bind. Our task is to create institutions that bond us all. Our test is to show that at the end of each project we undertake, each reform we implement, each report we write, each conference we hold, a new bond is created between individuals, a new link that did not exist before.

If we meet that test, we respond to the challenge of Kofi Annan:

> *We must focus, as never before, on improving the conditions of the individual men and women who give the state or nation its richness and character. We must begin with the young Afghan girl, recognizing that saving one life is to save humanity itself.*

Endnote

1 Information Technologies Group. *Readiness for the Networked World: A Guide for Developing Countries*. Cambridge, Mass: Center for International Development at Harvard University, 2000.

CHAPTER 2

The Networked Readiness Index: Measuring the Preparedness of Nations for the Networked World

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Overview

One of the central research objectives of the Center for International Development (CID) at Harvard University is to develop a better understanding of technology's pivotal role in economic development. In recent years, due to the dynamic evolution of information and communication technologies (ICTs) and the increasing importance of ICT diffusion in the process of economic growth, we recognized the need for a broad and systematic comparison of the ICT development of countries around the globe. To that end, this chapter presents the Networked Readiness Index (NRI), a major international assessment of countries' capacity to exploit the opportunities offered by ICTs, and the first global framework to map out factors that contribute to this capacity. Our short-term aim is for the information presented in the NRI to enhance business leaders' and public policymakers' understanding of the factors contributing to ICT advancement, so that business practice and public policy can be shaped in the most informed manner possible. In the longer term, we hope this information will help extend the benefits of a Networked World to a greater number of people, organizations, and communities worldwide.

To be sure, the NRI forms just one summary measure that helps to focus attention on overall levels of ICT development. We should stress that the NRI rankings are not meant to stand alone. We encourage readers to examine the underlying factors that contribute to the NRI rankings. Understanding ICT systems is a challenge that we are only beginning to tackle through the NRI.[1] The NRI analysis of national-level Networked Readiness is bolstered not only by the other authored chapters in the first part of this report, which examine specific thematic issues related to Networked Readiness, but also by the Country Profiles section, where we present discussion of subnational trends within each of the 75 countries included in the NRI.

The chapter proceeds in three sections. The first presents the overall Networked Readiness Index and rankings for 75 countries, representing more than 80 percent of the world's population and more than 90 percent of its economic output. The second presents the NRI's component indexes and corresponding subindexes, providing more detailed rankings of countries' relative strengths and weaknesses across numerous dimensions relevant to the Networked World. The third explores the relationships between the pillars of the NRI, with emphasis on the links between Enabling Factors and Network Use. A technical appendix describes in detail how the NRI was constructed.

The Networked Readiness Index 2001–2002

In previous work we defined Networked Readiness as “the degree to which a community is *prepared* to participate in the Networked World.”[2] In this report, we expand that definition to include a community’s *potential* to participate in the Networked World in the future. With this in mind, the NRI transforms the complex dynamics of Networked Readiness into more easily understood shorthand, not unlike the Human Development Index, published annually by our colleagues at the United Nations Development Programme (UNDP), or the Growth Competitiveness Index, published annually by CID in collaboration with the World Economic Forum.

While any attempt to narrow Networked Readiness down to a single measure is admittedly artificial, the research performed in the creation of the NRI has significantly improved our understanding of how different national environments affect the adoption and use of ICTs. Most previous indexes, analytical assessments, or national rankings relevant to Networked Readiness, including those we ourselves compiled, paid insufficient attention to how ICT indicator variables relate to one another. For instance, measures relating to speed and quality of network infrastructure are often measured as analytically equivalent to variables that reflect the degree of electronic government conducted within a community, or the number of Internet users.

The Networked Readiness Index marks an important step forward by distinguishing between factors that determine the usability of the Network (the Enabling Factors) and variables that reflect the extent of Network Use. Our perspective on Networked Readiness suggests that *the top-ranked country is the one with the most highly developed ICT networks and the greatest potential to exploit those networks’ capacity.* To capture this relationship, we have constructed a Network Use component index that measures the extent of current network connectivity, and an Enabling Factors component index that measures a country’s capacity to exploit existing networks and create new ones. The relationship between Network Use and Enabling Factors is a subject of ongoing research. The evidence gathered to date indicates that a high score on Enabling Factors contributes to high levels of Network Use. However, a high score on Enabling Factors also signals a country’s ability to draw upon existing ICT networks. For conceptual simplicity, countries’ overall Networked Readiness Index scores are calculated as the simple average of their scores on Network Use and Enabling Factors.

Results

Overall Networked Readiness Index results are presented in Table 1, where one sees that the United States ranks as the country best positioned to take advantage of the opportunities afforded by ICTs. Iceland ranks 2nd, just behind the U.S. Finland and Sweden are slightly further behind, followed by Norway and the Netherlands, the latter two with almost exactly the same NRI score. (Note that overall NRI scores are presented

Table 1: **Networked Readiness Index**

Country	Networked Readiness	NRI Rank
United States	6.05	1
Iceland	6.03	2
Finland	5.91	3
Sweden	5.76	4
Norway	5.68	5
Netherlands	5.68	6
Denmark	5.56	7
Singapore	5.47	8
Austria	5.32	9
United Kingdom	5.31	10
New Zealand	5.23	11
Canada	5.23	12
Hong Kong SAR	5.23	13
Australia	5.22	14
Taiwan	5.18	15
Switzerland	5.17	16
Germany	5.11	17
Belgium	4.90	18
Ireland	4.89	19
Korea	4.86	20
Japan	4.86	21
Israel	4.84	22
Estonia	4.73	23
France	4.71	24
Italy	4.70	25
Spain	4.62	26
Portugal	4.57	27
Czech Republic	4.38	28
Slovenia	4.24	29
Hungary	4.14	30
Greece	4.13	31
Argentina	4.01	32
Slovak Republic	4.01	33
Chile	4.00	34
Poland	3.85	35
Malaysia	3.82	36
Uruguay	3.80	37
Brazil	3.79	38
Latvia	3.78	39
South Africa	3.71	40
Turkey	3.67	41
Lithuania	3.59	42
Thailand	3.58	43
Mexico	3.58	44
Costa Rica	3.57	45
Trinidad and Tobago	3.52	46
Dominican Republic	3.52	47
Panama	3.42	48
Jordan	3.42	49
Venezuela	3.41	50
Mauritius	3.40	51
Peru	3.38	52
Bulgaria	3.38	53
India	3.32	54
El Salvador	3.30	55
Jamaica	3.29	56
Colombia	3.29	57
Philippines	3.27	58
Indonesia	3.24	59
Egypt	3.20	60
Russian Federation	3.17	61
Sri Lanka	3.15	62
Paraguay	3.15	63
China	3.10	64
Romania	3.10	65
Ukraine	3.05	66
Bolivia	3.04	67
Guatemala	3.00	68
Nicaragua	2.83	69
Zimbabwe	2.78	70
Ecuador	2.65	71
Honduras	2.64	72
Bangladesh	2.53	73
Vietnam	2.42	74
Nigeria	2.10	75

only to two decimal places in the tables, but the corresponding rankings are based on absolute values of greater specificity.) Another Northern European country, Denmark, ranks 7th, followed by Singapore in 8th, Austria in 9th and the United Kingdom in 10th place. Singapore's outstanding result on the NRI serves as testimony to that city-state's tremendous emphasis on ICT infrastructure as a centerpiece of its economic growth strategy.

Further down the list, one sees that Japan ranks 21st, only slightly ahead of Estonia (23rd), which is in turn ranked ahead of France, Italy, and Spain, ranked at 24th, 25th and 26th, respectively. That Estonia, a country under communist rule only a decade ago, is now equivalent in Networked Readiness to Japan, France, Italy, and Spain, underscores how far that country has come in a short period, and how well positioned it is to continue its recent history of economic growth. In the lower half of the rankings, one sees that Russia is struggling to develop its Networked Readiness, scoring 61st. Likewise, China, despite its phenomenal economic performance in recent years, rates poorly at 64th. Other relatively poorly positioned countries include the Philippines (58th), Egypt (60th), and Ukraine (66th). At the bottom of the Index stand Ecuador, Honduras, Bangladesh, Vietnam, and Nigeria, respectively.

The regional groupings of rankings are notable. Within the 25 countries that make up the top third of the NRI there are:

- 14 in Western Europe (with the best results from Scandinavia)
- Seven in Asia and Oceania (led by Singapore)
- Two in North America (the U.S. and Canada)
- One in the Middle East and North Africa (Israel)
- One in Central and Eastern Europe (Estonia)

Meanwhile, in the bottom third of the NRI there are:

- Ten in Latin America (led by Peru)
- Seven in Asia (led by India)
- Four in Eastern Europe/former Soviet Union (with a top score by Bulgaria)
- Three in sub-Saharan Africa (with Mauritius having the best showing)
- One in the Middle East and North Africa (Egypt)

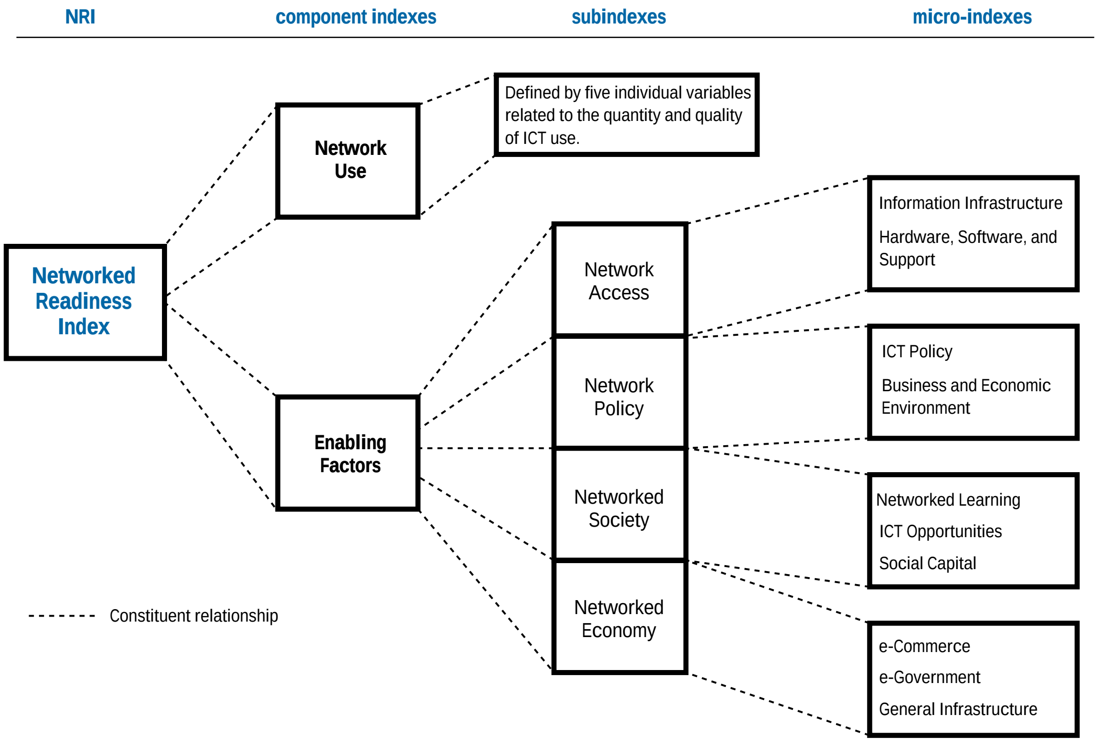
Clearly, some regions—most notably the Andean nations, much of Central America, the Middle East, sub-Saharan Africa, and South Asia—are lagging behind the rest of the world. Yet even these regions show exceptions, with nations such as Costa Rica, South Africa, and Turkey providing global leadership in many areas. Furthermore, in spite of their poor overall scores on the NRI, a number of countries within these lower-ranked regions, such as Bolivia, India, and Bangladesh, perform better than one might expect given their average levels of economic development. There are uneven levels of Networked Readiness throughout the nations of Central and Eastern Europe, East and Southeast Asia, and South America; these areas have both global leaders, such as Estonia and Korea, and those who do not fare as well, such as Russia, Romania, and Ecuador. Within the top tier of leaders in our findings, there are nations (most notably France and Japan) that, given their wealth and level of human development, perform worse than expected.

How to use the Index

The NRI has been designed as a macrolevel tool for policymakers and global leaders. The Index signals broad trends, flags opportunities and deficits, and makes a unique contribution to the understanding of how nations are performing relative to one another with regard to their participation in the Networked World. Profiles that explore the detailed Networked Readiness situation of each nation in the Index can be found in the second part of the *Global Information Technology Report*; these country-specific profiles provide an excellent companion to the broad findings of the NRI. Readers and researchers are also encouraged to refer to this report's Data Rankings section, where results are presented for all of the individual variables used to compile the NRI. Together, the NRI, its underlying data, and the country profiles serve as an excellent complement to, and reality check for, country-level Networked Readiness Assessments performed at the behest of domestic governments and international organizations. Such assessments, whether they are quick snapshots or long-term engagements exploring the Networked Readiness of a particular community, can provide valuable input for policymaking or agenda setting, and should be aided by the NRI and the country profiles.

While the NRI rankings are indicative of the relative Networked Readiness of these 75 nations, it is important to keep in mind that this is an aggregate index capturing broad Readiness trends. As such, *we urge appropriate caution in the interpretation of the rankings*. One should not over-interpret the relative positions of nations within a few spots of each other in the rankings, since the Index does not finely distinguish between the Networked Readiness of similarly ranked countries. Likewise, when assessing the bottom group of countries on the NRI, an important point should be taken into consideration. Today, there are 151 countries in the world with a population of one million or more. Due to data limitations, in this report we are able to assess only 74 of those countries plus Iceland, with Central Asia and Africa being particularly underrepresented.[3] The other 77 are not included because of the sheer difficulty of collecting data in them, a challenge closely correlated with a lack of economic and ICT development. So while Bangladesh, Vietnam, and Nigeria might rank below other countries on this Index, they are likely doing much better than most of the other 77 countries not included. Rather than interpreting these countries' low rankings as a sign of futility, we would urge policymakers to consider these countries' inclusion in

Figure 1: **The Structure of the Networked Readiness Index**



Source: Information Technologies Group, Center for International Development at Harvard University

the NRI Index as a major step forward, providing a large amount of information for new policy priorities as well as benchmarks upon which to measure future initiatives. For our part, we hope to expand the overall number of countries covered in future editions of the *Global Information Technology Report.* While ambitious, it would seem appropriate to include all nations that have Internet access.

Furthermore, because this is the first year in which we have produced the NRI, we do not yet have access to time-series data that would allow us to track trends over time. Yet, while we are well aware of the dangers of relying too much on cross-sectional characterizations of the 75 countries that constitute the rankings in the NRI, the Index still represents a major step forward in helping understand Networked Readiness.

Finally, one has to recognize what we call "the challenge of comparing the big fish in a little pond to the big fish in a big pond." While the NRI provides important evidence for understanding relative levels of Networked Readiness, there are certain inherent limitations that stem from using the nation-state as the basic unit of measure. A direct comparison of two countries such as Iceland, which scores very highly on the index (2nd), and India, which is in the bottom third of the NRI (54th), could be misleading when one considers the relative sizes of these nations and their different impacts on the global Networked scene. It also fails to capture the wide internal variation in India's enormous economy of more than one billion people, which is quite different from Iceland's more economically homogenous population of roughly 250 thousand people.

Indeed, Iceland's total population is much smaller than the number of sophisticated IT users in India, and India is renowned for its preeminence in software programming and for providing the world with highly skilled IT workers. India is effectively penalized in our Index for its size, the scope and scale of its many social and economic development challenges, and the smaller degree of IT penetration throughout the country as a whole. In India, as in many other countries around the world, there are successful miniature "Silicon Valleys" or ICT growth zones, but in most cases the national data do not pick up the impacts of these regional endeavors. Nonetheless, many of these subnational pockets of excellence are discussed within the Country Profiles section of the Report. We look forward to finding more creative ways of incorporating such size and internal ICT density issues in CID's future Networked Readiness research.

Beneath the Aggregate Results: Network Use and Enabling Factors

While the NRI provides a novel method for assessing overall Networked Readiness, one clearly needs to go beyond a single synthetic measure to understand the underlying reasons for countries' differing ICT performances. To uncover the source of these differences, one must look at the specific elements of our two component indexes, that is, Network Use and Enabling Factors. For further level of detail, one can then turn to the four subindexes that make up the Enabling Factors index: Network Access, Network Policy, Networked Society, and Networked Economy. At an even greater level of detail, these four subindexes can be broken into their 10 constituent micro-indexes.[4] A schematic diagram outlines the relationship among these measures in Figure 1.

The NRI data sources fall under two general categories. First, we collected a variety of measures—mainly "hard" variables but also some "soft" ones—from sources such as the World Bank, the International Telecommunications Union, Freedom House, and the Business Software Alliance. Second, we drew heavily on questionnaire responses from more than 4,500 business and government leaders surveyed in 75 countries by the Global Competitiveness Report's 2001 Global Executive Opinion Survey, conducted by Harvard University and the World Economic Forum.[5] This unique data source provides a rich array of insights on a range of ICT issues and, crucially, provides information on aspects of ICT networks for which there are no "hard" data, such as the quality of local Internet Service Provider (ISP), market competition, or the efficacy of government ICT policy.[6]

Network Use

The Network Use component index is defined as a straightforward measure of the extent of ICT proliferation in a specific country. It consists of five variables: Internet users per hundred inhabitants, cellular subscribers per hundred inhabitants, Internet users per host, percentage of computers connected to the Internet, and availability of public access to the Internet. Results for the Network Use component index are presented on the left side of Table 2. The top performers on this measure are Iceland, the U.S., Finland, Norway, and Sweden, once again showing the dominance of Scandinavia in Networked World measures. The bottom five ranked countries are Bangladesh, Honduras, Ecuador, Vietnam, and Nigeria.

As we discuss in more detail later in our analysis, relative income levels provide an excellent benchmark for comparison of countries' rankings in the NRI and its constituent indexes. In the Network Use component index, a number of countries, such as Estonia (21st), Bolivia (52nd), Taiwan (10th), Finland (3rd), and Iceland (1st) rank well above nations of equal or greater income level. Of these, Estonia is an outstanding case as a relative leader in ICT use, as it ranks on par or above wealthier nations such as Italy (19th), Japan (23rd), Israel (24th), and France (27th). Other nations with incomes similar to Estonia are found farther down the Network Use component index: Chile (34th), Russia (59th), or South Africa (41st).

Enabling Factors

The Enabling Factors component index is constructed to reflect the preconditions for high quality Network Use as well as the potential for future Network proliferation and use in a country. The four subindexes that make up Enabling Factors are (with constituent micro-indexes in parentheses):

- Network Access (Information Infrastructure and Hardware, Software, and Support)
- Network Policy (ICT Policy, Business and Economic Environment)
- Networked Society (Networked Learning, ICT Opportunities, Social Capital)
- Networked Economy (e-Commerce, e-Government, General Infrastructure)

Network Access considers the extent and quality of the network infrastructure and the existence of the equipment, programs, and support services that allow ICTs to be used. Network Policy relates to the information and communications policy environment as well as the business and economic climate. Networked Society assesses quality of learning using information and communication technologies, the extent of their use in the learning process, the extent of opportunities in the ICT industry, and societal and demographic factors. Finally, Networked Economy considers the extent to which the public and private sectors are participating in the Networked World and the quality and availability of complementary infrastructure.

Results for the Enabling Factors index are presented on the right side of Table 2. The highest scoring countries are Finland, the U.S., Sweden, the Netherlands, and Iceland. At the bottom of the index are Honduras, Vietnam, Nicaragua, Nigeria, and Bangladesh. Just as in Network Use, Estonia proves to be a strong performer at 24th. Notably, this ranking is two spots ahead of Italy (ranked at 26th), a country with twice the per capita income. Also noteworthy is that Finland's top performance in Enabling Factors is significantly higher than its 14th rank in per capita income among the sampled countries. This is a country that has made tremendous efforts, and met great success, in deploying its available resources to promote ICTs throughout its society.

Table 3 shows the rankings and scores for the four subindexes—Network Access, Network Policy, Networked Society, and Networked Economy—that make up the Enabling Factors component index. Tables 4, 5, 6, and 7 then present results for the more granular micro-indexes. The specific variables that make up these measures can be found in the technical appendix, and detailed national rankings for each variable are presented in the third part of the *GITR*. Glancing down the columns of Table 3, one sees some interesting differences in countries' rankings across the four subindexes. It is instructive briefly to consider each of these in turn.

Table 2: **Networked Readiness Index Component Indexes**

NETWORK USE			ENABLING FACTORS		
Country	Score	Rank	Country	Score	Rank
Iceland	6.35	1	Finland	6.11	1
United States	6.07	2	United States	6.03	2
Finland	5.71	3	Sweden	5.86	3
Norway	5.68	4	Netherlands	5.74	4
Sweden	5.67	5	Iceland	5.71	5
Netherlands	5.61	6	Denmark	5.69	6
Denmark	5.43	7	Norway	5.67	7
Singapore	5.29	8	United Kingdom	5.67	8
New Zealand	5.26	9	Canada	5.66	9
Taiwan	5.17	10	Germany	5.66	10
Austria	5.13	11	Singapore	5.65	11
Hong Kong SAR	5.06	12	Switzerland	5.60	12
Australia	5.04	13	Austria	5.50	13
United Kingdom	4.95	14	France	5.46	14
Korea	4.82	15	Hong Kong SAR	5.40	15
Canada	4.80	16	Australia	5.39	16
Switzerland	4.74	17	Belgium	5.29	17
Germany	4.57	18	Ireland	5.26	18
Italy	4.55	19	Israel	5.23	19
Ireland	4.52	20	Japan	5.22	20
Estonia	4.51	21	New Zealand	5.21	21
Belgium	4.51	22	Taiwan	5.19	22
Japan	4.49	23	Spain	5.06	23
Israel	4.45	24	Estonia	4.95	24
Portugal	4.35	25	Korea	4.90	25
Spain	4.18	26	Italy	4.85	26
France	3.95	27	Czech Republic	4.84	27
Czech Republic	3.93	28	Portugal	4.79	28
Slovenia	3.91	29	Hungary	4.68	29
Greece	3.91	30	Chile	4.65	30
Argentina	3.69	31	Slovak Republic	4.63	31
Hungary	3.60	32	Slovenia	4.58	32
Slovak Republic	3.38	33	Poland	4.38	33
Chile	3.36	34	Brazil	4.38	34
Malaysia	3.34	35	Greece	4.36	35
Poland	3.32	36	Argentina	4.34	36
Uruguay	3.30	37	Latvia	4.31	37
Latvia	3.26	38	Malaysia	4.29	38
Turkey	3.25	39	Uruguay	4.29	39
Brazil	3.21	40	Thailand	4.29	40
South Africa	3.17	41	South Africa	4.24	41
Dominican Republic	3.13	42	Jordan	4.12	42
Mexico	3.13	43	Lithuania	4.11	43
Peru	3.13	44	Turkey	4.09	44
Bulgaria	3.09	45	Costa Rica	4.09	45
Lithuania	3.08	46	Mexico	4.03	46
Paraguay	3.08	47	Trinidad and Tobago	4.01	47
Costa Rica	3.06	48	Panama	3.97	48
Trinidad and Tobago	3.04	49	India	3.93	49
Venezuela	3.01	50	Jamaica	3.92	50
Mauritius	2.95	51	Dominican Republic	3.91	51
Bolivia	2.91	52	Egypt	3.90	52
Colombia	2.89	53	Philippines	3.86	53
Thailand	2.88	54	Mauritius	3.86	54
Panama	2.88	55	Venezuela	3.82	55
El Salvador	2.87	56	China	3.79	56
Romania	2.85	57	Indonesia	3.77	57
Jordan	2.71	58	El Salvador	3.73	58
Russian Federation	2.71	59	Sri Lanka	3.72	59
India	2.71	60	Colombia	3.68	60
Indonesia	2.70	61	Bulgaria	3.67	61
Guatemala	2.69	62	Peru	3.64	62
Philippines	2.68	63	Russian Federation	3.63	63
Jamaica	2.66	64	Ukraine	3.46	64
Nicaragua	2.64	65	Romania	3.35	65
Ukraine	2.63	66	Guatemala	3.30	66
Sri Lanka	2.58	67	Ecuador	3.27	67
Zimbabwe	2.50	68	Paraguay	3.22	68
Egypt	2.50	69	Bolivia	3.17	69
China	2.41	70	Zimbabwe	3.06	70
Bangladesh	2.40	71	Honduras	3.06	71
Honduras	2.22	72	Vietnam	3.04	72
Ecuador	2.03	73	Nicaragua	3.02	73
Vietnam	1.80	74	Nigeria	2.96	74
Nigeria	1.24	75	Bangladesh	2.65	75

Measuring Network Access

The Network Access subindex includes variables related to the telecommunications and information infrastructure and the availability of software, hardware, and ICT services locally. Clearly, where the Network does not exist, and where there are no mechanisms in place to support its users, it is not possible to reap the benefits of the Networked World. The global leaders in Network Access are the U.S., Sweden, Finland, Denmark, and the United Kingdom, while Zimbabwe, Paraguay, Bangladesh, Nigeria, and Vietnam rank in the last five places. South Africa ranks quite well in Network Access compared to its overall income level, while Greece ranks poorly in the same comparison. It is also noteworthy that in some countries with highly developed software industries, the software industry and local ICT services seem to outpace local infrastructure development. These include Israel, Ireland, and India, all countries in which software industries are among the world's best known. India, for example, ranks 51st in overall Network Access, a result made worse by its 65th place in Information Infrastructure, which counters its 34th rank in Hardware, Software, and Support.

Measuring Network Policy

The Network Policy subindex considers levels of competition in the telecommunications and ICT sectors as well as the overall business and economic climate. Within this area, the best scores come from Finland, Singapore, the U.S., Iceland, and Hong Kong, nations that are also at the top of most NRI rankings. Zimbabwe, Nicaragua, Honduras, Nigeria, and Bangladesh fill out the bottom. Interestingly, as shown in Table 5, several countries exhibit wide variance between their rankings on ICT Policy and Business and Economic Environment micro-indexes. For example:

- Costa Rica ranks 53rd in Network Policy because of its relatively good score (i.e., 40th) on the Business and Economic Environment micro-index, but a much poorer showing (57th) on the ICT policy micro-index, due mainly to the nation's continuing telecommunications monopoly;
- Lithuania, Mauritius, Slovenia, Poland, and Trinidad and Tobago, all countries lacking telecommunications competition, show similar patterns of relatively good economic conditions yet poor policy environments;
- Several countries, like Brazil, Colombia, and Venezuela, exhibit the opposite tendency. These are countries where a large gap exists between a relatively effective ICT Policy and much lower quality Business and Economic Environment.

Measuring Networked Society

The Networked Society subindex is formed by combining measures of nations' demographic characteristics, educational levels, and the extent to which ICTs are incorporated into learning systems, all factors instrumental in the diffusion of ICTs. The top five performers in this area are Finland, the U.S., the Netherlands, Iceland, and Norway, while Boliva, Guatemala, Nigeria, Nicaragua, and Bangladesh occupy the last places.

Table 3: Enabling Factors Subindexes

Enabling Factors component index = 1/4 Network Access + 1/4 Network Policy + 1/4 Networked Society + 1/4 Networked Economy

Country	Network Access	Rank	Country	Network Policy	Rank	Country	Networked Society	Rank	Country	Networked Economy	Rank
United States	6.61	1	Finland	6.40	1	Finland	6.42	1	Finland	5.29	1
Sweden	6.39	2	Singapore	6.25	2	United States	6.22	2	United States	5.15	2
Finland	6.35	3	United States	6.15	3	Netherlands	6.07	3	Sweden	5.11	3
Denmark	6.14	4	Iceland	6.07	4	Iceland	5.96	4	Singapore	5.04	4
United Kingdom	6.08	5	Hong Kong SAR	6.06	5	Norway	5.94	5	Iceland	4.98	5
Germany	6.05	6	United Kingdom	6.06	6	Sweden	5.91	6	Germany	4.96	6
Norway	6.04	7	Sweden	6.04	7	Denmark	5.88	7	Canada	4.95	7
Switzerland	6.02	8	Canada	5.99	8	Germany	5.84	8	Netherlands	4.94	8
Netherlands	5.97	9	Netherlands	5.97	9	Austria	5.80	9	Denmark	4.93	9
Canada	5.97	10	Switzerland	5.89	10	Switzerland	5.78	10	United Kingdom	4.92	10
France	5.85	11	Denmark	5.82	11	Belgium	5.73	11	Norway	4.90	11
Iceland	5.82	12	Norway	5.81	12	Canada	5.73	12	France	4.84	12
Australia	5.81	13	Austria	5.80	13	Taiwan	5.66	13	Hong Kong SAR	4.81	13
Singapore	5.75	14	Germany	5.78	14	United Kingdom	5.61	14	Switzerland	4.69	14
Austria	5.72	15	Australia	5.78	15	Ireland	5.60	15	Austria	4.68	15
Belgium	5.70	16	New Zealand	5.69	16	Singapore	5.57	16	Australia	4.60	16
New Zealand	5.70	17	France	5.65	17	France	5.52	17	Taiwan	4.55	17
Japan	5.69	18	Ireland	5.57	18	Israel	5.49	18	Spain	4.45	18
Hong Kong SAR	5.58	19	Israel	5.44	19	Japan	5.47	19	Belgium	4.43	19
Israel	5.57	20	Taiwan	5.36	20	Czech Republic	5.44	20	Japan	4.42	20
Ireland	5.50	21	Japan	5.30	21	Australia	5.39	21	Israel	4.41	21
Italy	5.31	22	Belgium	5.29	22	Spain	5.30	22	Ireland	4.37	22
Spain	5.29	23	Estonia	5.21	23	Estonia	5.26	23	Italy	4.37	23
Korea	5.25	24	Spain	5.19	24	Hungary	5.15	24	New Zealand	4.35	24
Taiwan	5.17	25	Portugal	5.17	25	Hong Kong SAR	5.14	25	Korea	4.35	25
Portugal	5.05	26	Chile	5.05	26	Slovenia	5.10	26	Estonia	4.31	26
Czech Republic	5.02	27	Korea	5.04	27	New Zealand	5.08	27	Portugal	4.13	27
Estonia	5.02	28	Italy	4.89	28	Slovak Republic	5.03	28	Czech Republic	4.09	28
Hungary	4.96	29	Jordan	4.88	29	Korea	4.97	29	Brazil	4.01	29
Chile	4.93	30	Hungary	4.85	30	Poland	4.84	30	Slovenia	3.91	30
Lithuania	4.90	31	Slovak Republic	4.85	31	Italy	4.81	31	South Africa	3.88	31
Slovak Republic	4.86	32	Czech Republic	4.79	32	Chile	4.80	32	Poland	3.86	32
Argentina	4.75	33	Malaysia	4.76	33	Portugal	4.80	33	Thailand	3.85	33
South Africa	4.75	34	Uruguay	4.65	34	Costa Rica	4.78	34	Chile	3.80	34
Dominican Republic	4.72	35	Argentina	4.64	35	Greece	4.69	35	Malaysia	3.78	35
Slovenia	4.69	36	Slovenia	4.60	36	Thailand	4.60	36	Hungary	3.77	36
Brazil	4.68	37	Brazil	4.55	37	Latvia	4.57	37	Slovak Republic	3.76	37
Uruguay	4.67	38	Thailand	4.53	38	Trinidad and Tobago	4.32	38	Argentina	3.71	38
Greece	4.59	39	Greece	4.48	39	Brazil	4.28	39	Latvia	3.70	39
Latvia	4.53	40	Poland	4.44	40	Argentina	4.25	40	Uruguay	3.67	40
Mexico	4.50	41	Latvia	4.43	41	Malaysia	4.19	41	Greece	3.66	41
Malaysia	4.45	42	Turkey	4.42	42	Uruguay	4.17	42	Lithuania	3.63	42
Turkey	4.42	43	El Salvador	4.42	43	Lithuania	4.15	43	Jordan	3.60	43
Venezuela	4.39	44	Jamaica	4.41	44	Mauritius	4.08	44	India	3.57	44
Poland	4.38	45	Egypt	4.39	45	Panama	4.07	45	Mexico	3.57	45
Peru	4.32	46	Trinidad and Tobago	4.36	46	Mexico	4.05	46	Turkey	3.50	46
Panama	4.31	47	South Africa	4.33	47	Turkey	4.04	47	Egypt	3.48	47
Egypt	4.30	48	Philippines	4.33	48	South Africa	4.01	48	Jamaica	3.45	48
Philippines	4.26	49	India	4.30	49	Jamaica	3.99	49	Ukraine	3.35	49
Jordan	4.26	50	Dominican Republic	4.29	50	Indonesia	3.99	50	China	3.35	50
India	4.23	51	China	4.28	51	Russian Federation	3.86	51	Trinidad and Tobago	3.26	51
Colombia	4.22	52	Panama	4.23	52	Philippines	3.84	52	Panama	3.26	52
Costa Rica	4.20	53	Costa Rica	4.20	53	Jordan	3.73	53	Mauritius	3.21	53
Thailand	4.18	54	Venezuela	4.14	54	Bulgaria	3.72	54	Bulgaria	3.21	54
Mauritius	4.14	55	Sri Lanka	4.13	55	Venezuela	3.69	55	Costa Rica	3.17	55
Sri Lanka	4.12	56	Colombia	4.12	56	China	3.68	56	Russian Federation	3.12	56
Indonesia	4.10	57	Mauritius	4.02	57	Dominican Republic	3.64	57	Indonesia	3.11	57
Trinidad and Tobago	4.10	58	Mexico	3.99	58	India	3.64	58	Venezuela	3.06	58
Guatemala	3.99	59	Indonesia	3.89	59	Sri Lanka	3.58	59	Sri Lanka	3.05	59
El Salvador	3.98	60	Bulgaria	3.82	60	Peru	3.55	60	Philippines	3.02	60
Bulgaria	3.92	61	Russian Federation	3.79	61	El Salvador	3.52	61	El Salvador	3.01	61
Ecuador	3.89	62	Lithuania	3.75	62	Romania	3.51	62	Dominican Republic	2.98	62
China	3.84	63	Peru	3.73	63	Colombia	3.44	63	Peru	2.96	63
Jamaica	3.83	64	Romania	3.66	64	Paraguay	3.41	64	Colombia	2.93	64
Romania	3.77	65	Guatemala	3.55	65	Egypt	3.41	65	Paraguay	2.86	65
Russian Federation	3.73	66	Bolivia	3.49	66	Ukraine	3.40	66	Ecuador	2.65	66
Bolivia	3.67	67	Ukraine	3.46	67	Vietnam	3.35	67	Guatemala	2.65	67
Ukraine	3.63	68	Vietnam	3.37	68	Ecuador	3.32	68	Nigeria	2.63	68
Nicaragua	3.53	69	Paraguay	3.24	69	Zimbabwe	3.24	69	Vietnam	2.55	69
Honduras	3.49	70	Ecuador	3.21	70	Honduras	3.22	70	Zimbabwe	2.53	70
Zimbabwe	3.38	71	Zimbabwe	3.11	71	Bolivia	3.13	71	Honduras	2.51	71
Paraguay	3.36	72	Nicaragua	3.09	72	Guatemala	3.03	72	Nicaragua	2.48	72
Bangladesh	3.26	73	Honduras	3.03	73	Nigeria	2.99	73	Romania	2.45	73
Nigeria	3.22	74	Nigeria	2.99	74	Nicaragua	2.98	74	Bolivia	2.38	74
Vietnam	2.88	75	Bangladesh	2.74	75	Bangladesh	2.26	75	Bangladesh	2.35	75

Table 4: Network Access Micro-indexes

Network Access Subindex = 1/2 Information Infrastructure + 1/2 Hardware, Software, and Support

Country	Information Infra-structure	Rank	Country	Hardware, Software, and Support	Rank
Finland	6.65	1	United States	6.76	1
Sweden	6.62	2	Sweden	6.16	2
Denmark	6.46	3	Finland	6.05	3
United States	6.45	4	United Kingdom	5.94	4
Norway	6.41	5	Germany	5.88	5
Canada	6.36	6	Denmark	5.83	6
Netherlands	6.32	7	Switzerland	5.83	7
Iceland	6.27	8	Australia	5.72	8
Hong Kong SAR	6.24	9	Norway	5.66	9
United Kingdom	6.22	10	Netherlands	5.63	10
Switzerland	6.22	11	Canada	5.59	11
Germany	6.21	12	France	5.58	12
Austria	6.12	13	Ireland	5.53	13
France	6.11	14	New Zealand	5.47	14
Singapore	6.10	15	Israel	5.44	15
Belgium	6.03	16	Singapore	5.40	16
Japan	6.02	17	Iceland	5.38	17
Korea	6.02	18	Belgium	5.38	18
New Zealand	5.92	19	Japan	5.37	19
Australia	5.90	20	Austria	5.31	20
Italy	5.82	21	Lithuania	4.97	21
Spain	5.77	22	Hong Kong SAR	4.91	22
Israel	5.70	23	Spain	4.81	23
Taiwan	5.68	24	Italy	4.80	24
Portugal	5.57	25	Estonia	4.77	25
Ireland	5.48	26	Czech Republic	4.76	26
Chile	5.46	27	Taiwan	4.66	27
Argentina	5.38	28	South Africa	4.58	28
Hungary	5.37	29	Hungary	4.55	29
Greece	5.33	30	Portugal	4.54	30
Czech Republic	5.29	31	Dominican Republic	4.52	31
Estonia	5.28	32	Slovak Republic	4.50	32
Turkey	5.26	33	Korea	4.48	33
Slovak Republic	5.23	34	India	4.41	34
Malaysia	5.14	35	Chile	4.40	35
Slovenia	5.13	36	Brazil	4.35	36
Thailand	5.13	37	Uruguay	4.25	37
Uruguay	5.08	38	Slovenia	4.25	38
Mexico	5.06	39	Poland	4.21	39
Venezuela	5.03	40	Costa Rica	4.14	40
Brazil	5.00	41	Argentina	4.12	41
Indonesia	4.99	42	Latvia	4.09	42
Latvia	4.96	43	Colombia	3.95	43
South Africa	4.92	44	Mexico	3.94	44
Dominican Republic	4.92	45	Panama	3.91	45
Jordan	4.91	46	Philippines	3.89	46
Peru	4.88	47	Greece	3.85	47
Egypt	4.87	48	Peru	3.76	48
Lithuania	4.82	49	Malaysia	3.76	49
Panama	4.72	50	Mauritius	3.76	50
El Salvador	4.68	51	Venezuela	3.75	51
Philippines	4.64	52	Egypt	3.74	52
Guatemala	4.62	53	Sri Lanka	3.66	53
Sri Lanka	4.59	54	Trinidad and Tobago	3.64	54
China	4.58	55	Jamaica	3.63	55
Poland	4.56	56	Jordan	3.61	56
Trinidad and Tobago	4.55	57	Turkey	3.58	57
Mauritius	4.53	58	Zimbabwe	3.55	58
Colombia	4.49	59	Nigeria	3.48	59
Romania	4.39	60	Bulgaria	3.47	60
Bulgaria	4.37	61	Ecuador	3.46	61
Ecuador	4.31	62	Russian Federation	3.43	62
Bolivia	4.30	63	Guatemala	3.37	63
Costa Rica	4.26	64	Honduras	3.31	64
India	4.06	65	El Salvador	3.27	65
Russian Federation	4.04	66	Ukraine	3.26	66
Jamaica	4.03	67	Thailand	3.22	67
Ukraine	4.00	68	Indonesia	3.21	68
Nicaragua	3.88	69	Nicaragua	3.19	69
Paraguay	3.67	70	Romania	3.14	70
Honduras	3.66	71	China	3.10	71
Bangladesh	3.59	72	Bolivia	3.05	72
Vietnam	3.23	73	Paraguay	3.05	73
Zimbabwe	3.21	74	Bangladesh	2.93	74
Nigeria	2.96	75	Vietnam	2.52	75

Table 5: Network Policy Micro-indexes

Network Policy Subindex = 1/2 ICT Policy + 1/2 Business and Economic Environment

Country	ICT Policy	Rank	Country	Business and Economic Environment	Rank
Finland	6.64	1	Singapore	6.22	1
Sweden	6.34	2	Finland	6.16	2
United States	6.29	3	United Kingdom	6.08	3
Singapore	6.29	4	Iceland	6.05	4
Hong Kong SAR	6.15	5	Switzerland	6.01	5
Iceland	6.10	6	United States	6.01	6
Canada	6.07	7	Hong Kong SAR	5.97	7
Austria	6.03	8	Netherlands	5.96	8
United Kingdom	6.03	9	Canada	5.90	9
Netherlands	5.99	10	Denmark	5.83	10
Germany	5.92	11	Norway	5.80	11
France	5.89	12	Sweden	5.74	12
Australia	5.84	13	Australia	5.71	13
Norway	5.82	14	New Zealand	5.67	14
Denmark	5.81	15	Germany	5.64	15
Estonia	5.79	16	Ireland	5.62	16
Switzerland	5.77	17	Austria	5.58	17
Korea	5.76	18	France	5.42	18
New Zealand	5.71	19	Israel	5.31	19
Spain	5.66	20	Japan	5.24	20
Chile	5.65	21	Taiwan	5.09	21
Belgium	5.64	22	Belgium	4.93	22
Taiwan	5.63	23	Portugal	4.78	23
Israel	5.56	24	Spain	4.72	24
Portugal	5.56	25	Estonia	4.63	25
Italy	5.55	26	Slovenia	4.59	26
Ireland	5.51	27	Poland	4.56	27
Brazil	5.48	28	Hungary	4.54	28
Japan	5.35	29	Trinidad and Tobago	4.49	29
Jordan	5.31	30	Jordan	4.46	30
Malaysia	5.29	31	Chile	4.45	31
Slovak Republic	5.28	32	Slovak Republic	4.41	32
Argentina	5.23	33	Czech Republic	4.40	33
Czech Republic	5.17	34	Uruguay	4.34	34
Hungary	5.17	35	Korea	4.32	35
India	5.13	36	Malaysia	4.24	36
El Salvador	5.13	37	Italy	4.23	37
Dominican Republic	5.13	38	Latvia	4.22	38
Egypt	5.10	39	Thailand	4.21	39
Venezuela	5.09	40	Costa Rica	4.14	40
Colombia	4.98	41	Turkey	4.10	41
Uruguay	4.96	42	Greece	4.06	42
Greece	4.90	43	Mauritius	4.05	43
Jamaica	4.86	44	China	4.05	44
Thailand	4.84	45	Argentina	4.04	45
South Africa	4.82	46	Jamaica	3.95	46
Philippines	4.79	47	Philippines	3.86	47
Turkey	4.74	48	South Africa	3.83	48
Panama	4.70	49	Lithuania	3.83	49
Latvia	4.63	50	Panama	3.76	50
Slovenia	4.61	51	El Salvador	3.71	51
Mexico	4.61	52	Sri Lanka	3.71	52
Sri Lanka	4.56	53	Romania	3.70	53
China	4.52	54	Egypt	3.69	54
Indonesia	4.46	55	Brazil	3.61	55
Poland	4.33	56	Bulgaria	3.53	56
Costa Rica	4.26	57	India	3.47	57
Trinidad and Tobago	4.23	58	Dominican Republic	3.45	58
Russian Federation	4.22	59	Mexico	3.38	59
Guatemala	4.15	60	Peru	3.36	60
Bulgaria	4.12	61	Russian Federation	3.35	61
Peru	4.10	62	Indonesia	3.33	62
Mauritius	3.99	63	Colombia	3.27	63
Bolivia	3.98	64	Vietnam	3.26	64
Ukraine	3.86	65	Venezuela	3.19	65
Ecuador	3.69	66	Ukraine	3.05	66
Lithuania	3.68	67	Bolivia	3.00	67
Paraguay	3.64	68	Guatemala	2.95	68
Romania	3.63	69	Zimbabwe	2.85	69
Vietnam	3.49	70	Paraguay	2.85	70
Honduras	3.47	71	Nicaragua	2.83	71
Zimbabwe	3.38	72	Ecuador	2.72	72
Nicaragua	3.35	73	Nigeria	2.69	73
Nigeria	3.28	74	Honduras	2.60	74
Bangladesh	2.98	75	Bangladesh	2.50	75

Table 6: Networked Society Micro-indexes

Networked Society Subindex = 1/3 Networked Learning + 1/3 ICT Opportunities + 1/3 Social Capital

Country	Networked Learning	Rank
Finland	6.23	1
Sweden	5.97	2
United States	5.97	2
Iceland	5.90	4
Singapore	5.90	4
Canada	5.70	6
Netherlands	5.70	6
Denmark	5.60	8
United Kingdom	5.60	8
Taiwan	5.43	10
Australia	5.33	11
Austria	5.27	12
Norway	5.27	12
Switzerland	5.23	14
Germany	5.20	15
Hong Kong SAR	5.20	15
Ireland	5.20	15
Belgium	5.17	18
Israel	5.13	19
New Zealand	5.07	20
Hungary	5.07	21
Estonia	5.00	22
Czech Republic	4.97	23
Spain	4.90	24
Korea	4.87	25
France	4.83	26
Slovenia	4.70	27
Chile	4.57	28
Portugal	4.53	29
Slovak Republic	4.53	29
India	4.43	31
Japan	4.40	32
Costa Rica	4.33	33
Latvia	4.23	34
Thailand	4.23	34
Brazil	4.10	36
Philippines	4.10	36
Argentina	4.00	38
Poland	4.00	38
Turkey	4.00	38
Italy	3.97	41
Greece	3.93	42
South Africa	3.93	42
Malaysia	3.90	44
Uruguay	3.87	45
Jordan	3.80	46
Mexico	3.80	46
Trinidad and Tobago	3.67	48
Indonesia	3.63	49
Jamaica	3.60	50
Mauritius	3.57	51
El Salvador	3.50	52
Venezuela	3.50	52
China	3.47	54
Colombia	3.43	55
Dominican Republic	3.43	55
Peru	3.43	55
Zimbabwe	3.43	58
Sri Lanka	3.40	59
Panama	3.37	60
Egypt	3.33	61
Lithuania	3.27	62
Nigeria	3.17	63
Bulgaria	3.13	64
Ecuador	3.07	65
Paraguay	3.03	66
Nicaragua	2.97	67
Ukraine	2.97	67
Vietnam	2.93	69
Guatemala	2.83	70
Bolivia	2.73	71
Russia	2.73	71
Bangladesh	2.53	73
Honduras	2.50	74
Romania	2.23	75

Country	ICT Opportunities	Rank
United States	6.65	1
Finland	6.35	2
Netherlands	6.10	3
Germany	5.95	4
Norway	5.95	4
Belgium	5.75	6
Japan	5.75	6
Austria	5.70	8
Singapore	5.70	8
Denmark	5.60	10
Iceland	5.60	10
Switzerland	5.55	12
Taiwan	5.55	12
United Kingdom	5.55	12
France	5.50	15
Ireland	5.50	15
Israel	5.45	17
Sweden	5.45	17
Spain	5.40	19
Chile	5.25	20
Hong Kong SAR	5.20	21
Czech Republic	5.15	22
Canada	5.10	23
Costa Rica	5.05	24
Brazil	5.00	25
Italy	5.00	25
Thailand	4.95	27
Portugal	4.90	28
Greece	4.85	29
Indonesia	4.85	29
Estonia	4.80	31
Australia	4.75	32
Poland	4.60	33
Slovenia	4.55	34
Turkey	4.55	34
Korea	4.45	36
Egypt	4.40	37
Hungary	4.40	37
Malaysia	4.35	39
China	4.15	40
Panama	4.15	40
Slovak Republic	4.10	42
Mexico	4.05	43
Mauritius	4.00	44
Dominican Republic	3.95	45
Trinidad and Tobago	3.95	45
New Zealand	3.90	47
Honduras	3.80	48
Russia	3.80	48
South Africa	3.75	50
Argentina	3.70	51
Latvia	3.70	51
India	3.65	53
Venezuela	3.65	53
Vietnam	3.65	53
El Salvador	3.60	56
Guatemala	3.60	56
Jamaica	3.60	56
Lithuania	3.45	59
Uruguay	3.40	60
Jordan	3.30	61
Colombia	3.20	62
Paraguay	3.20	62
Peru	3.15	64
Nigeria	3.10	65
Nicaragua	3.00	66
Ecuador	2.95	67
Sri Lanka	2.95	67
Bolivia	2.90	69
Ukraine	2.90	69
Philippines	2.85	71
Zimbabwe	2.85	71
Romania	2.75	73
Bulgaria	2.50	74
Bangladesh	2.35	75

Country	Social Capital	Rank
Finland	6.66	1
Norway	6.59	2
Switzerland	6.55	3
Slovak Republic	6.47	4
Denmark	6.45	5
Austria	6.44	6
Netherlands	6.41	7
Iceland	6.38	8
Canada	6.38	9
Germany	6.37	10
Sweden	6.31	11
New Zealand	6.28	12
Japan	6.27	13
Belgium	6.27	14
France	6.23	15
Czech Republic	6.21	16
Ireland	6.10	17
Australia	6.08	18
Slovenia	6.05	19
United States	6.04	20
Taiwan	6.01	21
Hungary	5.99	22
Estonia	5.98	23
Poland	5.92	24
Israel	5.89	25
Latvia	5.77	26
Lithuania	5.73	27
United Kingdom	5.69	28
Korea	5.60	29
Spain	5.59	30
Romania	5.54	31
Bulgaria	5.53	32
Italy	5.48	33
Trinidad and Tobago	5.34	34
Greece	5.29	35
Uruguay	5.25	36
Singapore	5.12	37
Russian Federation	5.06	38
Argentina	5.06	39
Hong Kong SAR	5.03	40
Portugal	4.95	41
Costa Rica	4.95	42
Jamaica	4.78	43
Panama	4.69	44
Mauritius	4.67	45
Thailand	4.61	46
Chile	4.59	47
Philippines	4.57	48
Sri Lanka	4.38	49
South Africa	4.34	50
Ukraine	4.32	51
Malaysia	4.31	52
Mexico	4.31	53
Jordan	4.08	54
Peru	4.05	55
Paraguay	4.01	56
Ecuador	3.95	57
Venezuela	3.92	58
Bolivia	3.77	59
Brazil	3.73	60
Colombia	3.68	61
Turkey	3.57	62
Dominican Republic	3.54	63
Indonesia	3.49	64
El Salvador	3.47	65
Vietnam	3.46	66
Zimbabwe	3.44	67
China	3.43	68
Honduras	3.36	69
Nicaragua	2.97	70
India	2.83	71
Nigeria	2.70	72
Guatemala	2.66	73
Egypt	2.50	74
Bangladesh	1.88	75

Table 7: **Networked Economy Micro-indexes**

Networked Economy Subindex = 1/3 e-Commerce + 1/3 e-Government + 1/3 General Infrastructure

Country	e-Commerce	Rank
United States	4.91	1
Finland	4.88	2
Germany	4.86	3
Sweden	4.74	4
United Kingdom	4.56	5
Canada	4.53	6
Netherlands	4.52	7
France	4.47	8
Iceland	4.42	9
Switzerland	4.41	10
Hong Kong SAR	4.36	11
Denmark	4.33	12
Singapore	4.27	13
Norway	4.26	14
Korea	4.21	15
Israel	4.20	16
Taiwan	4.18	17
Australia	4.17	18
Brazil	4.17	18
Austria	4.13	20
Italy	4.12	21
Japan	4.10	22
Ireland	4.02	23
Belgium	4.01	24
Estonia	3.99	25
Spain	3.96	26
New Zealand	3.93	27
South Africa	3.91	28
India	3.82	29
Poland	3.81	30
Argentina	3.76	31
Czech Republic	3.66	32
Turkey	3.64	33
Portugal	3.60	34
Chile	3.49	35
Hungary	3.46	36
Philippines	3.39	37
Slovenia	3.39	38
Indonesia	3.38	39
Thailand	3.38	40
Mexico	3.37	41
Malaysia	3.37	42
Latvia	3.34	43
Slovak Republic	3.33	44
Egypt	3.26	45
China	3.18	46
Greece	3.18	47
Panama	3.16	48
Uruguay	3.16	48
Venezuela	3.14	50
Jordan	3.13	51
Sri Lanka	3.04	52
Trinidad and Tobago	3.00	53
Ukraine	2.92	54
Costa Rica	2.90	55
Dominican Republic	2.90	55
Russian Federation	2.84	57
Lithuania	2.83	58
Nigeria	2.82	59
Colombia	2.82	60
Jamaica	2.78	61
Peru	2.77	62
Paraguay	2.74	63
El Salvador	2.68	64
Guatemala	2.66	65
Bulgaria	2.66	66
Zimbabwe	2.63	67
Nicaragua	2.60	68
Bangladesh	2.57	69
Honduras	2.54	70
Mauritius	2.53	71
Ecuador	2.48	72
Vietnam	2.31	73
Bolivia	2.29	74
Romania	2.06	75

Country	e-Government	Rank
Singapore	5.43	1
Finland	5.40	2
Iceland	5.35	3
Sweden	5.10	4
Estonia	4.95	5
Canada	4.93	6
Hong Kong SAR	4.90	7
Taiwan	4.90	7
Denmark	4.88	9
United States	4.88	9
United Kingdom	4.83	11
Norway	4.70	12
Netherlands	4.65	13
Austria	4.63	14
Australia	4.58	15
Brazil	4.58	15
Ireland	4.58	15
Korea	4.38	18
France	4.35	19
New Zealand	4.33	20
Spain	4.30	21
Germany	4.28	22
Switzerland	4.28	22
Chile	4.18	24
Hungary	4.13	25
Israel	4.08	26
Italy	4.08	26
Portugal	4.08	26
Belgium	3.98	29
Czech Republic	3.93	30
Japan	3.85	31
Mexico	3.85	31
India	3.80	33
Argentina	3.75	34
Poland	3.75	34
Slovak Republic	3.75	34
Latvia	3.73	37
Slovenia	3.73	37
South Africa	3.73	37
Lithuania	3.65	40
Thailand	3.58	41
Uruguay	3.50	42
Jordan	3.48	43
China	3.43	44
Malaysia	3.40	45
Jamaica	3.35	46
Turkey	3.35	46
Costa Rica	3.28	48
Colombia	3.25	49
Peru	3.23	50
Egypt	3.18	51
El Salvador	3.18	51
Panama	3.15	53
Greece	3.10	54
Bulgaria	3.05	55
Dominican Republic	3.03	56
Philippines	3.00	57
Ukraine	2.93	58
Venezuela	2.93	58
Russian Federation	2.78	60
Mauritius	2.75	61
Indonesia	2.70	62
Nigeria	2.68	63
Nicaragua	2.63	64
Ecuador	2.60	65
Guatemala	2.60	65
Sri Lanka	2.60	65
Vietnam	2.60	65
Trinidad and Tobago	2.48	69
Paraguay	2.38	70
Bolivia	2.33	71
Honduras	2.20	72
Bangladesh	2.10	73
Zimbabwe	1.75	74
Romania	1.35	75

Country	General Infrastructure	Rank
Germany	5.76	1
Norway	5.74	2
France	5.69	3
United States	5.68	4
Netherlands	5.66	5
Finland	5.59	6
Denmark	5.58	7
Sweden	5.49	8
Singapore	5.42	9
Canada	5.39	10
Switzerland	5.39	11
United Kingdom	5.39	12
Belgium	5.32	13
Japan	5.31	14
Austria	5.28	15
Hong Kong SAR	5.18	16
Iceland	5.15	17
Spain	5.10	18
Australia	5.07	19
Israel	4.96	20
Italy	4.91	21
New Zealand	4.80	22
Greece	4.72	23
Portugal	4.70	24
Czech Republic	4.68	25
Slovenia	4.62	26
Thailand	4.59	27
Malaysia	4.56	28
Taiwan	4.56	29
Ireland	4.51	30
Korea	4.46	31
Lithuania	4.40	32
Uruguay	4.36	33
Mauritius	4.35	34
Trinidad and Tobago	4.31	35
Ukraine	4.22	36
Jamaica	4.21	37
Slovak Republic	4.19	38
Jordan	4.18	39
Latvia	4.04	40
Poland	4.01	41
Egypt	4.00	42
South Africa	4.00	43
Estonia	3.98	44
Romania	3.94	45
Bulgaria	3.91	46
Russian Federation	3.75	47
Hungary	3.73	48
Chile	3.72	49
Argentina	3.62	50
Sri Lanka	3.50	51
Turkey	3.50	52
Mexico	3.49	53
Panama	3.48	54
China	3.45	55
Paraguay	3.45	56
Costa Rica	3.34	57
Brazil	3.30	58
Indonesia	3.25	59
Zimbabwe	3.19	60
El Salvador	3.18	61
Venezuela	3.12	62
India	3.08	63
Dominican Republic	3.03	64
Peru	2.88	65
Ecuador	2.86	66
Honduras	2.78	67
Vietnam	2.74	68
Colombia	2.70	69
Guatemala	2.68	70
Philippines	2.68	71
Bolivia	2.53	72
Bangladesh	2.40	73
Nigeria	2.39	74
Nicaragua	2.20	75

Some countries show strong performance in Networked Society relative to the other three Enabling Factor subindexes. For example:

- Trinidad and Tobago scores very well in the Networked Society subindex (38th), thanks to a strong result in our micro-index of Social Capital (34th). This is significantly higher than the country's scores on the Network Access (58th), Network Policy (46th) and Networked Economy (51st) sub-indexes.
- The Czech Republic also ranks well in Networked Society (20th) relative to its performance in Network Access (27th), Network Policy (32nd), and Networked Economy (28th). This result is driven by high placements on the Social Capital (16th), ICT opportunities (22nd), and Networked Learning (23rd) micro-indexes.

There are also countries that have performed much worse in the area of Networked Society relative to other Enabling Factors. For example:

- Egypt scores much lower (65th) in Networked Society than in Network Access (48th), Network Policy (45th), and Networked Economy (47th) because of its low performance in the Social Capital micro-index (74th), despite the country's relative strength in the ICT Opportunities micro-index (37th).
- Guatemala ranks low (72nd) in Networked Society compared with its rank in Network Access (59th), Network Policy (65th), and Networked Economy (67th). This Networked Society result is due to low scores on the Networked Learning micro-index (70th) and the Social Capital micro-index (73rd).

Measuring Networked Economy

The Networked Economy subindex measures the extent to which ICTs have been incorporated into economic activity within a country, such as the use by businesses and government of the World Wide Web and the Internet in their transactions, and includes variables relating to electronic commerce, electronic government, and complementary non-ICT infrastructure. Here, the top five performers are Finland, the U.S., Sweden, Singapore, and Iceland, while Honduras, Nicaragua, Romania, Bolivia, and Bangladesh rank as the five lowest. Perhaps most notably, there are also countries in which Networked Economy is one of the primary positive drivers of their Networked Readiness, relative to their other Enabling Factors.

For example:

- Brazil has its highest subindex ranking (29th) in Networked Economy, compared with 37th on Network Access, 37th on Network Policy, and 39th on Networked Society. This strong result is caused by Brazil's global leadership in the e-Commerce micro-index, where it ranks 18th, and the e-Government micro-index, in which it ranks 15th. These high micro-index rankings contrast greatly with Brazil's poor showing (58th) in General Infrastructure.
- South Africa's strong showing (31st) in Networked Economy is comparable to its score in Network Access (34th), yet significantly higher than its performance in other Enabling Factors (47th in Network Policy and 48th in Networked Society). The nation's best result within the Networked Economy subindex is in the e-Commerce micro-index, where it ranks 28th.
- India's 44th place in Networked Economy contrasts with its 58th position in Networked Society, and is somewhat higher than its rankings in Network Policy (49th) and Network Access (51st). The country's ranking in Networked Economy is raised by its 29th place in e-Commerce and 33rd rank in e-Government, although these strong results are tempered by the country's showing of 63rd in the General Infrastructure micro-index.
- China ranks comparably in both Networked Economy (50th) and Network Policy (51st); this is better than its results in Network Access (63rd) and Networked Society (56th). One major reason for this appears to be its relatively high ranking in e-Government (44th) and e-Commerce (46th), relative to General Infrastructure (55th) and the other relevant micro-indexes.
- Although Nigeria fares rather poorly with a 74th ranking in the General Infrastructure micro-index, its relatively high ranking in the e-Commerce micro-index (59th) and e-Government micro-index (63rd) give the nation a slightly better Networked Economy rank (68th) than its 74th, 74th, and 73rd place rankings in Network Access, Network Policy, and Networked Society, respectively.

Other notable over- and under-performers

Looking at countries' relative places across subindexes helps highlight specific national strengths and weaknesses. Just as countries show varying degrees of success at leveraging the Enabling Factors at an aggregate level, a comparison of each nation's relative performance in the subindexes gives a good sense of whether it is under- or over-performing vis-à-vis the factors in question, and whether nations are leveraging specific Enabling Factors. For instance:

- Germany, which ranks between 6th and 8th places in most factors, ranks 14th in Network Policy, a phenomenon which can be explained by the country's 15th ranking in the Business and Economic Environment micro-index of the Network Policy subindex.
- While Costa Rica ranks consistently in the 50s in Network Access, Network Policy, and Networked Economy, it ranks 34th in Networked Society, driven by its respective 33rd and 24th rankings in the Networked Learning and ICT Opportunities micro-indexes of the Networked Society subindex.
- Colombia, despite its respective 52nd and 56th place rankings in the Network Access and Network Policy subindexes, suffers overall from its poor performance in Networked Economy (64th) and Networked Society (63rd). This is caused by the nation's low ranking in the General Infrastructure (69th), e-Commerce (60th), ICT Opportunities (62nd), and Social Capital (61st) micro-indexes.

Untangling Networked Readiness

Readiness is a constantly shifting phenomenon determined by a complex interaction of factors. One of the biggest challenges of constructing the NRI was to strike a balance between over-simplifying a very dynamic concept and successfully untangling the factors that lead to Networked Readiness.

Getting beyond the income effect

Looking down Table 2 might suggest something obvious to many readers–that Network Use is linked to income, and that richer countries are the greatest users of ICTs. However, our findings indicate that the Enabling Factors are very important as well. For example, when comparing Finland and France, which have roughly the same income levels, one sees two countries with radically different levels of Network Use: Finland ranks 3rd while France rates 27th in Network Use. Our analysis indicates that this difference is clearly linked to the two countries' scores on Enabling Factors, where Finland ranks 1st and France 14th.

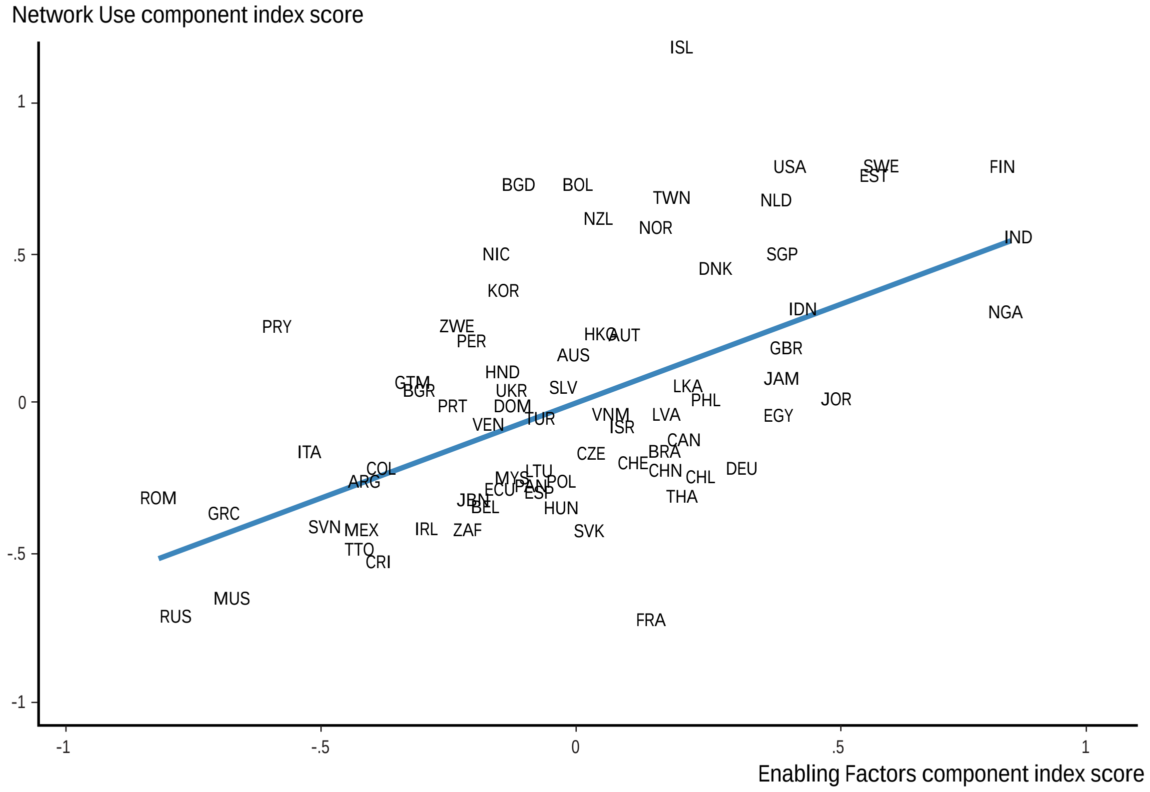
The major discrepancies in ICT use between Finland and France underscore another key finding. While income appears to be important in getting a nation to a certain level of Network Use, after reaching that point, further increases in income are less relevant and Enabling Factors play the dominant role. For example, if we look at only the 28 countries with average annual GDP per person of more than US$15,000 (measured at purchasing power parity), we find that income is statistically unrelated to Network Use but that Enabling Factors and Network Use are linked very closely.[7] Meanwhile, for the 47 countries in our sample with average GDP per person of less than US$15,000 per year, statistical tests indicate that *both* income and Enabling Factors are crucial in determining Use.

The role of Enabling Factors can be most clearly seen among countries that have Network Use levels atypical to their income level, many of which were discussed in the previous section. For example, Taiwan, Estonia, and India all score higher than expected given their income per capita. At the same time, Japan, Ireland, Mauritius, France, Greece, Russia, and Romania fare poorly on the Networked Readiness Index relative to their income level.

Leveraging Enabling Factors to generate Network Use

The relative position of nations in the Enabling Factors and Network Use component indexes forms one of the most revealing and interesting elements of the Networked Readiness Index. A high score in Enabling Factors is very important, but does not necessarily ensure good performance in Network Use, or vice versa. It seems that each country takes advantage of its Enabling Factors to a different extent in the generation of Network Use, resulting in major discrepancies between Enabling Factors and Network Use scores for a number of nations. Figure 2 illustrates the relationship between the two component indexes when controlling for the effect of income per capita. By isolating the

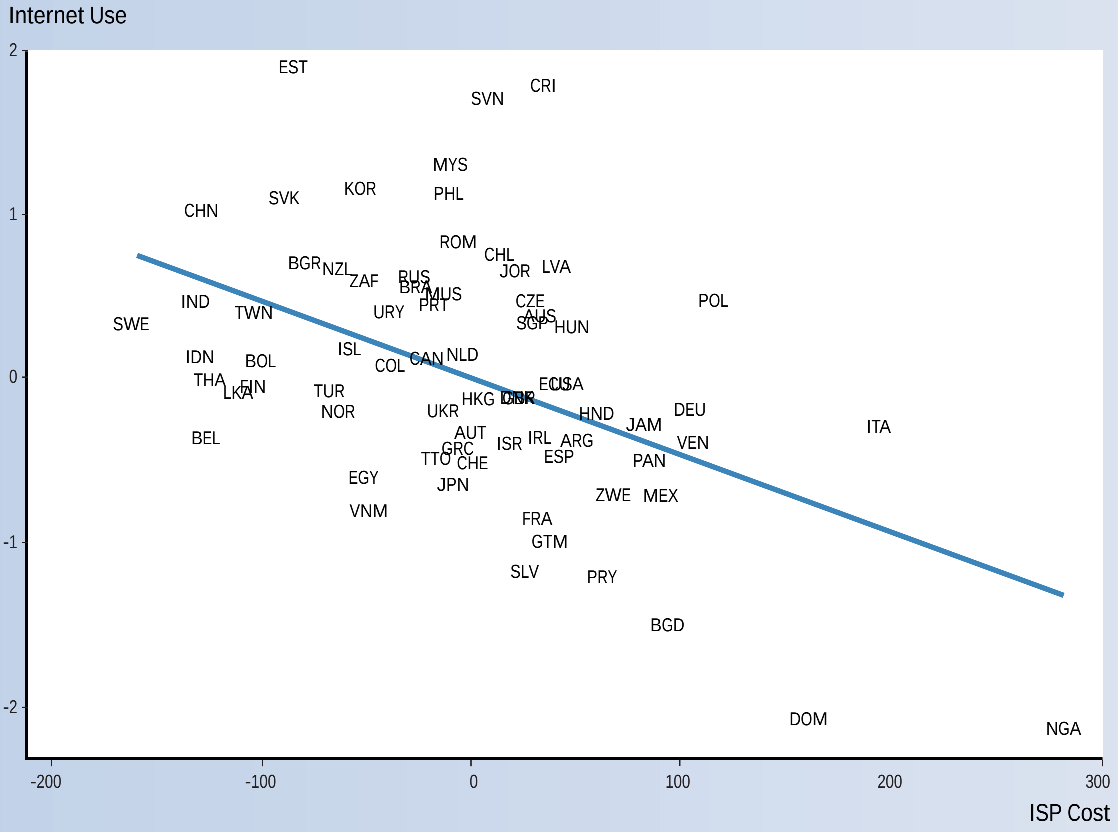
Figure 2: **Enabling Factors versus Network Use, Controlling by 2000 GDP per Capita PPP (log), Partial Regression**



Source: Information Technologies Group, Center for International Development at Harvard University.

Box 1: The Exorbitant Cost of Internet Access as a Widespread Obstacle to Network Use

Figure 3: **Annual ISP Cost for 20 Hours of Monthly Use Versus Internet Users per 100 Inhabitants (log), Controlling for 2000 GDP (log), Partial Regression**



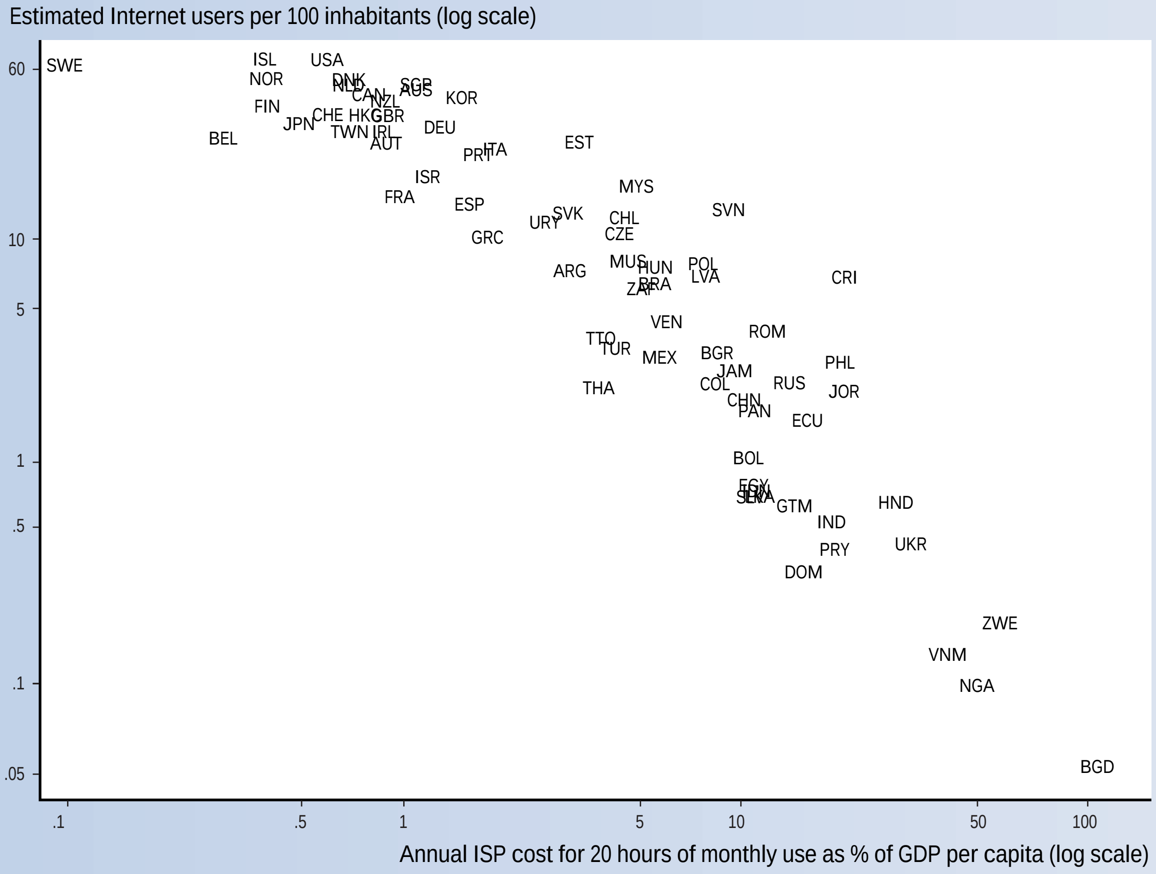
Source: Information Technologies Group, Center for International Development at Harvard University

Affordability is a clear determinant of Internet use. But affordability is a product of two things: cost of access and users' income. Our analysis has shown that both of these factors are statistically significant in explaining Internet use across countries. While it may not be surprising that Internet use is closely linked to levels of per capita income, it may be surprising to note the high variance of ISP access cost around the world. In Sweden, for example, GDP per capita is nearly US$24,000 per year, the typical ISP cost for 20 hours of monthly dial-up Internet access is roughly US$31 annually and there are 56 Internet users per 100 population. In France, GDP per capita is roughly the same, but ISP access costs more than US$250 per year and there are only 14 users per 100 population. Figure 3 shows the relationship between Internet users and ISP cost when holding income per capita constant, highlighting the negative relationship between price and use.

Regardless of the price effect, it is important to remember that the absolute cost of Internet access remains a serious stumbling block to extending connectivity in the developing world. In only 37 of the countries in our Networked Readiness sample does the average annual ISP cost for twenty hours of monthly dial-up access represent 5 percent of GDP per capita, or less, as can be seen in Figure 4. In 12 of the remaining nations, however, the cost of Internet access amounts to between 5 and 10 percent of income per capita; in 14 countries, it is between 10 percent and 20 percent of per capita GDP; and for nine countries, 20 hours of Internet use per month astonishingly represents more than 20 percent of GDP per capita. In Ukraine, Vietnam, Nigeria, Zimbabwe, Nigeria and Bangladesh, the average cost of 20 hours of monthly access represents 32 percent, 41 percent, 51 percent, 59 percent and a whopping 115 percent, respectively, of average per capita income! Considering the poor service and limited bandwidth in these countries, it would take either an extremely devoted web-surfer or a very wealthy subscriber to spend much time online.

Box 1 (continued)

Figure 4: **Internet Penetration and ISP Access Cost as Percentage of GDP per Capita**[1]



Source: Information Technologies Group, Center for International Development at Harvard University

[1] Global ISP Price Database Project, Information Technologies Group, Center for International Development at Harvard University, 2001

relationship between Enabling Factors and Network Use, numerous interesting relationships stand out. For example:

- Iceland, Finland, the U.S., Sweden, Estonia, Bolivia, Bangladesh, and Paraguay all leverage their Enabling Factors to create Network Use to a greater degree than the other nations in the Index.
- In contrast, France, Russia, Germany, Jordan, South Africa, Nigeria, and Costa Rica are among the countries with lower-than-expected Network Use given their levels of Enabling Factors and income per capita.

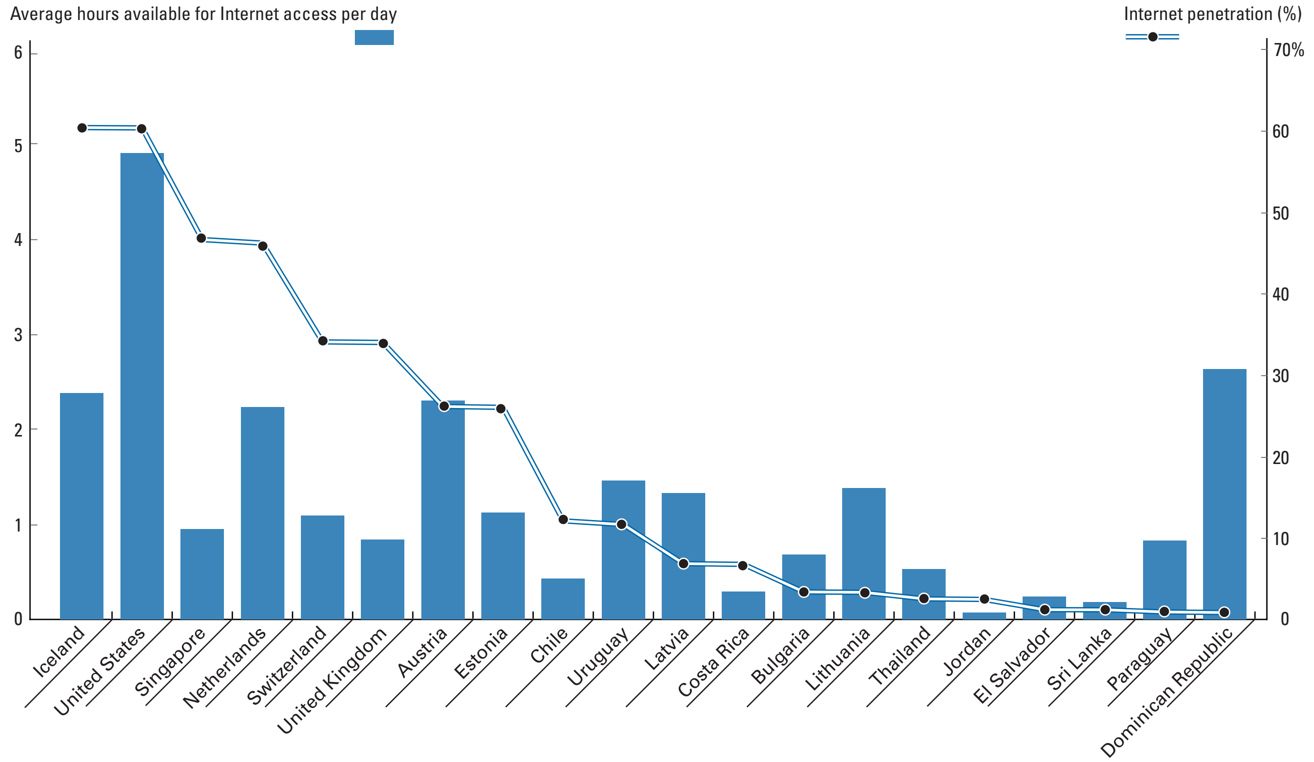
How do the Enabling Factors affect each other and overall Network Use?

It would be a mistake to think that physical infrastructure, ICT policy or any of the other individual elements within the Enabling Factors can solely determine a country's overall level of Network Use. Our research to date indicates that these are all important. However, it is difficult to disentangle the individual contributions made by each Enabling Factor since they are all highly correlated with one another. We hope that further evidence, experience and analysis will allow us in the future to delineate the specific roles of the Enabling Factors in promoting Network Use.

Open questions in measuring Network Use

Most standard, cross-country indicators of network use strictly measure the quantity of use, and focus on rates of ICT diffusion or numbers of users as the most important elements of the Networked World. Unfortunately, the latter tell us little, or nothing, about how people are using ICTs. Decision making on policies and programs to promote ICT-use often relies too much on absolute numbers rather than qualitative aspects of connectivity. There is a tendency to believe that more is better—more Internet users, more computers, more computer labs. However, a focus on extending ICT coverage without complementary

Figure 5: **Per Capita Internet Users and Available Online Hours in Selected Countries**[8]



Source: Information Technologies Group, Center for International Development at Harvard University

training or content can dilute users' experience with ICTs, leaving users with poor quality access or turning them off from the technology completely.

Likewise, Internet host density can be a poor indicator if it is not considered with respect to the numbers of personal computers, in the same way that the numbers of Internet users can be misleading if they are not considered in the context of how many computers have an Internet connection. Likewise, the number of Internet users per 100 inhabitants is considered by many to be the best indicator of Networked Readiness. This statistic only shows the number of people online, but not how many hours a day a single user could actually physically be online or use a computer. As can be seen in Figure 5, countries that have similar levels of per capita Internet users can have widely disparate numbers of available hours online. While Singapore and Netherlands have similar levels of overall Internet penetration, Netherlands comes out significantly ahead when the

Box 2: Some Preliminary Evidence about Software Piracy

We have used piracy as one of our indicators within the Hardware, Software, and Support micro-index of the NRI. Analysis around the piracy variable vis-à-vis other factors has given us preliminary indications that the causes of illegal copying of software may be linked to factors other than the oft-cited effects of income and cost. We have examined the effect of a nation's legal framework, the extent to which software products fit local needs, and competition in the domestic software market upon software piracy, controlling for the effect of income. We have found that low income is closely tied to software piracy. More specifically, software piracy appears to be closely related to the relative cost of copying versus buying software in an environment of limited financial resources. The legal framework also plays a major role in enabling piracy, relating to questions of attitude towards copyright enforcement, as do low levels of competition in the software market, and limited availability of software products that meet local needs. Software piracy likely has a negative effect on Networked Readiness by presenting disincentives for software companies to invent new products and serve new markets. But if the lack of domestic competition in local software markets and limited supply of locally relevant software are major drivers of piracy, then an additional, appropriate response from multinational software vendors to piracy in relatively untapped markets would be to enter those markets, not to shun them because of the threat of piracy or simply to focus on copyright enforcement. The best antidote to software piracy may well turn out be increased private sector activity in underserved markets, and a renewed focus on software localization.

average daily available Internet time is considered. Similarly, the Dominican Republic and Sri Lanka, which have similarly low Internet penetration rates, have marked differences in average available Internet time. When the two overall Networked Readiness leaders, the U.S. and Iceland, are compared, we find a similar pattern, with the U.S. having over twice the number of hours of available Internet time per day, despite similar penetration rates.

We introduce this concept of daily available hours of Internet access in order to stress that many of the indicators that are most commonly used to measure Network Use do not adequately capture the quality of that use. We do not mean to suggest that the situation in the Dominican Republic, in which there are low numbers of per capita Internet users who have more hours of Internet access, is the ideal. We do not even know whether or not greater number of hours translates into higher quality use. Greater possible hourly use by a small elite likely does not extend the benefits of the Networked World to an entire community. But neither is the Sri Lankan situation desirable, in which there is low Internet penetration and low average daily hours of available Internet (likely with little locally relevant content over a slow dial-up Internet connection). Decision makers should keep in mind that in most cases, there is a balance to be struck between getting people online and enhancing their experience with ICTs, and that quantitative statistics can be misleading. Given the importance of quality network use, now is the time for creative solutions to the dearth of qualitative data. More statistical agencies need to focus on the qualitative aspects of the Networked World and consider the demand side of Networked Readiness.

In Sum

A full understanding of the Networked World and its benefits is far from complete. With such a multitude of variables, aggregated effects, and systems resulting from ICTs, mapping the ways in which the adoption and use of new technologies occur remains a research challenge. If global leaders are to make responsible decisions for their governments, people, businesses, and future, better analysis is needed to understand exactly how policy and business decisions translate into greater (or less), or better (or worse), participation in the Networked World. The Networked Readiness Index embodies the first attempt to capture the complexities and nuances of Networked Readiness at the national level. The Index makes clear that Networked Readiness is about much more than technology.

Big questions remain. How can the prices of Internet access be reduced so that ICTs do not remain solely within the purview of the wealthiest in the world? How can we remove obstacles to e-commerce, given its tremendous promise, to further extend the benefits of the Network? How can we improve education and learning systems to more effectively incorporate ICTs? And how can we better understand the ways in which people are using the Internet and the new technologies, and what value these technologies are adding to their lives? Answering these and other ICT-related questions, through rigorous analysis, in order to contribute to helping the world tap into the power and promise of ICTs, is the research goal of the Information Technologies Group at the Center for International Development at Harvard University. The findings in the Networked Readiness Index are but one element in a broader, complex endeavor that extends well beyond our own work. It is a global challenge that merits the attention and effort of the world.

Technical Appendix: Constructing the Networked Readiness Index[9]

The first step we made in the construction of the NRI was to differentiate variables that enable Use (Enabling Factors) from specific indicators of Use (Network Use), building on the Networked Readiness analytical framework that we introduced in *Readiness for the Networked World: A Guide for Developing Countries.*[10,11] We originally considered 135 variables from hard data and the Executive Opinion Survey, and narrowed these down to 65 based on a variety of analytic criteria. For example, variables that were too highly correlated with or dependent upon major variables were discarded, as were others that did not appear to impact Use. Of the remaining 65 variables, the hard data were converted into a 1-to-7 scale using linear transformation to be consistent with the data from the Executive Opinion Survey, using the formula[12]

$$6 \text{ x } \frac{(\text{Country Value—Sample Minimum})}{(\text{Sample Maximum—Sample Minimum})} +1$$

The 65 variables were grouped into 11 separate micro-indexes (based on research and experience on Networked Readiness of the Information Technologies Group at the Center for International Development at Harvard University). One micro-index comprises the Network Use component index, and the remaining 10 are used to create the Network Policy, Network Access, Networked Society, and Networked Economy subindexes, which in turn form the Enabling Factors component index.

In the definitions of the individual variables below, the numbers (1.1, 1.2…) refer to the data tables in the Data Rankings section of the *Global Information Technology Report*.

Definitions of the Networked Readiness Index, component indexes, subindexes and micro-indexes

I. The Networked Readiness Index is defined as follows:

Networked Readiness Index = 1/2 Network Use + 1/2 Enabling Factors

A. The Network Use Index is defined as follows:

Network Use = 4/5 Hard Data + 1/5 Survey Data

Hard Data

1.1 Percentage of computers with Internet connection, 2000
1.2 Internet Users per host, 2000
1.3 Estimated Internet users per 100 inhabitants, 2000
1.4 Cellular subscribers per 100 inhabitants, 2000

Survey Data

1.5 Availability of public Internet access

B. The Enabling Factors Index is defined as follows:

Enabling Factors = 1/4 Network Access + 1/4 Network Policy + 1/4 Networked Society + 1/4 Networked Economy

1. Network Access Subindex is defined as follows:

Network Access = 1/2 Information Infrastructure + 1/2 Hardware, Software and Support

Information Infrastructure micro-index = 5/9 Hard Data + 4/9 Survey Data

Hard Data

2.1 Teledensity, 2000
2.2 Years to first adopt cellular telephony
2.3 Waiting list for telephone lines
2.4 Telecommunication staff per 1,000 mainlines
2.5 Telephone faults per 100 mainlines

Survey Data

2.6 Availability of telephone lines for businesses
2.7 Perceptions of broadband Internet access
2.8 Price and quality of Internet connection
2.9 Availability and cost of mobile telephony

Hardware, Software and Support micro-index = 2/5 Hard Data + 3/5 Survey Data

Hard Data

3.1 PCs per 100 Inhabitants
3.2 Software piracy

Survey Data

3.3 Availability of specialized IT services
3.4 Software products fitting local needs
3.5 Competition in the domestic software market

2. The Network Policy subindex is defined as follows:

Network Policy = 1/2 ICT Policy + 1/2 Business and Economic Environment

ICT Policy micro-index = 1/5 Hard Data + 4/5 Survey Data

Hard Data

4.1 Internet access cost

Survey Data

4.2 Perceived effect of telecommunications competition on quality and price
4.3 Perceived effect of ISP competition on quality and price
4.4 Legal framework supporting IT businesses
4.5 ICTs as overall priority for the Government

Business and Economic Environment micro-index = 1/10 Hard Data + 9/10 Survey Data

Hard Data

5.1 Income per capita (PPP)

Survey Data

5.2 Rule of Law
5.3 Government Effectiveness
5.4 Regulatory Burden
5.5 Number of days to start a new firm
5.6 Women's participation in the economy
5.7 Minority groups' participation in the economy
5.8 Country's relative position in technology
5.9 New government's respect for previous government's commitments
5.10 Trust in public postal system

3. The Networked Society subindex is defined as follows:

Networked Society = 1/3 Networked Learning + 1/3 ICT Opportunity + 1/3 Social Capital

Networked Learning micro-index = average of Survey Data

Survey Data

6.1 Investment in employees' development of IT skills
6.2 Quality of IT training and educational programs
6.3 Internet access in schools

ICT Opportunity micro-index = average of Survey Data

Survey Data

7.1 Brain drain of IT-skilled workforce
7.2 Brain drain of scientists and engineers

Social Capital micro-index = 3/6 Hard Data + 3/6 Survey Data

Hard Data

8.1 No schooling in the total population
8.2 Average years of schooling in the total population
8.3 Illiteracy

Survey Data

8.4 Political Rights
8.5 Quality of public schools
8.6 Difference in quality of schooling for rich and poor children

4. The Networked Economy Subindex is defined as follows:
Networked Economy = 1/3 e-Commerce + 1/3 e-Government + 1/3 General Infrastructure

e-Commerce micro-index = average of Survey Data

Survey Data

9.1 Business to consumer e-commerce transactions
9.2 Business to business e-commerce transactions
9.3 Business Intranet sophistication
9.4 Commercial websites
9.5 Domestic venture capital investment in e-commerce
9.6 Competition in dotcom market
9.7 Prevalence of Internet start-ups
9.8 Use of Internet-based payment systems
9.9 Sophistication of online marketing

e-Government micro-index = average of Survey Data

Survey Data

10.1 Government effectiveness in promoting the use of ICTs
10.2 Availability of online government services
10.3 Extent of Government websites
10.4 Business Internet-based interactions with government

General Infrastructure micro-index = 4/7 Hard Data + 3/7 Survey Data

Hard Data

11.1 Electricity consumption
11.2 Electric power transmission and distribution losses
11.3 Percentage of paved roads
11.4 Television penetration

Survey Data

11.5 Typical driving speed between cities
11.6 Quality of ports' facilities and waterways
11.7 Quality of air transport

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Endnotes

1 See Kaufmann, Kraay, and Zoido-Lobaton’s (1999 and 1999a) work on measuring other elusive, unobservable phenomena such as institutional strength and corruption for sophisticated approaches to these measurement challenges.

2 Information Technologies Group, *Readiness for the Networked World: A Guide for Developing Countries*, Center for International Development at Harvard University, 2000.

3 The 75 nations that we rank in our Indexes constitute the same group of countries that are measured in the *Global Competitiveness Report 2001–2002*.

4 Interested readers should contact the authors for details of their statistical analysis of the relationships discussed in this chapter.

5 The World Economic Forum and Harvard University’s Center for International Development and Institute for Strategy and Competitiveness jointly undertook the Global Executive Opinion Survey.

6 Detailed results of the ICT-specific survey questions can be found in the third part of this report, and a thorough description of the Global Executive Opinion Survey can be obtained in Cornelius and McArthur (2002: 166–177).

7 See Table 5.1 in the data section at the end of this book for a listing of countries’ GDP per capita.

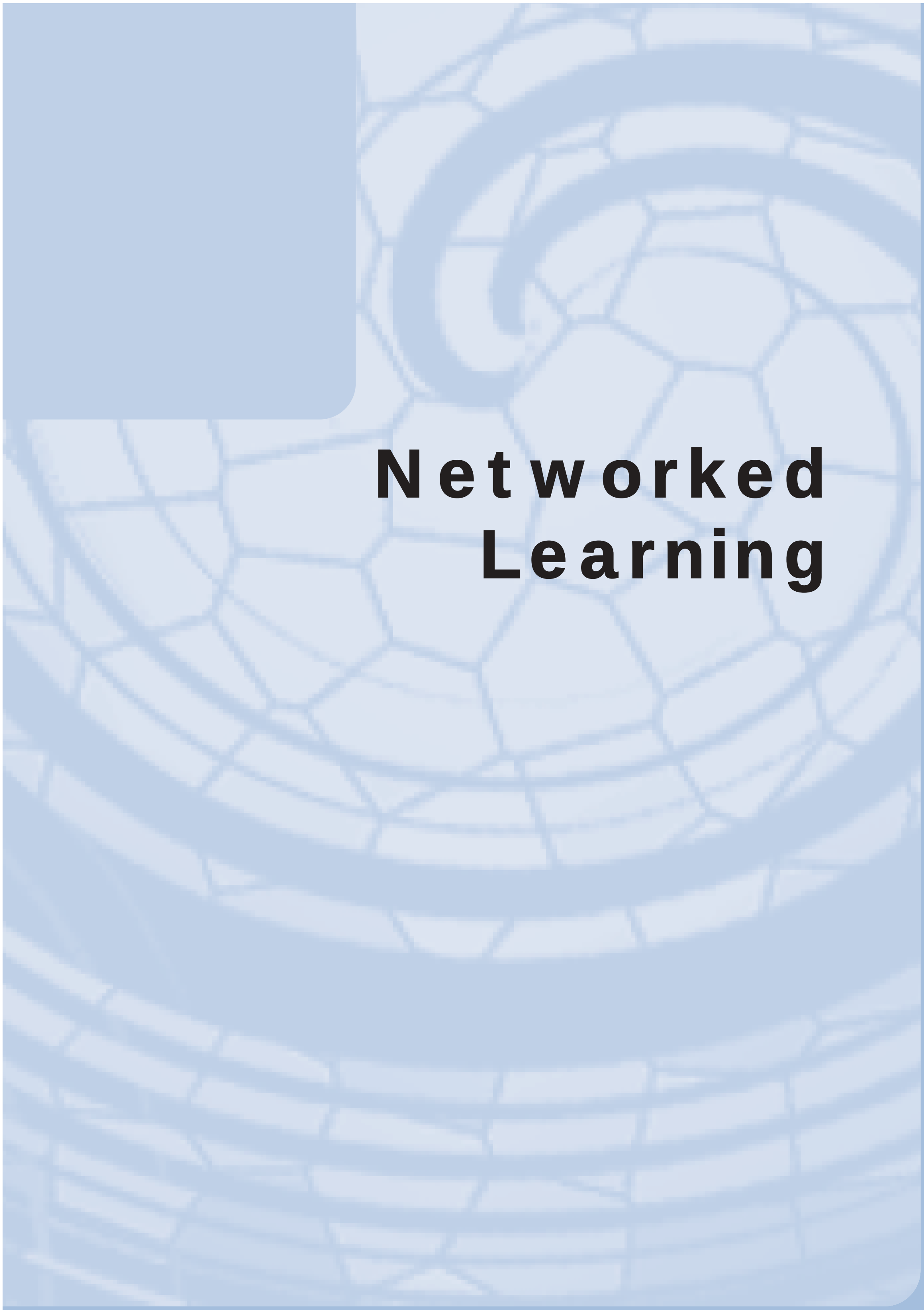
8 Average available time for daily Internet use was calculated assuming that a personal computer with Internet connection on average works ten hours a day, multiplying this number by the number of personal computers with Internet connection, and dividing by the total number of users.

9 As we set out to construct the Networked Readiness Index and analyze the complex relationships between the numerous Readiness factors across our pool of seventy-five nations, we initially wanted to establish a cross-country comparison measure that captured the relationship between variables of Networked Readiness and economic competitiveness. However, we found very little in the literature to guide us in cementing the impact of ICTs on economic competitiveness. We are heartened to see that very recent studies have begun to link ICT diffusion and economic growth. We look forward to increasing efforts to link Networked Readiness more explicitly to economic competitiveness. For example, see Chapter 7 of this report, where Eggleston, Jensen, and Zeckhauser discuss some of the existing literature that links telecommunications and economic development, or see recent reports by McKinsey Global Institute (2001), or Organization for Economic Co-operation and Development (2001).

10 Information Technologies Group (2000).

11 We have made some modifications to *Readiness for the Networked World* (2000) definitions of the categorization of variables, based on analysis and research subsequent to the Guide’s publication. These changes are reflected in the construction of the NRI.

12 See McArthur and Sachs (2002: 28–51).



Networked Learning

CHAPTER 3

Rethinking Learning in the Digital Age

Mitchel Resnick

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First, the good news: in the years ahead, the declining cost of computation will make digital technologies accessible to nearly everyone in all parts of the world, from inner-city neighborhoods in the United States to rural villages in developing nations. These new technologies have the potential to fundamentally transform how and what people learn throughout their lives. Just as advances in biotechnologies made possible the "green revolution" in agriculture, new digital technologies make possible a "learning revolution" in education.

Now, the bad news: while new digital technologies make a learning revolution possible, they certainly do not guarantee it. Early results are not encouraging. In most places where new technologies are being used in education today, the technologies are used simply to reinforce outmoded approaches to learning. Even as scientific and technological advances are transforming agriculture, medicine, and industry, ideas about and approaches to teaching and learning remain largely unchanged.

To take full advantage of new technologies, we need to fundamentally rethink our approaches to learning and education—and our ideas of how new technologies can support them.

Beyond Information

When people think about education and learning, they often think about information. They ask questions like: What information is most important for people to know? What are the best ways to transmit that information from one person (a teacher) to another (a learner)? What are the best ways to represent and display information so that it is both understandable and learnable?

It's not surprising that people see a natural connection between computers and education. Computers enable people to transmit, access, represent, and manipulate information in many new ways. Because education is associated with information and computers are associated with information, the two seem to make a perfect marriage.

This focus on information, however, is limiting and distorting, both for the field of education and for computers. If we want to take full advantage of new computational technologies, and if we want to help people become better thinkers and learners, we need to move beyond these information-centric views of computing and learning.

Over the past fifty years, psychologists and educational researchers, building on the pioneering work of Jean Piaget, have come to understand that learning is not a simple matter of information transmission. Teachers cannot simply pour information into the heads of learners; rather, learning is an active process in which people construct new understandings of the world around them through active exploration, experimentation, discussion, and reflection. In short: people don't *get* ideas; they *make* them.

As for computers, they are more than simply information machines, despite the common use of the phrase "information technology" or "IT." Of course, computers are wonderful for transmitting and accessing information, but they are, more broadly, a new medium through which people can create and express. If we use computers simply to deliver information to students, we are missing the revolutionary potential of the new technology for transforming learning and education.

Consider the following three things: computers, television, finger paint. Which of the three doesn't belong? For most people, the answer seems obvious: "finger paint" doesn't fit. After all, computers and televisions were both invented in the twentieth century, both involve electronic technology, and both can deliver information to large numbers of people. None of that is true for finger paint.

But until we start to think of computers more like finger paint and less like television, computers will not live up to their full potential. Like finger paint (and unlike television), computers can be used for designing and creating things. In addition to accessing Web pages, people can create their own Web pages. In addition to downloading MP3 music files, people can compose their own music. In addition to playing SimCity, people can create their own simulated worlds.

It is design activities such as these that offer the greatest new learning opportunities with computers. Research has shown that many of our best learning experiences come when we are engaged in designing and creating things, especially things that are meaningful either to us or others around us (e.g., Papert 1993). When children create pictures with finger paint, for example, they learn how colors mix together. When they build houses and castles with building blocks, they learn about structures and stability. When they make bracelets with colored beads, they learn about symmetries and patterns.

Like finger paint, blocks, and beads, computers can also be used as a "material" for making things—and not just by children, but by everyone. Indeed, the computer is the most extraordinary construction material ever invented, enabling people to create anything from music videos to scientific simulations to robotic creatures. Computers can be seen as a universal construction material, greatly expanding what people can create and what they can learn in the process (Resnick 1998).

Digital Fluency

Unfortunately, most people don't use computers that way today. When people are introduced to computers today, they are typically taught how to look up information on the Web, how to use a word processor, how to send e-mail. But they don't become *fluent* with the technology.

What does it mean to be digitally fluent? Consider the analogy with learning a foreign language. If someone learned a few phrases so that they could read menus in restaurants and ask for directions on the street, would you consider them fluent in the language? Certainly not. That type of phrase-book knowledge is equivalent to the way most people use computers today. Is such knowledge useful? Yes. But it is not fluency.

To be truly fluent in a foreign language, you must be able to articulate a complex idea or tell an engaging story; in other words, you must be able to "make things" with language. Analogously, being digitally fluent involves not only knowing how to use technological tools, but also knowing how to construct things of significance with those tools (Papert and Resnick 1995).

Fluency with language not only has great utilitarian value in everyday life but also has a catalytic effect on learning. When you learn to read and write, you are in a better position to learn many other things. So, too, with digital fluency. In the years ahead, digital fluency will become a prerequisite for obtaining jobs, participating meaningfully in society, and learning throughout a lifetime.

Today, discussions about the "digital divide" typically focus on differences in access to computers. That will change. As the costs of computing decline, people everywhere will gain better access to digital technologies. But there is a real risk that only a small handful will be able to use the technologies fluently. In short, the "access gap" will shrink, but a serious "fluency gap" could remain.

Computer Clubhouses

To provide more young people with the opportunity to become digitally fluent, the Massachusetts Institute of Technology (MIT) Media Lab and the Boston Museum of Science have established a network of learning centers in economically disadvantaged communities. At these centers, called Computer Clubhouses, young people become designers and creators with new digital technologies. Clubhouse members use leading-edge software to create their own artwork, animations, simulations, multimedia presentations, musical compositions, websites, and robotic constructions (Resnick et al. 1998).

The first Computer Clubhouse opened in 1993 in Boston, serving youth between the ages of ten and eighteen. Based on the success of the initial Clubhouse, a dozen more communities opened Computer Clubhouses over the next six years. Then, in 2000, Intel announced that it would provide support to open an additional hundred Computer Clubhouses around the world over the ensuing five years. There are now Clubhouses in India, Ireland, Israel, Colombia, Germany, the Philippines, and the United States, with new Clubhouses planned for 2002 in China, Costa Rica, Mexico, South Africa, and Taiwan.

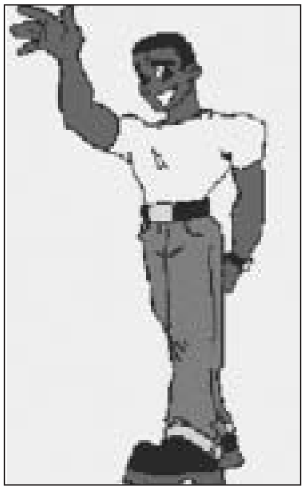
Computer Clubhouses are very different from most telecenters and community technology centers, which typically fall in one of two categories. Some technology centers merely provide access. People can do whatever they want: play games, surf the Web, use online chat rooms. Other centers offer structured courses teaching basic computer skills (such as keyboarding) and basic applications (such as word processing and spreadsheets).

Computer Clubhouses offer a third path, with different goals and a different approach. The aim is not simply to teach basic skills, but to help young people learn to express themselves and gain confidence in themselves as learners. If they are interested in video games, they don't come to the Clubhouse to play games; they come to create their own games. They don't download videos from the Web; they create their own videos. In the process, youth learn the heuristics of being a good designer: how to conceptualize a project, how to make use of the materials available, how to persist and find alternatives when things go wrong, how to collaborate with others, and how to view a project through the eyes of others. In short, they learn how to manage a complex project from start to finish.

The Computer Clubhouse approach strikes a balance between structure and freedom in the learning process. As Clubhouse youth work on projects based on their own interests, they receive a great deal of support from other members of the Clubhouse community (e.g., staff members, volunteer mentors, and other Clubhouse youth). There is a large collection of sample projects on the walls, shelves, and hard drives of the Clubhouses; these provide Clubhouse youth with a sense of the possible, and multiple entry points through which they can start. The goal is to provide enough freedom to enable Clubhouse youth to follow their fantasies, but also enough support to help them turn those fantasies into realities.

There is no doubt that the lives of many Computer Clubhouse members have been transformed by their time at the Clubhouses. Consider Mike Lee, who spent time at the original Computer Clubhouse in Boston. Mike first came to the Clubhouse after he had dropped out of high school. His true passion was drawing. He filled up notebook after notebook with sketches of cartoon characters. At the Clubhouse, Mike Lee developed a new method for his artwork. First, he would draw black-and-white sketches by hand. Then, he would scan the sketches into the computer and use the computer to color them in. His work often involved comic-book images of himself and his friends (Figure 1).

Figure 1



Over time, Mike learned to use more advanced computer techniques in his artwork (Figure 2). Everyone in the Clubhouse was impressed with Mike's creations, and other youth began to come to him for advice. Some members explicitly mimicked Mike's artistic style. Before long, a collection of "Mike Lee style" artwork filled the bulletin boards of the Clubhouse (Figure 3). "It's kind of flattering," says Mike.

For the first time in Mike's life, other people were looking up to him. He began to feel a new sense of responsibility. He decided to stop using guns in his artwork, feeling that it was a bad influence on the younger Clubhouse members. "My own personal artwork is more hard core, about street violence. I had a close friend who was shot and died," Mike explains. "But I don't want to bring that here. I have an extra responsibility. Kids don't understand about guns; they think it's cool. They see a fight, it's natural they want to go see it. They don't understand. They're just kids."

Figure 2

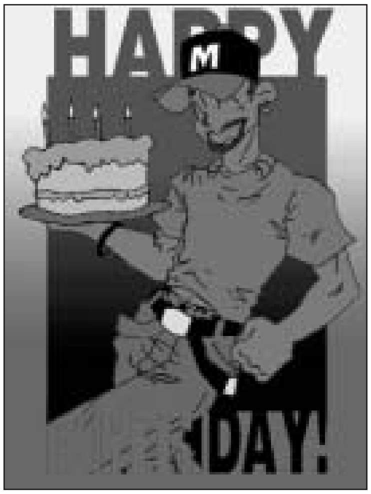
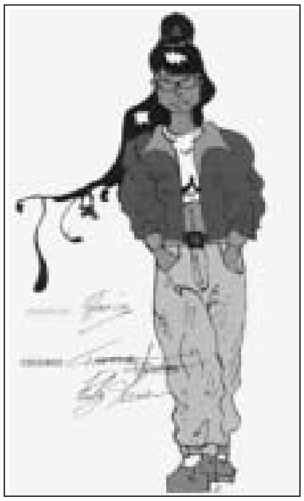


Figure 3



Mike Lee began working with others at the Clubhouse on collaborative projects. Together, they created an online art gallery. Once a week, they met with a local artist who agreed to be a mentor for the project. After a year, their online art show was accepted as an exhibition at Siggraph, the world's premiere computer-graphics conference.

Figure 4

As Mike worked with others at the Clubhouse, he began to experiment with new artistic techniques. He added more computer effects, and he began working on digital collages combining photographs and graphics, while still maintaining his distinctive style (Figure 4). Over time, Mike explored how he might use his artwork as a form of social commentary and political expression (Figure 5).

As he worked at the Clubhouse, Mike Lee clearly learned a lot about computers and about graphic design. But he also began to develop his own ideas about teaching and learning. “At the Clubhouse, I was free to do what I wanted, learn what I wanted,” says Mike. “Whatever I did was just for me. If I had taken computer courses [in school], there would have been all those assignments. Here I could be totally creative.” Mike remembers—and appreciates—how the staff members treated him when he first started at the Clubhouse. They asked him to design the sign for the entrance to the Clubhouse, and looked to him as a resource. They never thought of him as a “high-school dropout” but as an artist.

Mike’s artwork still has the same distinctive style, but he has become more fluent in expressing himself in computer-based media. Describing his current work, Mike talks about “dither nightmares” and “anti-aliasing problems”—ideas that would have been alien to him a few years ago. He says his artwork is “ten times better than last year.”

Rethinking Technologies

In addition to rethinking our approaches to learning and education, we also need to rethink the technologies that we provide to young people.

Most of today’s computers were designed primarily for use by adults in the workplace. We need to develop a new generation of computer technologies *worthy* of the next generation of children. It’s not enough just to make computers faster; we need to develop new types of computers. Today’s youth are ready and eager to do more with computers. We need to provide the hardware and software that will enable them to do so.

These new technologies might look very different from traditional computers. For example, my research group has developed a family of “programmable bricks”: tiny computers embedded inside children’s building blocks (Martin et al. 2000; Resnick et al. 1996). With these bricks, children can build computational power directly into their physical-world constructions, using the programmable bricks to control motors, receive information from sensors, and even communicate with one another. The LEGO Company now sells a commercial version of these programmable bricks, under the name LEGO MindStorms.

Figure 5

Children have used our programmable bricks to build a variety of creative constructions, including an odometer for rollerblades (using a magnetic sensor to count wheel rotations); a diary-security system (using a touch sensor to detect if anyone tried to open the diary); and an automated hamster cage (using a light sensor to monitor the hamster’s movements).

One 11-year-old girl, named Jenny, was very interested in birds, and she decided to use programmable bricks to build a new type of bird feeder. She started by making a wooden lever that served as a perch for the birds. When a bird landed, it would trigger a touch sensor, sending a signal to a programmable brick, which turned on a LEGO mechanism, which pushed down the shutter of a camera, taking a picture of the bird.

The design-oriented nature of the project was clearly very important for Jenny. As she described it: “The fun part is knowing that *you* made it; *my* machine can take pictures of birds.” At the same time, the project served as a rich context for engaging in scientific inquiry and learning science-related concepts. Jenny developed a deeper understanding of some concepts (such as mechanical advantage) that she had previously studied in school but had never really appreciated. She also began to work with some engineering concepts (related to feedback and control) that are traditionally taught only at the university level (Resnick et al. 2000).

Programmable bricks provided Jenny with “design leverage,” enabling her to create things that would have been difficult for her to create in the past. At the same time, the bricks provided Jenny with “conceptual leverage,” enabling her to learn concepts that would have been difficult for her to learn in the past.

Reforming Educational Reform

Increasingly, nations are recognizing that improving education is the best way to increase wealth, enhance health, and maintain peace. But there is little consensus on how to achieve an educated population, or even on what it means to have an educated population. Can progress towards an educated population be measured by counting the number of people in school? By the number of years they spend in school? By assessing their grades on standardized tests?

Every country in the world, it seems, has a plan for educational reform. But, in most cases, reform initiatives are superficial and incremental, and do not get at the heart of the problem. These initiatives often introduce new forms of testing and assessment, but leave in place (or make only small incremental changes to) existing curricula and existing teaching strategies. We need to reform educational reform.

Rethink how people learn. We need to fundamentally reorganize school classrooms. Instead of a centralized-control model (with a teacher delivering information to a roomful of students), we should take a more entrepreneurial approach to learning. Students can become more active and independent learners, with the teacher serving as consultant, not chief executive. Instead of dividing up the curriculum into separate disciplines (math, science, social studies, language), we should focus on themes and projects that cut across the disciplines, taking advantage of the rich connections among different domains of knowledge. Instead of dividing students according to age, we should encourage students of all ages to work together on projects, enabling them to learn from one another (and to learn by teaching one another). Instead of dividing the school day into hour-long slices, we should let students work on projects for extended periods of time, enabling them to follow through more deeply and meaningfully on the ideas that arise in the course of their work.

Rethink what people learn. Much of what children learn in schools today was designed for the era of paper-and-pencil. We need to update curricula for the digital age. One reason is obvious: Schools must prepare students with the new skills and ideas that are needed for living and working in a digital society. There is a second, subtler reason: new technologies are changing not only what students *should* learn, but also what they *can* learn. There are many ideas and topics that have always been important but were left out of traditional school curricula because they were too difficult to teach and learn with only paper, pencil, books, and blackboard. Some of these ideas are now accessible through creative use of new digital technologies. For example, children can now use computer simulations to explore the workings of systems in the world (everything from ecosystems to economic systems to immune systems) in ways that were previously not possible. Some ideas that were previously introduced only at the university level can and should be learned much earlier. Finally, and perhaps most importantly, we need to transform curricula so that they focus less on "things to know" and more on "strategies for learning the things you don't know." As new technologies continue to quicken the pace of change in all parts of our lives, learning to become a better learner is far more important than learning to multiply fractions or memorizing the capitals of the world.

Rethink where and when people learn. Most education-reform initiatives appear to assume that learning takes place only between the ages of 6 and 18, between 8:00 A.M. and 3:00 P.M.—that is, when children are in schools. But schools are just part of a broader learning ecosystem. In the digital age, learning can and must become a daylong and lifelong experience. National education initiatives should aim to improve learning opportunities not only in schools, but also in homes, community centers, museums, and workplaces. In Denmark, for example, the Ministry of Education joined with the Ministry of Business and Industry to create Learning Lab Denmark, a new research lab that studies learning in all settings, in all stages of life. In the years ahead, the Internet will open up new learning opportunities, enabling new types of "knowledge-building communities" in which children (and adults) around the globe collaborate on projects and learn from one another.

Towards the Creative Society

In the 1980s, there was much talk about the transition from the "Industrial Society" to the "Information Society." No longer would natural resources and manufacturing be the driving forces in our economies and societies. Information was the new king.

In the 1990s, people began to talk about the "Knowledge Society." They began to realize that information itself would not bring about important change. Rather, the key was how people transformed information into knowledge and managed that knowledge.

The shift in focus from "information" to "knowledge" is an improvement. But I prefer a different conception: the "Creative Society." As I see it, success in the future will be based not on how much we know, but on our ability to think and act creatively.

The proliferation of digital technologies has accentuated the need for creative thinking in all aspects of our lives, and has also provided tools that can help us improve and reinvent ourselves. Throughout the world, computing and communications technologies are sparking a new entrepreneurial spirit, the creation of innovative products and services, and increased productivity. The importance of a well-educated, creative citizenry is greater than ever before.

Children should play a central role in this transition to the Creative Society. Childhood is one of the most creative periods of our lives. We must make sure that children's creativity is nourished and developed, and we must help children learn how to extend and refine their creative abilities, so that the creativity of childhood persists and grows throughout life.

To achieve these goals will require new approaches to education and learning, and new types of technologies to support those new approaches. The ultimate goal is a society of creative individuals who are constantly inventing new possibilities for themselves and their communities.

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CHAPTER 4

Ten Lessons for ICT and Education in the Developing World

Robert J. Hawkins

World Links for Development Program

The World Bank Institute

The skills to productively transform knowledge and information into innovative products and services will define successful knowledge economies. Because knowledge and information have become the most important currency for productivity, competitiveness, and increased wealth and prosperity, nations have placed greater priority on developing their human capital. Governments around the world are thus focusing on strategies to increase access to and improve the quality of education. Decision makers find themselves asking key questions: What defines a quality education in today's global information-based economy? Has education kept pace with a rapidly changing world? Are there good models for reform that we can follow?

A Changed World with Unchanged Classrooms

If you compared our world today with the world one hundred years ago, you would encounter amazing advances in science, commerce, health care, transportation, and countless other areas. But if you were to compare the classroom of a hundred years ago with an average classroom today, you would recognize it immediately: students lined up in rows, paper and pencil in hand; a teacher at the blackboard jotting down important facts; students furiously copying all that is written and said, expecting to memorize the facts and spit them out on an exam. While much has been changed by the advances of science and technology, education and the way that students learn and teachers' teach have remained largely unchanged. However, in today's information and knowledge-driven world, a whole new set of skills is required.

New Skills for the Networked World

A relevant education is more important today then ever, because today's Networked World demands a workforce that understands how to use technology as a tool to increase productivity and creativity. These skills include "information reasoning," a process in which reliable sources of information are identified, effectively accessed, understood, contextualized, and communicated to colleagues. Furthermore, employers require workers to have the skills necessary to collaborate, work in teams, and share information across global networks, that is, to analyze issues from a multidisciplinary perspective. Because these networks are international, employers seek out individuals who have the capacity to effectively interact with others across cultures and languages. Finally, knowledge workers need to be flexible and able to learn quickly as work environments continue to change dynamically. Workers must learn how to learn, and quickly acquire new skills. The skills discussed here are not easy to find and, indeed, are a challenge to develop. How do nations prepare students for such a world?

World Links—A Model for Networked Learning

In 1997, the World Bank initiated the World Links program (www.worldbank.org/world links) in response to developing countries' demand for strategies to prepare their youth to compete in a world increasingly driven by information, technology, and knowledge. World Links is one of the most innovative and successful grant programs initiated by the World Bank to assist developing countries in bridging the "digital divide." Its principal capacity-building objective is to provide developing country schools and ministries of education with sustainable solutions for mobilizing the necessary technologies, skills, and educational resources to prepare students and teachers to enter the Networked World.

Over the past four years, World Links has worked with twenty-one countries[1] to bring underprivileged schools into a global school network. The network links thousands of students and teachers around the world for collaborative learning and helps ministries of education pilot and learn from this implementation of Networked Learning in schools. World Links is bridging the gap in skills, knowledge, and educational opportunities between students in industrialized and developing nations, as well as between rich and poor students within developing countries.

In developing its program, World Links drew lessons from the successes and failures of technology education programs throughout the world and designed customized pilots for each participating country. One of the key failures of many past programs was that schools were provided with expensive equipment but with little or no support for teachers' professional development, national ICT-in-education policies, or community involvement. Since World Links launched its first program in Uganda almost five years ago, a number of lessons regarding the constraints, as well as the potential of integrating technology into education in the developing world, have been learned. While getting schools wired to the Internet is the first step, a whole host of other factors need to be considered, ranging from teacher training to assessment to sustainability. The following are ten lessons that World Links has learned in its efforts to help developing countries span the knowledge divide.

Lesson #1: Computer labs in developing countries take time and money, but they work

Establishing a working computer lab and a reliable connection to the Internet remains a dream for most schools around the world. In a recent survey of teachers in developing countries conducted by SRI International for World Links, the majority of teachers in African and Latin American countries reported that the lack of adequate hardware and software as well as unreliable Internet access were significant barriers to using computers in instruction. This report reflects the fact that many schools in developing countries have a student-teacher ratio as high as 80:1, and must contend with a computer lab of ten to twenty computers for the entire school—if they are lucky. Moreover, most schools with computers can only afford dial-up connectivity, which in many cases runs over old lines and antiquated telephone exchanges. With this level of connectivity, a lab with ten to twenty computers in Uganda is like a fire hose dangling over a thirsty traveler in the desert that releases only drops of water into his parched mouth.

Despite many limitations, schools make these labs work. Schools squeeze as much use as possible out of poor connectivity through technical solutions such as store-and-forward e-mail, caching Web pages locally, extensive use of CD-ROMs, and pulling Web pages through e-mail. Teachers have also learned to manage their classes to work with these limitations. Many teachers divide their classes into groups to allow some students to work off-line while others use the computer to either search for information, input information, or create information for a project. For instance, in Ghana, Edward Tetteh from Accra Academy brings his students to the computer lab to work on a collaborative project focused on HIV/AIDS (http://www.world-links.org/aidsweb/testing/index.html). While one group of students researches the HIV/AIDS statistics for Ghana online, another group reviews e-mail messages from partner schools in South Africa, Zimbabwe, the United States, and Uganda, and yet a third group begins to write a response to one of the partner schools in South Africa. While Edward manages his class creatively to ensure that all students are on task and have some access to the computer, Edward and his students are in the minority in his country. The small number of students who touch a computer in his classroom and his school is indicative of a greater challenge—information and computer technology needs to become more readily available to a larger number of students and teachers. Existing computer technology is still not appropriate in terms of complexity and cost for a school environment—particularly in a developing country. Cheaper, easier-to-use technology must be developed and implemented in schools to allow for greater use among students and teachers.

Lesson #2: Technical support cannot be overlooked

Getting computers into schools is relatively easy; keeping them working is a greater challenge. A myriad of problems ranging from electrical spikes, to viruses, dust, heat, and normal wear-and-tear can bring activity in a developing country computer lab to a screeching halt. Most schools lack the funds for a full-time computer technician, and when one is hired and trained, he is often lured away to a more lucrative job elsewhere, leaving the school to start the search over again. Moreover, most ministries of education are ill equipped to effectively service a large number of schools. Most schools are therefore left with very little technical support when inevitable technical glitches arise. However, a few innovative solutions have emerged in countries around the world. One solution is to give students more responsibility for maintaining the labs. Many students are as or more adept with the technology than the "professional" technicians who are often hired. An example of such a program is the "Kids on the Block" initiative in Namibia, in which Schoolnet Namibia works with youth to provide them with the technical training necessary to refurbish, install, and maintain the school computer labs. Providing students with some basic training and a whole lot of trust can save a school and a school system time and money. Other solutions, however, must also be evaluated, such as additional training for technical staff in schools and administration offices and outsourcing this technical support to private organizations.

Lesson #3: Noncompetitive telecommunications infrastructure, policies, and regulations impede connectivity and sustainability

Because most developing countries charge by the minute even for local calls, reluctant principals with tight budgets limit the amount of time on the Internet throughout the day. Results of the aforementioned SRI study do suggest, however, that when schools or ministries of education invest in high speed Internet access, there is an increase in satisfaction, use, and integration into the curriculum. For instance, in Mauritania the ministry of education has made a commitment to connect the six pilot schools participating in the World Links program with dedicated leased lines providing high speed access twenty-four hours a day, seven days a week. Because these schools have fast connectivity with subsidized costs, only a small minority of the teachers listed unreliable Internet access as a major barrier and the evaluation results for Mauritania were higher than any other World Links participating country.

Ministries of education can also make a more concerted effort to partner with their local or national telecommunications company. Such partnerships can lead to a win-win situation in which not only educational aims are furthered, but also telecommunication company goals—such as an expanded user base. In Chile, for instance, the ministry negotiated a deal with the Compania de Telecomunicaciones de Chile (CTC), a prominent telecommunications firm, to provide free Internet connectivity for up to 6,500 schools for ten years. In addition to the Internet connectivity, CTC offers the schools digital or analog lines and provides service, an e-mail account, Web hosting up to five megabytes, Web browsing and e-mail software, Internet blocking software, installation, and technical assistance—all free of charge. Governments need to follow this example and work more closely with telecommunications providers to show them the benefits of providing subsidized access for education. In the long run, it makes good business sense as well for the companies as they build their future user base, potentially reach parents through students, and accrue the public relations benefits of providing a social service.

Emerging wireless technologies is another regulatory area that needs attention. Because reliable fixed line connectivity is still mostly limited to only urban areas in developing countries, wireless options are attractive to rural and peri-urban communities. As wireless technologies continue to develop and become more ubiquitous, however, governments need to evaluate their spectrum allocation and licensing policies to ensure that satellite connectivity options allow for a broad range of choices for the connection of underserved areas of the country.

Lesson #4: Lose the wires

World Links has found that the most effective technology for connecting schools in developing countries is wireless. The telecommunications infrastructure is so poor in many African countries, for instance, that fixed line dial-up connectivity will never be a viable solution. Developing country schools are now bypassing their local fixed line infrastructure and establishing wireless Internet access. In Uganda, there is a telling case of the schools' evolution to broader band Internet connectivity using wireless solutions. Five of the original ten schools selected to participate in the World Links pilot project in 1997 could not use the Internet due to antiquated exchanges. These schools were moved to a cellular telephone connection through Celltel, a local company that donated one hour of free airtime per day. This allowed students to send e-mail only, at a speed of 9.5 Kbps. In order to overcome the deficiencies of the existing fixed line infrastructure and the slow data rates of the cellular telephone link, a number of schools moved to a broader band wireless connection. Makerere College School established the first line-of-sight spread spectrum wireless Internet link (this technology has a limited distance of around 20 km because the sender and receiver must have a clear path or "line-of-sight between them) with a capital outlay of US$1,500. The connection has worked flawlessly, and has given the school connectivity twenty-four hours a day, seven days a week. The school paid AFSAT, the local Internet Service provider, US$250 per month in recurrent costs; this was equivalent to payments made to the local telecommunications provider for the slow, unreliable, limited Internet access over the dial-up connection.

The World Links program is now experimenting with wireless satellite or VSAT (Very Small Aperture Terminal) technology in rural areas in a wireless connectivity pilot. If successful, the solution will be replicated in other rural areas throughout Africa and elsewhere. With the assistance of a donation from the Gates Foundation, fifteen schools in the most rural areas of Uganda will be connected with satellite-provided Internet connectivity, teachers and students will be trained in use of the equipment, and the results of the pilot will be monitored and evaluated to determine the technical and financial sustainability of the satellite solution. Thus far, the pilot has provided a wonderful learning experience. Additional funds, for instance, were required to fence in all of the satellite dishes to keep monkeys from jumping on the dishes to eat the cables.

Lesson #5: Get the community involved

Lack of financing is one of the greatest challenges to connecting schools in developing countries to the Internet. How does a school in a country like Uganda, with a per capita income of US$310, afford US$250 per month for an Internet connection? Part of the answer is to share the facilities and the costs with the broader community. The rural pilot mentioned above in Uganda will be used to test a number of sustainability models for schools to recoup the recurrent costs of Internet connectivity. With fifteen schools participating in the pilot, the monthly recurrent costs for sharing a 256Kps space segment come to around US$400 per school, per month. The World Links program plans to subsidize half of this cost for two years, while the communities participating in the pilot will need to pay the other US$200 per month. In order to support these costs, poorer rural areas that participate in the pilot will need to develop an innovative plan. Some of the resources will come from a community education tax, and the remaining resources will be raised by opening the school after school hours, on weekends, and during holidays to the community to provide training and information access. World Links has provided the participating pilot schools with a forty-hour training course on the use of schools as community learning centers. The training helps schools identify services, market these services, staff the center appropriately, and manage the finances of the center. This strategy not only accomplishes the objective of spreading the recurrent costs across a larger number of users, but also engages the community in the activities of the school and provides a venue for adult and life-long education.

World Links first piloted this concept in Zimbabwe. At the Bindura-World Links community learning center in Zimbabwe, over half of the “clients” are adult learners who come to receive basic computer literacy training. Another important user group for this facility is the Zimbabwe Open University, where over three hundred students use the center to access their course material and interact with professors online. Finally, approximately 70 percent of the users of this center in Zimbabwe are women. The success of these pilots suggests that developing countries should encourage schools to open up to the community as a means of bridging the digital divide between urban and rural areas of the country, between in-school and out-of-school youth and, finally, between girls’ and boys’ access to education.

Lesson #6: Private-public sector partnerships are essential

A ministry of education cannot take on the task of equipping schools alone. It is simply too big a job. Governments will need to form strategic partnerships if they are to succeed. India presents a wonderful example of an effective partnership between the public and private sectors. A number of states in India have implemented a variation of the community learning center concept by partnering with private sector computer training companies. The state government of Karnataka, for instance, has equipped seven hundred schools with ICT labs in an astonishingly fast time frame—only forty-five days! How was this feat accomplished? Through a partnership with NIIT, a private computer training institute. The Karnataka government contracted with NIIT to equip and maintain the school computer labs and provide an instructor for technical training for students during school hours. In exchange, the training institute is compensated with a five-year contract for providing the training, and is allowed to use the facilities after school hours for delivery of its private training courses to the community. The initiative also created some unforeseen externalities. As Ravi Kiran, the manager for the project, indicated:

> In some districts, there was nothing before we started this project. We brought power and telecommunications services to these areas where none existed before. We hired 1,400 trainers, mostly from the local communities. We would ride through town with a bullhorn announcing these job openings and the people would flock to us. When we drove into a community to set up the school lab, the kids would run after the truck and the whole community helped with the installation. The whole company is very proud of this project.

The initiative in Karnataka has received high marks thus far from both government officials and the private training institutes.

Lesson #7: Link ICT and education efforts to broader education reforms

These examples of private-public partnerships to equip labs and provide cost-effective Internet connectivity represent very good models of innovative public sector leadership, but installing the physical infrastructure is the easiest part of the battle. While many ministries of education around the world have made the commitment to computerize schools, few have developed coherent strategies to fully integrate the use of computers as pedagogical tools in the classroom. One of the significant bottlenecks that World Links has encountered is the lack of a clear policy in ministries of education with regard to use of computers in education. Many ministries of education view computers as a stand-alone subject requiring a curriculum focusing on basic computer literacy skills. While computer literacy represents a start, the integration of computers and the Internet into the broader curriculum is where real learning gains will be made. Results of the SRI-World Links evaluation show that teachers enthusiastically engage in collaborative projects and constructivist pedagogy, but school administrators offer very little structural support and incentives to effectively use the technology in the classroom. First, the curriculum that teachers in most developing countries need to follow is rigid and overloaded, leaving little time for innovative classroom practices. Second, exams represent the greatest incentive for the majority of students and teachers. The common view is that "if it's not going to be tested, then it must not be important." Ministries must make a commitment to helping teachers effectively integrate computers and Internet technologies into their schools by aligning curriculums, exams, and incentives with the educational outcomes that they hope to gain. Computers by themselves bring very little to the learning process—they are only tools, like many others. Linking computers and the Internet to learning objectives is a challenging goal, but is one of the most important that education policy makers can achieve.

Lesson #8: Training, training, training

The professional development of teachers sits at the heart of any successful technology and education program. Teachers need not only formal training, but also sustained and ongoing support from their colleagues to help them learn how best to integrate technology into their teaching. Training must go well beyond basic cutting-and-pasting. Teachers need to be able to transform their classrooms from places where a static one-way flow of information from teacher to student occurs, into dynamic, student-centered learning environments in which learners interact with peers in teams, both in their own classroom as well as with virtual classes around the world through the Internet.

Most teachers, however, are intimidated by technology and are comfortable with their own teaching styles. Any teacher-training program should help teachers see past the technology to the pedagogical and educational gains that use of the technology will bring to the classroom. Furthermore, teachers need to be transformed from information consumers, using the Internet to access resources, into information producers, adapting the information for their particular cultural and educational reality. Some countries have established online networks or communities-of-practice, in which teachers share resources that enhance their curriculum, get peer reviews of lesson plans they have created, and exchange ideas and good practices with other teachers of their subject.

World Links has focused its training on helping teachers to use technology as a tool, and to transform their classrooms into interactive, inquisitive learning environments. According to a physics teacher in Peru, "After the training, I now learn with my students and often from them. They enjoy it and I take pride in it." Indeed, the SRI evaluation of World Links shows that as a result of training, three quarters of participating teachers stated that computers and the Internet enabled them to greatly improve their knowledge of a subject matter. Over 80 percent of surveyed teachers said that their interest and enthusiasm for teaching had increased greatly under the World Links program—and it is well known how important a motivated, enthusiastic teacher is for improving student outcomes. Teachers need support, examples of good practice, and leadership from their school principal to receive the necessary time for professional development, in order to truly transform teaching and learning in the classroom.

Lesson #9: Technology empowers girls

A small Muslim girl from Mauritania states, "We get our freedom from the Internet, since in our society girls are not allowed to go wherever we want…the Internet takes us out to other people, places and realities…it is our way of escaping from our closed society. It is vital to us, it gives us liberty."

Among international development practitioners, female education is recognized as one of the critical factors in promoting social and economic development. For instance, an educated woman is more productive at work—studies suggest that an extra year of schooling will increase a woman's future earnings by about 15 percent, compared to 11 percent for a man (UNICEF 1996). Also, because women are the primary caregivers in developing countries, it is often said that, "when you educate a woman, you educate a whole family." While 80 percent of girls attend primary school in Mauritania, the gross enrollment rates drop to only 11 percent at the secondary school level (World Bank 1998). In other developing countries, the statistics are worse. Educating girls, therefore, is a top development priority. A recent World Links study on the differential impact of the program on boys and girls showed that in areas such as academics and communication skills, girls have benefited more, while in the area of technological skills, boys have benefited more. Moreover, once online, girls appear to do extensive research on teen-related information that is often taboo in their cultures, such as sexually transmitted diseases, teen pregnancies, and AIDS and its prevention. Seventy percent of girls in World Links schools in Mauritania, for instance, emphasize the fact that the Internet provides freedom to them as women since they no longer need to limit themselves to the controlled information given by their society and family. A girl from Ghana states, "Our self-esteem has really improved because of the World Links program. Now we can rub shoulders with boys that want to step on our toes. We walk with our chests out! Anytime we are confronted with questions we feel confident answering, even with older people we come boldly!"

Lesson #10: Technology motivates students and energizes classrooms

When schools are connected to the Internet, teachers taught to rethink their teaching methods, and students empowered to use technology, the impact can be profound. Teachers quickly see how the use of computers energizes the students and makes the classroom a more interactive learning environment. In the SRI-World Links evaluation, two-thirds of teachers, for instance, reported that the World Links program had a "large or great impact" on students' attitudes toward schools. One teacher in Peru said, "I learned to break the routine of using the chalk and the blackboard. World Links forced me to make my classes more interesting, more tangible—students are more interested and attentive." Teachers have also reported that World Links has helped students develop confidence, a sense of responsibility, the ability to work as team members, think creatively for solutions, and share knowledge (Kozma 2000). In a focus group of teachers in the Palestine Authority, the greatest benefit of the use of computers and the World Links training was that it broke down the barriers between teachers and students in the classroom. As one Palestinian teacher stated, "There is now a more collegial environment and less hierarchy—students feel comfortable asking teachers questions and teachers are less intimidated to seek help from students." Many teachers, however, initially feel threatened by the loss of control in the classroom as students, who are usually more adept at using technology, can quickly access information and challenge the teacher's role as the sole font of information. Teachers who receive professional development, however, learn how to more effectively manage their classroom and use the technology to create a more stimulating learning environment. A student in Senegal noted that, "Our teachers, because of our participation in collaborative projects and Internet access, have to do a better job. They carefully prepare their lessons before coming to class. We challenge them; we are no longer passive receivers of information. We analyze and question things."

Conclusion

While limited in scope because of the fact that it is a pilot, World Links has, in five years, shown the effect that a carefully thought-out, integrated approach to introducing computers and the Internet into learning environments in developing countries can have on teaching and learning. In countries where learning resources are limited and teachers never dream of having a fully stocked library, let alone the Internet, teachers and students have been introduced to a new world of learning. As a result, those participating in the pilot have been greatly empowered, and now believe they can compete in a global knowledge-based economy because they know that their knowledge, ideas, culture, and passions are as valuable as any in the world. In order to more effectively prepare its youth to participate in this Networked World, greater commitments and willingness to share and adopt innovative solutions are needed from all aspects of society—from governments, the private sector, communities, donors, parents, and students. Schools should be transformed into active learning environments open to their communities; telecommunication and power infrastructure policies should focus on schools as starting points for rural transformation; teachers and students must be empowered to be creative agents for change in their schools; and leaders must embrace a vision that will prepare their youth for tomorrow's challenges.

While the world has fundamentally changed over the past hundred years and will continue to do so at an accelerating pace, the classroom has not. But it will, soon. The issues outlined in this paper are not unique to developing countries. Schools around the world face the same challenges and by and large the same lessons apply. It is time to collectively change our approach to the learning process, and particularly, take advantage of the power of technology to improve learning outcomes, enhance economic opportunities, foster greater creativity, and realize the dreams of disadvantaged youth in developing countries. If together we can begin this transformation, schools a hundred years from now will sit at the heart of a learning society and allow youth from any country in the world—rich or poor—to have the same opportunities to create a better world.

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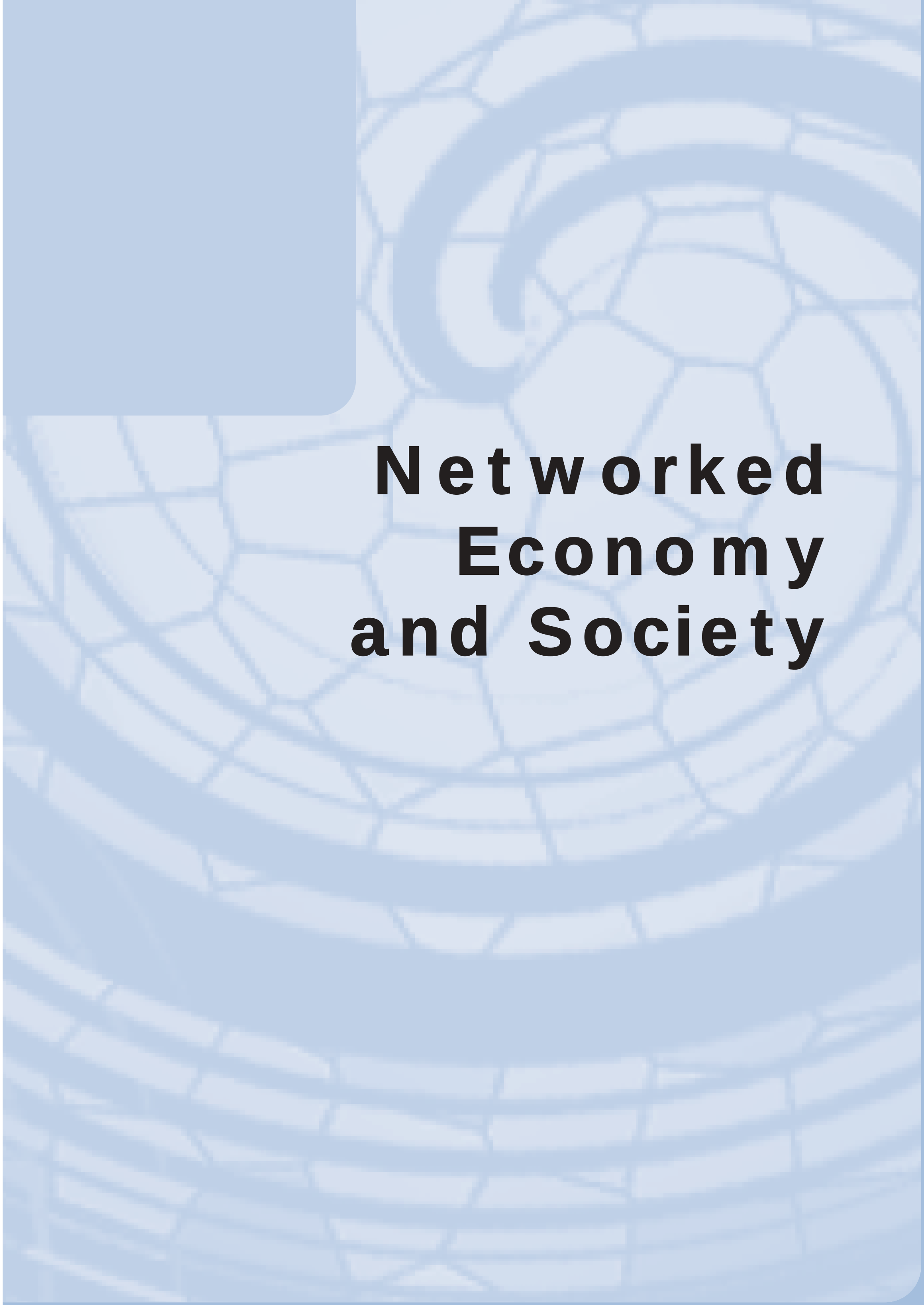
Endnotes

1 The twenty-one World Links countries include Botswana, Brazil, Burkina Faso, Chile, Colombia, Costa Rica, El Salvador, the Gambia, Ghana, India, Mauritania, Mozambique, Palestine Authority, Paraguay, Peru, Senegal, South Africa, Sri Lanka, Turkey, Uganda, and Zimbabwe; the program is in a preparatory phase in Cambodia, Jordan, Indonesia, Laos, the Philippines, and Vietnam.



Networked Economy and Society

CHAPTER 5

The X Internet: Leveling the Playing Field for Businesses in Developing Nations

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Abstract

Businesses in developing countries have struggled to capitalize on the capabilities of the Internet to improve their performance and increase their global competitive advantage. But current Internet applications and services are deployed over the World Wide Web (Web), a communication platform that wasn't optimally designed for the limited communications capacity typical of emerging nations, or to provide the interactivity and real-world–awareness needed to support complex business-to-business (B2B) interactions.

But, things are about to change for the better. In this paper, we will explore the emergence of post-Web-era Internet technologies that we call X Internet*. With its executable and extended properties that both optimize limited telecommunications bandwidth and bridge the physical and virtual worlds, the budding X Internet holds a more promising value proposition for businesses in developing economies than did the Web at its origin. The promise of the X Internet is already being realized by early adopters in emerging markets who are using it to boost their product innovation capabilities, reduce operational costs, and sustain customer loyalty. Industry leaders and policymakers in developing nations must aggressively adopt the X Internet—or else miss this rare opportunity to boost their economies' Networked Readiness.*

The Unrealized Promise of the Internet

For decades, developing countries have viewed technology as a driver for economic growth and have instituted national policies and initiatives to boost the technology Readiness of their country. In the recent past, public policymakers in emerging economies have begun to view the Internet as a major catalyst for economic growth. But despite the abundance of spirited entrepreneurs and skilled workers in developing nations, infrastructure constraints have made Internet-driven gains slow to materialize. In this paper, we will explore how emerging Internet technologies, here called the X Internet, will finally offer businesses in developing nations a unique chance to circumvent infrastructure shortcomings and achieve global competitiveness.

The Internet has come a long way from its roots as a U.S. government-sponsored, communications research project. As the year 2001 dawned, the Internet hosted more than one hundred

Figure 1. **Unique Characteristics of X Internet Technologies**

	The Web	Executable Internet	Extended Internet
Number of Devices	Millions	Hundreds of millions	Billions
Focus	Browsers	User-focused software	Devices
Killer Applications	Websites for e-Commerce	Responsive user experiences	Real-time business applications
Data	HTML, XML	Executables and XML	Environmental data
Model	Server-centric	Peer-to-peer	Device-centric
Connections	User-driven	Opportunistic	Opportunistic
Time Frame	1993 to 2001	2001 onward	2003 onward

million computers and more than four hundred million users worldwide. The Internet today connects users and servers in every country in the world. Asia—which was late in catching the Internet wave—is poised to have 173 million Internet users by 2004.[1]

Since its birth thirty years ago, the Internet has been driven by evolutions of software—FTP, Gopher, WAIS, and, more recently, the World Wide Web. Each version replaced the previous, less-sophisticated one. But the Web is failing to keep up with the escalating expectations of business users, who are losing patience with its context-insensitive content and lack of interactivity. In developing countries such as India and Egypt that are telecommunications bandwidth-constrained, Web users experience inordinately long delays, further hampering their user experience.

Firms have come to rely more on their globally dispersed trading partners to help them improve their supply chain performance and customer service, but these firms have found Web-based technologies incapable of integrating them tightly enough with those partners. To meet the new realities of a Networked Economy, companies and their partners need more than a Web-anchored Internet—they need an Internet that can support rich real-time collaboration and close the information loop between the real world and so-called cyberspace.

The X Internet: A Boost for B2B Collaboration

To meet these needs, we expect scores of post-Web technologies to emerge and take hold in the next decade, paving the way for a more compelling Net; that is, the X Internet. Unlike today's Web-rooted Internet, the X Internet will be:

- **Executable.** The X Internet will exploit smart code such as Java and a distributed infrastructure to push the locus of business application execution closer to end-user devices; this will enable these devices to use self-describing data to talk back and forth with services in the network. Such an executable Internet will not only reduce latency and enhance online users' experience, but also greatly ease the integration of partners' information systems.
- **Extended.** The X Internet's reach will extend deep into the physical environment in which firms operate—a real world made up of billions of physical objects ranging from shop-floor equipment to pallets. The X Internet will exploit ever-cheaper sensors as well as smart tagging and tracing technologies to enable manufacturers to track every product they make from inception to phase-out.

Not only will the X Internet improve user experience, but also it will bridge the gap between the physical and online worlds, improving the way firms work with their suppliers and customers. (See Figure 1.)

For developing nations, a major appeal of the X Internet and, particularly, the executable Net, is its ability to optimize telecommunications bandwidth. Applications (apps) that are Web-rooted tend to *centralize* all the application processing logic on the server-side, forcing the client software (the "dumb" Web browser) to continuously "ping" the server to request the results of executed code. It is this incessant question-and-answer process between Web-based clients and server software that currently clogs the Internet. Executable apps, on the other hand, can be run using as little as 10 percent of the bandwidth capacity required to operate traditional Web-anchored apps. Why? Because with executable apps, the processing logic is *distributed* between the server and "smart" client devices, and these devices can execute code locally.[2] As a result, the communication between server and client doesn't need to be either continuous or permanent—a plus for many developing countries, where businesses typically access the Net via dial-up with 28.8 Kbps modems.

How does the X Internet work, concretely? Imagine the case of a toy manufacturer based in Thailand. X Internet technologies will expand the scope of online B2B interactions:

- *From passive data exchange to context-rich collaboration*. Today, faxes or flat Web pages are exchanged with the company's partners. But the X Internet allows the exchange of executables—software components that encapsulate app logic, data, and knowledge about the rules and constraints of the business.
- *From people-centric to any-to-any interactions*. Today, if an item that was ordered has not been received, the toy manufacturer must call the supplier to find out the status of the order. But with the X Internet, if the supplier's truck is stuck in traffic, the truck itself will notify the toy maker's shop floor systems and send an alert to the plant manager's cellular telephone.
- *From face-to-face negotiations to software-agent-based negotiations*. Today, many business decisions are negotiated with trading partners at a roundtable. But with the X Internet, the toy maker won't have to travel to meet, or even talk to its retail customers. Software agents—tiny executable apps that the toy maker can configure—will directly interface with agents of the retail customers to negotiate the terms of a promotion.
- *From decisions by hunch to decisions through real-time data*. With billions of sensors continually monitoring the location and status of all supply chain assets within its trading network the toy maker will have access to real-time data that can be analyzed and acted upon in an instant.
- *From islands of optimization to network optimization*. This is the most important point: it means that whereas today, firms optimize their operational decisions in isolation without considering the negative impact of their decisions on partner performance, real-time data provided by the X Internet will enable a manufacturer like the Thai toy maker to create a production plan that not only addresses the company's own needs, but also takes into account the constraints of its suppliers.

The Lead Established by X Internet's Early Adopters

While all of the advantages noted above won't be fully realized for another decade, some companies have already begun to experiment with, and are reaping the benefits of, X Internet technologies. These early-adopters aim to use the X Internet to get new products to market faster, more tightly integrate supply and demand, and better serve customers. Three examples can illustrate these efforts.

First, consider the impact the X Internet is already having on one company's ability to bring new products to market faster.

Studies show that 60 to 70 percent of product launches are delayed because of operational problems, which means that by the time a product gets to market, customers no longer want it. One particular industry where delayed product launches have been creating havoc is the apparel industry. It takes most apparel manufacturers more than six months to get a new product to retail stores. But fashion trends change very quickly, almost overnight. So, naturally, if you are an apparel manufacturer with long development cycles, you are exposed to competition from players who can get their products to market much faster. One such manufacturer is a Spanish company called Zara.

Unlike most apparel makers, Zara doesn't believe there are just four fashion seasons; Zara believes there can be as many fashion seasons as there are customer whims. Zara has connected all its point-of-sale systems to the Net, so it can track changes in customer needs in real-time. It also dispatches its marketing staff around the world to patrol public places for hot new trends and report them to Zara's designers using wireless Personal Digital Assistants (PDAs). Zara is so good at rapidly detecting shifts in fashion trends that it introduces new designs to its retail stores twice a week! The real secret behind Zara's success is its responsive supply network, most of which is located in remote rural areas of Southwestern Europe. Zara's Net-connected factories there can change the color of a skirt even the day before it gets shipped to Paris or London. Zara's high-tech supply network is so tightly integrated that new product ideas can go from concept to store in less than fifteen days. As Zara expands its retail empire beyond Europe, it plans to set up its high-tech factories in developing nations such as Mexico.

Next, look at how the X Internet can transform supply chain management, even in one of the stodgiest industries: construction. Today, the best delivery window a cement supplier like Lafarge or Apasco can promise its customers is three hours. But three hours won't cut it, because if the concrete arrives late, the construction site schedule is thrown out of whack and the customer isn't happy. To make things worse, cement concrete has less than a two-hour shelf life. So if a cement truck is stuck in traffic, the load is wasted and needs to be junked.

But if a cement manufacturer could somehow get the pulse of supply and demand in real-time, it could dramatically improve its delivery performance and beat the competition. That's exactly what a hundred-year-old Mexican company called Cemex is trying to do. Cemex uses a Global Positioning System (GPS) network to track the status and location of all its trucks in real-time. It also monitors, in real-time, traffic conditions, which are terrible in Mexico City. If one of its trucks is about to get stuck in a looming traffic jam, Cemex can dynamically change that truck's itinerary, either by rerouting the truckload or having it deliver to a much closer construction site.

By using extended Net technologies like GPS, Cemex has reduced its delivery time to an impressive twenty minutes—nine times faster than the industry average. GPS has helped Cemex improve its asset utilization, allowing it to trim its truck fleet by 35 percent. Overall, Cemex estimates that X Internet technologies are saving it US$100 million a year in operational costs.

Finally, examine how customer service will be greatly impacted by the X Internet, using the example of High Volume Air Conditioning (HVAC) manufacturers. HVAC manufacturers such as Carrier China maintain their industrial air-conditioning equipment on set schedules. But most equipment problems occur between scheduled maintenance visits. What happens, then, when a defective filter causes an HVAC installed in a Malaysian chip-making foundry to malfunction, overheating the clean-room and damaging its equipment? Panic ensues. In the semiconductor industry, equipment downtime can cost US$100,000 an hour in lost revenues. In today's world, Carrier China will zoom a technician to the customer site; the technician identifies the filter as the source of the problem and logs into Carrier's Web-based supplier Extranet to issue a rush order for replacement parts. Because there is no *context* associated with this Web order, the filter supplier has no way of finding out what actually *caused* the filter to fail in the first place. If the supplier doesn't have any extra inventory of filters, his system simply responds "Out-of-stock!" And the nightmare begins, because that's all that we get today with static, context-insensitive Web page exchanges.

Carrier USA and its sister divisions worldwide have embarked on a major project that will use extended Net technologies to connect all Carriers' products to the Internet (SOURCE 2001)[3] Here, then, is a plausible alternative to the above scenario for the year 2005: Carrier China now has embedded sensors in all critical parts of its HVACs so it can monitor their condition in real-time. A sensor at a chip foundry in Singapore detects a performance-related degradation in the filter. It alerts Carrier China's software agent, which in turn rapidly identifies the nearest source for replacement filters and dispatches a technician.

But here's the most compelling part: Carrier China's software agent also extracts the performance history of all filters, bundles it with the details of the Singaporean filter failure into one executable, and pushes the executable to the filter supplier. The supplier analyzes the data in it, and identifies a systemic problem with its filter design (maybe the filter wasn't designed to operate well at temperatures below 65°F/18°C). So the supplier immediately communicates a stopgap fix to customers such as Carrier China. The filter supplier also directs its Research & Development team to work with its material suppliers to reengineer the filter design. While the redesign is in progress, the supplier's software agents negotiate an appropriate delivery schedule for the improved filters with Carrier China's agents. The filter supplier is relieved because it avoids a huge liability; Carrier China is also happy because it reduces its field service costs and increases customer loyalty. Finally, the chipmaker is happy because the company won't have expensive downtime. That's how the X Internet can transform the way companies collaborate with their partners.

Industry Adoption of the X Internet: Phased Entries

Three examples of smart firms that are already using the X Internet to boost their performance significantly and beat the competition have been explored. Notice that two of these firms are located in developing countries. During the Web-defined Internet era, developed nations—with their massively scaled telecommunications infrastructures—established an initial lead over developing nations that were constrained by a paucity of bandwidth. But X Internet de-emphasizes bandwidth capacity as the prerequisite for reaping the benefits of a Networked Economy. Consequently, the X Internet offers a more level playing field to companies in developing nations that want to improve their global competitiveness.

If the X Internet holds the promise of leveling the playing field, does that mean all industries will rush to adopt the X Internet simultaneously? No; some industries will be more predisposed to adopt X Internet technologies than others. We have identified two major factors that we believe will determine the pace of adoption of X Internet technologies across different industries.

The first factor is industry readiness, which evaluates an industry's:

Value chain simplicity. High-scoring industries are those with simple supply chains (e.g., financial services); these will benefit more rapidly from adopting X Internet's connectivity technologies than industries (e.g., the aerospace industry) that have complex value chains.

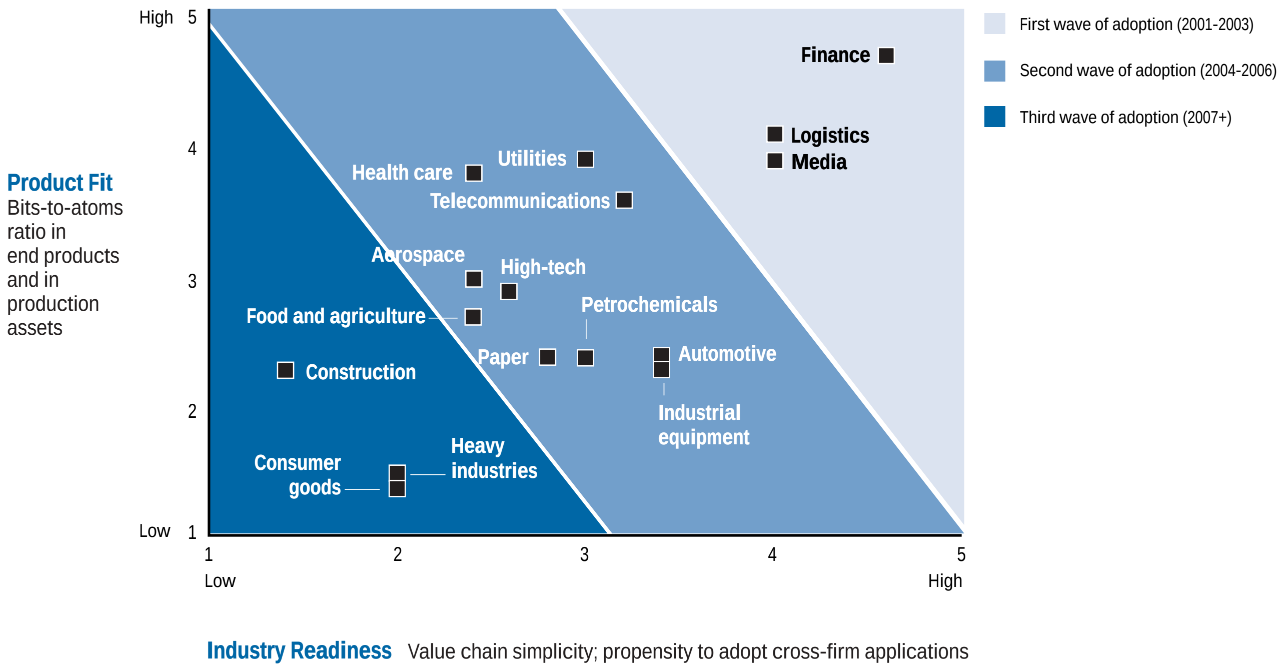
Propensity to adopt cross-firm business apps. Certain industries, such as consumer goods, are more conservative investors in business apps that improve B2B e-commerce collaboration than, say, industries in the high-tech sector.

The second factor is product fit, which evaluates an industry's:

Bits-to-atoms ratio in end products. Industries, such as construction, in which a lot of physical objects are made and moved will need more time to fix sensors to all their end products cost effectively. But this is not a problem for the media industry, because that industry mainly produces and delivers intangible products.

Intangibility of supply chain assets. Heavy industries that use a lot of capital assets to make and deliver their products will need more time to connect their huge physical asset base to the Net than industries, such as finance, that use very few tangible supply chain assets.

Figure 2. **Mainstream Adoption of the X Internet Across Industries**



Having ranked each industry across these two dimensions—industry readiness and product fit—we predict that the mainstream adoption of the X Internet will proceed in three waves. (See Figure 2.)

Wave 1. The first wave, which is only just beginning, will be led by service industries such as finance, and will include logistics and media; these industries will rapidly repackage their intangible products into executables.

Wave 2. The second wave will start in 2004 and be led by the utility and telecommunications industries which, despite owning physical assets, make and move intangible products. They will be followed rapidly by other industries such as health care (where medical equipment needs to be up-and-running all the time) and automotive (which is driven by telematics).

Wave 3. The third wave will begin in 2007 includes the construction and consumer goods industries—these industries have a conservative attitude towards B2B apps, and it will take them longer to connect their huge physical asset base to the Net.

Note that nothing will prevent a forward-looking firm in a late-adopting industry to begin exploring X Internet *today*—as was seen in our example of construction materials supplier Cemex. However, the majority of X Internet early adopters will belong to first-wave industries.

The X Internet: Leveling the Playing Field for Developing Nations

What's the macroeconomic significance of these staggered industry adoption patterns for developing countries? First, they mean that a developing nation, such as India, whose government expects to derive US$50 billion in revenues from IT-enabled services, must encourage its service industries to catch the first wave of X Internet adoption or else lose out to nimbler rivals.[4] Second, developing nations, such as China and Brazil, that have a huge manufacturing supply base should proactively upgrade their IT infrastructure to support the X Internet, so that by the time their slower-moving business customers catch the wave they are "all dressed and ready for the ball"; this is exactly what Cemex is doing. By aggressively deploying X Internet technologies like GPS, Cemex is preparing for a leadership position in the construction materials industry, which is unlikely to begin embracing the X Internet until at least 2006.

Historically, developing nations have adopted a wait-and-see attitude when new technologies arrive on the scene—learning from the mistakes of early adopters in Western countries while still being competitive when they later join the game. But with the X Internet, this reactive attitude has to go, because there will be no winner's curse for late adopters to exploit. Why not? Customers of early X Internet adopters will be so highly satisfied that they won't even give a second look to offerings of late-adopting competitors. For instance, Carrier China is connecting all its HVACs to the Net—soon it can guarantee its customers a 99.99 percent equipment uptime. When a Chinese customer gets that kind of service level, he will have few incentives to switch to a Carrier competitor like York International or LG Electronics.

The Beginning: How to Get Started with the X Internet

What characteristics should businesses in developing nations cultivate if they want to win in the X Internet era? The X Internet will favor firms that are:

(1) *Decentralization-minded*. Firms with a centralized decision-making structure will fail to fully exploit the sense-and-respond capabilities of the X Internet. X Internet technologies such as intelligent agent software will better fit companies that are more willing to distribute decision-making rights and push the locus of decision making to the edges of their organization.

(2) *Cooperative*. X Internet technologies do simplify partner integration, but if a company isn't willing to share data in the first place, it won't make the best use of those integration services. Cooperative-minded firms will.

(3) *Willing to look over the horizon*. Some X Internet investments, such as the Polish Ministry for Internal Affairs' investment in adisoft's executable app, can yield quick Return On Investment (ROI), but other investments, for instance, putting sensors in all physical assets in a supply chain, take longer to yield results. So when EAN International (a trading consortium including developing nations) invests in X Internet projects such as the Auto-ID Center (www.autoidcenter.org)—a firm that plans to tag every single physical object in the consumer goods supply chain with smart tags—EAN's members aren't looking for quick hits; they are in for the long run. That is an important attribute of X Internet winners.

What actions should CEOs in developing nations take now in order to get their organization ready for the X Internet? Firms (in the categories noted) should take the following preliminary steps:

- Service firms (e.g., a financial service company) should exploit Net-resident partner integration services to connect more rapidly with all trading partners, rather than hardwire connections to partners' systems one-by-one. For instance, investment banks such as South Africa's Investec, should tap emerging technologies such as Web services to improve collaboration with all its clients.[5]
- Manufacturers should first gain visibility into their own shop floor before trying to gain visibility into their suppliers' shop floors. (Solution providers such as GE Cisco Industrial Networks—a joint-venture firm that connects legacy factory-floor systems to the Internet—are able to help in this regard.) Later, as the costs of extended Net technologies (such as sensors) drop, manufacturers can begin deploying them to obtain real-time visibility into their extended supply chain. (See Box 1 for an indication of the plummeting costs of X Internet technologies.)

Box 1: Plummeting Costs, Accelerating Adoption Rates of X Internet Technologies in Developing Nations

Operators of manufacturing networks in developing nations may be pondering the costs associated with tagging and tracing physical supply chain assets with extended Internet technologies such as sensors. Indeed, Radio Frequency Identification (RFID) tags—tiny programmable chips that can electronically relay information about the identity and location of the physical objects that they are attached to—today cost about US$1 per tag.

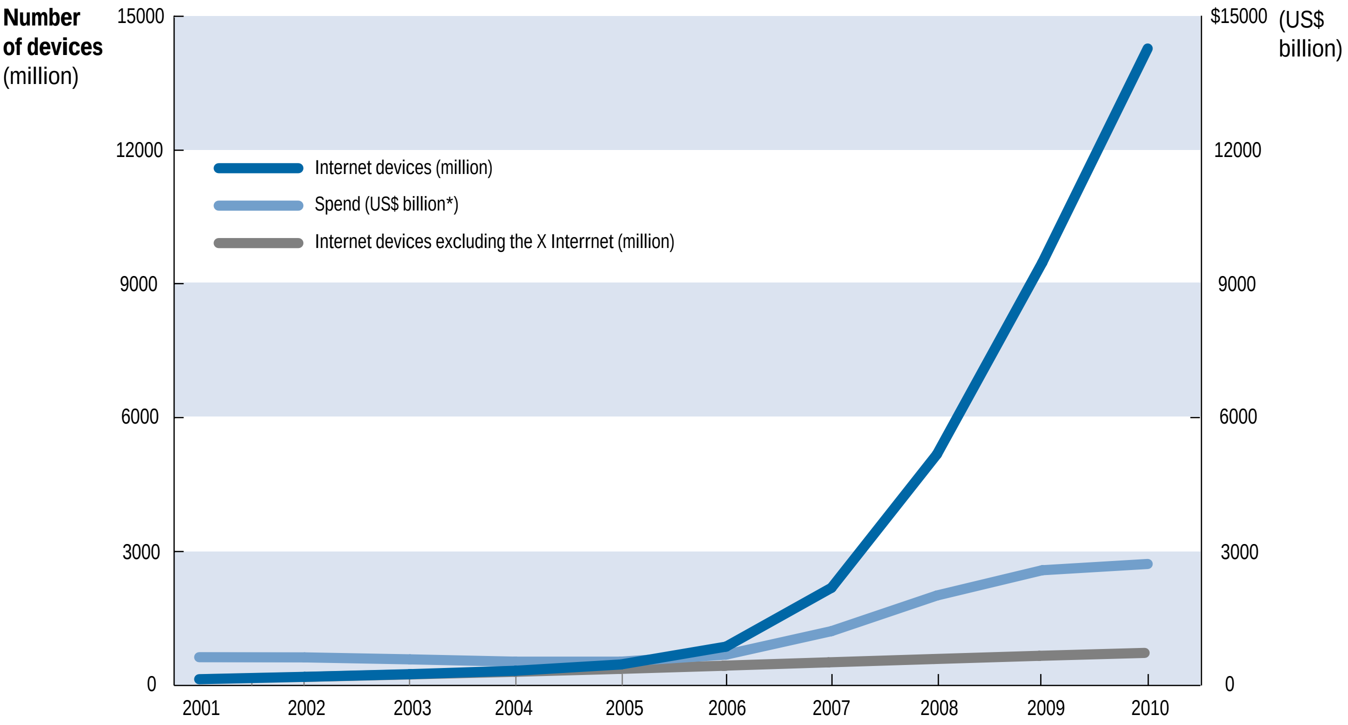
But several major initiatives are underway that will significantly reduce the cost of these RFID tags. For instance, the Auto-ID Center at MIT—sponsored by a veritable who's who of the global consumer goods industry—is working with chipmaker Alien Technology to market a new generation of RFID tags in 2002; these tags will cost as little as US$0.03 per unit. Further, collecting information from these ever-cheaper sensors won't require a US$19.95 per month wire from the phone company. Instead, data will be collected via wireless Ethernet links or will piggyback on existing connections such as power lines and cellular links. Companies such as Cambridge Silicon Radio make chips that use both Ethernet and Bluetooth wireless protocols, both of which are increasingly prevalent in many emerging markets, such as China.

Manufacturers, consumers, and service providers currently spend more than US$4,000 per year for each computer on the Internet. But with the opportunities afforded by X Internet's cheap connectivity and increasingly inexpensive telecommunications hardware equipment such as optical switches, we expect that figure to drop to slightly less than US$200 per year by 2010. The extended Internet will push applications to ever-cheaper embedded chips and increase the Internet population by billions of nodes. As a result, we predict that the X Internet market will boom to 14 billion devices (ranging from Internet-ready computers and cellular phones to RFID tagged cargo containers and GPS enabled trucks) worldwide by 2010, but with the unrelenting cost pressure on every device and connection, the boom will feel like a never-ending price war to providers. The result? Today's US$600 billion Internet devices and services market will grow to more than US$2.7 trillion worldwide by 2010. (See Figure 3.)

- Retailers must upgrade all legacy point-of-sale (POS) systems and connect them to the Net, as opposed to treating POS systems like black boxes. By doing this, retailers will be able to feed their suppliers with real-time sales data. This is exactly what CK Tang Department Store in Malaysia has already done, using Fujitsu's TeamPOS.

What actions should policymakers in emerging nations be taking to prepare their countries for the era of X Internet? First of all, they should immediately augment their countries'

Figure 3. **Forecast for Worldwide Internet Devices and Spending, 2001 to 2010**



Internet devices (million)	140	193	253	329	470	870	2,188	5,177	9,472	14,266
Internet devices excluding the X Interrnet (million)	139	191	247	306	372	443	518	592	664	729
Spend (US$ billion*)	$633	$629	$585	$533	$533	$691	$1,217	$2,015	$2,581	$2,721
Spend per node (US$)	$4,531	$3,262	$2,316	$1,621	$1,135	$794	$556	$389	$273	$191

*1 billion = 1,000,000,000

telecommunications infrastructure—or lose, in a big way. Countries that aspire to become regional manufacturing hubs exporting globally-competitive products, such as India and Poland, should lay the telecommunication foundation necessary for local manufacturers to track their sensor-enabled supply chain assets countrywide. Developing countries also need to make more of an effort to liberalize their local telecommunications market. Attempts, so far, have unfortunately been akin to a tango performance: one-step forward, two-steps backward—as in the case of Sankhya Vahini, a significant Carnegie Mellon University-sponsored telecommunications upgrade project that the Indian government initially endorsed, only to later abandon.[6] Policymakers in developing nations must relinquish such ambivalent attitudes if they are to attract the substantial foreign capital and know-how so critical to upgrading their countries' Internet infrastructure.

To summarize, the Web has failed to be revenue generating for businesses in developing nations for two reasons. First, the bandwidth-consuming properties of Web-rooted apps and services are not best utilized with emerging nations' limited telecommunications capacity. Second, Web-anchored apps and services were neither interactive nor real-world–aware enough for sophisticated B2B interactions. But, the X Internet (with its executable and extended properties), offers much more promise of value to businesses than did the Web at its inception. Pioneering firms that are already using the X Internet are reaping the benefits of improved time-to-market, reduced supply chain costs, and enhanced customer satisfaction. Businesses and policymakers in developing nations must embrace the X Internet, or miss this exceptional opportunity to boost their economies' Networked Readiness.

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Endnotes

1 Julia Scheeres, “The Emerging Net Giant,” <http://www.wired.com/new/business/0,1367,41717,00.html> (8 January 2002).

2 Executable applications that are downloaded to the client device can be as tiny as 15 Kilobytes—the size of a graphic file. The client device—PC or mobile telephone—will execute these downloaded, tiny software components using a locally installed run-time execution environment.

3 On April 9, 2001, Carrier announced its partnership with IBM Corporation. The partnership will allow Carrier to provide its HVAC customers with remote control and monitoring services. A press release on this announcement is available at <http://test.carrier-commercial.com/NAO_COM_PRESSRELEASE/pressrelease.htm?OUT_FILE=nao_rld113.html>.

4 The Indian government’s ninth quinquennial plan (1997 to 2002) stipulates policy incentives that will help increase the Indian software exports market to US$50 billion in 2008. See Chapter 7 in “India 2000”—an online reference publication from the Indian Embassy in the U.S. <http://www.indianembassy.org/indiainfo/india_2000/chapters/chp07.pdf>.

5 We define Web services as “software designed to be used by other software via Internet protocols and formats.” Web services will enable three kinds of links: private application integration within the firm, partner integration to known business partners, and public Web services to new parties.

6 In October 1998, the Indian government signed a Memorandum of Understanding with U.S.-based Carnegie Mellon University to deploy a nationwide high bandwidth data network named “Sankhya Vahini.” But in October 2001, Carnegie Mellon pulled out of the project, citing inaction and red tape on the part of the Indian government.

CHAPTER 6

The Importance of Organizational Leadership for Creating Technology Excellence

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Critical for Business Competitiveness

In today's world, Information Technology (IT) forms the backbone of industries such as banking, airlines, and publishing, and is an increasingly important value-adding component of consumer products such as television sets, cameras, cars, and mobile telephones. IT is the dominant force enabling companies to exploit new distribution channels, create new products, and deliver differentiated value-added services to customers. In reality, there is often little difference between an organization's IT strategy and its business strategy.

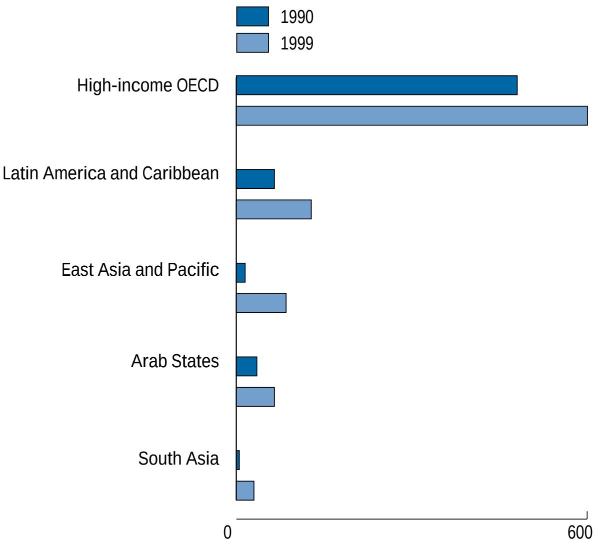
IT is critical for innovation and business competitiveness. James Brian Quinn et al. (1996) note: "A revolution is now underway. Most innovation occurs first in software. And software is the primary element in all aspects of innovation from basic research through product introduction." Even from a broader perspective, technology is today an important factor in economic growth and development of countries. In the *Global Competitiveness Report 2001–2002,* John McArthur and Jeffrey Sachs (2001) note that improvements in technological innovation (i.e., creating a new technology) and diffusion (adapting and adopting a new technology) play a central role in the economic growth of nations.

It is therefore not surprising to note that the global volume of IT services is growing at an astonishing rate. According to the International Data Corporation, global spending on IT services will grow from US$439 billion in 2001 to US$700.3 billion by 2005. The United States will lead all other nations in this category, spending US$335 billion in 2005, up from US$206.9 billion in 2001. Western Europe will spend US$192.4 billion in 2005, up from US$127.5 billion in 2001. Meanwhile, spending in Japan will grow from US$53.2 billion to US$75.2 billion.

Leadership in Technology: An Important Challenge

The Human Development Report 2001 published by the United Nations Development Program introduced a new index, the technology achievement index (TAI). There are other measures for national technological progress in the literature. Other sections of this report elaborate on the Networked Readiness Index. *The Global Competitiveness Report 2001–2002* has created indexes to measure technology development. Regardless of which index or measure is used, one fact stands out: there are large differences in the scores achieved by the richer, more developed nations and the poorer, developing nations. The gaps exist along virtually all dimensions used to construct the various indexes.

Figure 1: **Telephone Mainlines per 1,000 People**



Source: United Nations Development Program, International Telecommunication Union and the World Bank

Despite a high level of governmental awareness and previously formulated policy changes, the diffusion of technologies has proven to be painfully slow. Figure 1 depicts the progress in global telephone mainline penetration over the 1990s. At the current rate of progress, it will take South Asia more than two decades to reach levels comparable to those achieved by high-income countries. Though there are a few examples of successful, rapid penetration of new technologies such as mobile telephones in developing regions, the gaps between the developed and developing nations along key measures of technological progress are increasing, not decreasing.

The picture is grim for developing nations with respect to technological innovation and diffusion. If IT is critical for innovation and business competitiveness, it raises a fundamental question: Will firms from developing nations ever become capable of creating and sustaining the technological excellence necessary for global leadership? Or are they doomed to be followers of technological innovations created elsewhere and be trapped by a persistent competitive disadvantage?

The answers to these questions are not easy. Developing nations face many handicaps, such as lower levels of education and technology penetration and higher levels of poverty, as they attempt to compete with the more developed nations on the technology frontier. The battle is uphill right from the start. The situation may appear hopeless, but there is reason for hope.

Many developing nations are adopting a cluster strategy—that is, investing in local clusters of high technology start-ups and related educational and service institutions—and passing a set of favorable policy reforms to attract capital and talent to these clusters. A good example of such a cluster is the Multimedia Super Corridor in Malaysia. Other examples of successful clusters are the software companies in Bangalore and Hyderabad, both in India.

There is also concrete evidence that firms in developing nations can demonstrate business leadership when enabled by technology excellence. Technology itself may not provide the solution; rather, the answer may lie in the organizational context in which the technology is deployed. This paper attempts to provide some perspective on this issue by focusing on two specific examples: Motorola's software subsidiary in India and CEMEX in Mexico.

The Difficulty of Software Excellence

Developing competence in software in not easy. In addition to the ubiquitous nature of software, the amount of software code in most consumer products and systems doubles every two to three years. This increase is being driven both by escalating demands placed on the functionality of software systems and the rapid pace of progress in the enabling hardware technology. Consequently, software developers are scrambling to cope with the pressures of developing systems that are not only a couple of orders of magnitude larger and more complex than those developed a few years ago, but also need to meet ever-increasing demands for higher quality and superior performance.

Stories of the dramatic time and cost overruns of software projects are legendary in the software sector. Industry observers (Gibbs 1994) note that for every six new large-scale software systems put into operation two others are cancelled, and that the average software project overshoots its schedule by half. The industry benchmark for measuring software performance is the Capability Maturity Model (CMM 2001), developed by the Software Engineering Institute at Carnegie Mellon University, Pittsburgh in the late 1980s. The Capability Maturity Model (CMM) classifies the software capability of organizations into five levels, with level 1 being the lowest (software processes are ad-hoc and chaotic) and level 5 the highest (software processes are capable of self-improvement and incorporate the highest levels of quality).

The CMM model is widely used to assess software excellence by firms in all countries, both developed and developing. About 65 percent of all corporations worldwide are estimated to be at level 1. This means that the vast majority of software projects in these firms either fail or miss their cost, time, and quality targets by wide margins. As of 2001, only about fifty organizations worldwide have software processes rated at level 5. An organization at level 5 is not only able to deliver high-quality software projects consistently on time and within budget, but also able to predict the number of software bugs at different stages of the process and take action before the bugs actually appear (much like preventive maintenance in manufacturing).

A Success Story in India

India does not rank very high on most indexes measuring technological progress. For example, in the Networked Readiness Index, India is ranked at fifty-four out of a total of seventy-five ranked nations. Despite its low overall position in most rankings, the Indian software industry is widely recognized as a success story—the industry is one of the few bright spots in India's economy, with local companies competing successfully with other global players. Both local political leaders such as Prime Minister Atal Behari Vajpayee ("IT is India's tomorrow" [Ghemawat 2000]) and global software luminaries such as Bill Gates ("India is likely to be the next software superpower" [Guha 1998]) have attested to the promise of the Indian software industry.

According to industry estimates Indian software services as a percentage of global software services will more than triple from 1.6 percent in 1999 to around 5.4 percent in 2004. Data released from the 2001 annual industry survey of the National Association of Software and Service Companies (www.nasscom.org) show that Indian software exports in the period 2000 to 2001 grossed revenues of US$6.2 billion and registered a growth rate 55 percent greater than the 1999 to 2000 performance. Between 2000 and 2001, Indian software exports accounted for an impressive 14 percent of the country's total exports.

Indian software competence is not just a success in terms of total volumes. More important, it is a success in terms of quality and technical excellence. During 2001, the number of quality-certified software companies from India increased to over two hundred fifty; twenty-seven Indian companies now have the unique distinction of a CMM level 5 certification. This is the highest number from any one country in the world. One of the first companies in the world to attain level 5 certification was also an Indian company—the subsidiary of Motorola in Bangalore, India.

The success of Indian software companies is no small achievement. Software is critical for business competitiveness, and competence in software continues to elude firms in much of the developed world. As stated earlier, about 65 percent of firms worldwide have software processes with the lowest level of CMM maturity. The U.S. Internal Revenue Service (Johnston 1997) has conceded that despite having spent US$4 billion developing modern computer systems, the systems "do not work in the real world." Even organizations with a history of high IT achievement are not immune from such crises. American Airlines, for example, built its reputation of IT excellence during the 1980s on the back of its famous SABRE airline reservation system, but subsequently suffered major disasters while attempting to build the CONFIRM reservation system for hotel and car rental companies such as Hilton and Budget.

A Favorable Context

For a long time, the growth of the Indian software industry was retarded by nonsupportive government regulations. Pankaj Ghemawat et al. (2000) from the Harvard Business School describe it as follows: "The growth of the Indian software industry was held back by the slow rate of computerization; the Indian government was concerned that computers might threaten job creation. Furthermore, official policy stressed an import-substitution approach: the hardware and software deployed domestically was to be developed indigenously, with imports of computers and technology allowed only when strictly necessary. Until the mid-1980s, hardware importers had to be willing to pay tariffs as high as 350 percent and wait as long as four years for import clearances. And software imports were simply banned."

The challenges faced by the Indian IT sector were mirrored in most other aspects of the economy. Restrictive state controls on virtually all aspects of import, export, and foreign ownership were the norm. A wave of nationalization of critical industries in the mid-1970s forced global companies such as IBM and Coca-Cola out of the country. Sparked by economic crisis, the government of India embarked on the first serious attempt at economic reform at the start of the 1990s. A deliberate shift was made in government policy to favor private sector initiatives. Significant changes took place in the product and capital markets. For example, industrial licensing was abolished for most sectors, thus allowing operations to evolve more flexibly. Foreign ownership of firms in India was facilitated and firms were allowed to raise debt and equity in global capital markets.

Although the software industry in India was traditionally subject to fewer controls than other sectors, the changes in the overall macroeconomic climate proved to be a big boon. Successive Indian governments, prodded by local entrepreneurs and the growing numbers of Indian software experts abroad, acted to initiate several software sector-specific reforms. These reforms included investments in new telecommunications infrastructure support and the stimulation of IT use in both public and private services. Various state governments also stepped in with initiatives to create high-tech clusters by attracting leading global and national IT firms. The clusters around Hyderabad and Bangalore in the states of Andhra Pradesh and Karnataka, respectively, are the most notable successes in this regard.

A generally favorable regulatory environment coupled with an abundance of well-trained computing graduates may have helped the establishment of several low-cost software body shops, but these factors do not explain why some Indian software firms have been able to position themselves at the world's pinnacle of software excellence. It is necessary to look in depth at one such firm to understand the drivers critical to this success.

Motorola in India: Pioneering Excellence

Motorola's experience with offshore software development in India provides a unique perspective into how a world-class center of excellence can be created in a developing nation. Bucking the usual trend, Motorola has for over a decade assigned a unique strategic responsibility to its software development center in India. It has invested in developing the center's competence and given it some of the most challenging and mission-critical projects within the entire corporation.

The payoff has been significant. Started as a Greenfield site in 1991, Motorola India Electronics Limited (MIEL) stunned the software world by achieving in 1993 the highest possible CMM software process maturity rating of level 5 nearly two years ahead of schedule. By the mid-1990s MIEL was widely recognized for being one of only two organizations worldwide with software processes certified at CMM Level 5 maturity. Given the criticality of software for Motorola's business success, the achievements of MIEL have not gone unnoticed within the corporation: in 1994 MIEL became the first software unit to receive Motorola's Chief Executive Officer's Quality Award.

An ambitious Greenfield

Around the late 1980s, there was recognition by many in Motorola that software was going to be a big part of the future. At that time, the state of the art in software development was poor in terms of quality, cycle-time and customer satisfaction. Also, there was an urgent need to fill the estimated annual shortfall of 5,000 staff years of software skills within the corporation. So the decision was made to set up a Greenfield site outside the U.S.

When it came to putting a Greenfield together, the Motorola Software Engineering Steering Committee adopted a "clean sheet" approach. Certain questions were repeatedly asked: "How should we attack the (software) issues? How can we do it right? If we had a clean sheet, how would we do it? The discussions led to a decision to build a process-oriented entity somewhere outside the core Motorola organization with a high degree of management commitment and adequate resources.

An ambitious goal was set for the Greenfield: to start at CMM Level 3 from day one and to reach CMM Level 5 within four years. It was a daunting goal—no one else had attempted it before. Some software professionals doubted whether it was ever going to be possible to achieve level 5.

A razor-sharp focus on disciplined execution

A phased development approach with parallel development and test is standard in MIEL. Each phase is managed explicitly and rigorously by a series of quality audits, built-in causal analyses, and feedback mechanisms. Deliberate focus is placed on the extensive use of metrics. Each project team has a Software Quality Manager who is responsible for auditing adherence to key processes, helping the team in applying different quality tools, and ensuring the transfer of operational project metrics to the quality department.

The quality department is responsible for maintaining data for all MIEL projects along with other industry benchmark data. These data are utilized by project teams for making estimations for different aspects of the process such as productivity, quality, and number of defects. There is a constant focus on the adoption of rigorous management techniques during every phase of each project.

Building employee excellence

The initial team members were chosen very carefully, both in terms of skills and attitudes towards experimenting with new approaches. As additional employees were hired, MIEL followed one hard-and-fast principle: all engineers had to go through a mandatory six-week Induction Training Program (ITP) in batches of about twenty to twenty-five employees. This was seen as critical for getting all employees acquainted with MIEL's unique approach to software development and to create a common language among all employees.

Sarala Ravishankar, the quality manager of MIEL, commented on the role played by the ITP: "I would say the ITP is more a culture building exercise rather than a technical skills communication program. Techniques are taught to people, but more importantly we stress why we are doing what we are doing. As you start getting people to think about this, you create a fundamental belief in some of our systems" (Dutta and van Wassenhove 2000).

MIEL has an excellent reputation as an employer of choice among the top Indian technical universities and thus has little difficulty hiring the best talent. About 35 percent of all employees each year are fresh postgraduates from these colleges. To further nurture links with top universities, MIEL has invested substantial time and money in a University Relations Program, which sponsors university research, funds prizes for top students, cultivates links with professors, and invites students for internships.

A learning culture

Learning and sharing of knowledge play a key role within MIEL. Information about the performance of project teams is public and available to all. Project reviews are frequent and open to all. They serve as a forum, enabling everyone to constructively review and evaluate the experiences of a project team. Common problems are identified in these meetings and suggestions for improvements are given by all present. A manager characterizes it as a "common, practical learning environment, not just a theoretical process." The culture is seen to nurture creativity and openness.

Employees from different functional areas of the organization are brought together in a number of ways. An annual event is held to highlight best practices in different key process areas.

Special emphasis is put on learning from failures. Sarala Ravishankar explained, "We have had several failures. In fact I think that failure is good for the organization because that's the best and fastest way of communicating learning to the organization. If we fail in one project, we look at what are the reasons which really caused that failure. And we have a system in place which analyses those failures and spreads the learning across the organization" (Dutta and van Wassenhove 2000).

Global leadership

MIEL has established the benchmark of software excellence within Motorola's global corporation. Mohan Kumar, the managing director of MIEL, noted, "We have been successful to the point that we produce software for about one-sixth of Motorola's products by revenue. This organization is in the critical path of developments. We're core to the success of the business." Motorola groups from across the world look to MIEL for critical advice on product leadership. Roger Fordham, a former managing director of MIEL, described it thus in 1999, "We have gone through three generations in our relationships with customers. Stage 1—what do you want? You say 'I want it green, five by seven by three, and it's got to have this density.' We'll do that for you. As you evolve you come back and the customer says to you 'you know a bit more about my business now. Why don't you tell me what you think we should do?' And we have a mutual goal-setting activity. And today, we've moved on to a third generation, in which the customer is saying 'everything there is to know is known by you—so don't come to me asking me what to do. You'd better be telling me what to do.' And this is exactly what we're doing. We're telling the customer what…should be done next" (Dutta and van Wassenhove 2000).

Motorola has leveraged its success in India by starting a string of software centers in developing nations in Asia and Eastern Europe, all closely modeled on MIEL. Personnel transferred from MIEL, who bring with them valuable best-practice knowledge, have seeded these new software centers. Software has become a core competence of Motorola, thanks to MIEL.

Let us now turn to another developing country in a different part of the world: Mexico.

Mexico: Another Success Story

Mexico ranks higher than India on most measures and indexes. For example, in the Networked Readiness Index, Mexico is ranked at forty-four, compared with India's position of fifty-four (out of a total of seventy-five ranked nations). The higher rankings of Mexico are primarily due to a higher success rate in the diffusion of old and new technologies. However, if one looks at the detailed figures for technology innovation and diffusion for Mexico, it is difficult to find fertile substrate for the birth of world-class technology excellence. Unlike India, Mexico does not have a reputation for either producing top-notch computing graduates by the thousands (even though it has several excellent universities) or playing host to a booming local software industry. Despite these shortcomings, Mexico is home to CEMEX—its preeminent multinational company, a global industry leader that is also a pioneer in the application of IT and the Internet for business innovation.

CEMEX is the third largest cement company in the world and operates in four continents. While many would be hard pressed to name the two biggest cement companies in the world (France's Lafarge and Switzerland's Hocim), CEMEX has become a familiar name for most executives because in terms of profitability, CEMEX surpasses its larger competitors (in terms of cash flow-to-sales ratio). By 2000, CEMEX had achieved a ten-year EBITDA growth of 20 percent—an impressive achievement indeed. In a March 2001 article entitled "Mexico: CEMEX's stratospheric rise," *Latinfinance* had this to say: "CEMEX is the emerging market company that graduated to the big league. In just over a decade, a family run business from Mexico's north-eastern industrial capital, Monterrey, has transformed itself into a world class multinational giant" (Piggott 2001).

The critical success factors for CEMEX's rapid growth are relatively few and simple. In fact, they revolve around two concepts: market diversification and technological innovation. CEMEX has conclusively demonstrated its ability to thrive in some of the most demanding and dynamic market environments around the world—both in developed (such as the U.S.) and developing (such as countries in Latin America and Asia) nations. Central to its success in various markets has been its wholehearted embrace of new technologies. It has set the pace of technological innovation in the industry worldwide and transformed itself into an agile company that is both more efficient and more innovative in its business practices than its global competitors. Over the past decade, CEMEX has been transforming itself into an e-corporation that has earned it a place in the business media next to technology leaders such as Cisco and Dell.

CEMEX: Building an E-corporation

A top business priority

"Mexico and cement might seem to be the most unlikely combination to produce an agile, efficient, e-business pioneer. Yet CEMEX is just such a company" (Economist 2001). The annual report (2000) of CEMEX states it very explicitly—IT and e-business are among the company's top priorities:

> "The construction industry is ripe for a digital makeover, and CEMEX is leading the way, transforming itself from a conventional to a digital enterprise. CEMEX has long used information technology (IT) to streamline its operations, provide value-added customer services, and generate value for its stakeholders.

> To ensure that all its people and processes have access to the full power of the Internet, as well as the skills, tools, and networks to use that power, CEMEX is "e-enabling" every aspect of its business. **E-enabling is a top priority** [emphasis added]."

CEMEX's chief executive officer, Lorenzo Zambrano, is a firm believer in the power of IT to create business value. One of his first tasks after becoming CEO in 1985 was to create an IT department, something that CEMEX had never had. Under his leadership, IT has become core to the firm's business strategy.

Relentless focus on business value

In the first half of the 1980s, CEMEX's operations were much like what would be expected from a cement company—multiple autonomous plants, poor communication and coordination across plants, lack of real-time performance reports, frequent disruptions in mixing plant and delivery truck scheduling, and chaos caused by late customer order changes. CEO Zambrano made it a business priority to change all of that.

Extensive benchmarking was conducted with other leaders in sophisticated production and delivery methods—FedEx, Exxon and Houston's 911 emergency team—and investment was ramped up in basic infrastructure. Plant operations were automated, as well as other functions such as sales and accounting. In 1989, CEMEXnet, a satellite-based communications system linking all cement plants, was implemented. Central coordination of all plants based on real-time information was implemented. In the early 1990s, CEMEX installed a logistics system called Dynamic Synchronization of Operations, which uses the Global Positioning System (GPS) technology to link delivery trucks to a central control center.

The relentless focus has been on creating business value by delivering real-time information for operational effectiveness and higher levels of customer service. For example, CEMEX has been able to slash its delivery window from three hours to twenty minutes (satisfied in 98 percent of the cases)—a dramatic improvement of value delivered to customers when one notes that the company sells ready-mixed cement which can only survive for ninety minutes before solidifying. Notes an industry expert, "This is not just a good technology application. It's a brilliant business design" (Kaplan 2001).

Embracing new technologies for creating new businesses

CEMEX has embraced the Internet to increase its levels of connectedness, both inside and outside, with its many business partners. "CEMEX has formed multifunctional teams that are driving its digital evolution while identifying the company's best practices, incorporating them into standard platforms, and executing them throughout the organization. Their aim is to ensure that 60 percent of the company's business processes are managed on a Web-based environment by year-end 2001" (CEMEX 2000).

In September 2000, CEMEX launched CxNetworks. This company's goal is to deploy a network of e-businesses that leverage CEMEX's assets onto the Internet, and extends CEMEX's reach into areas that complement and add to its core business. CxNetworks is initially working in four areas: creating a network of construction initiatives in key markets worldwide; building Latinexus as a Pan-Latin e-procurement exchange for indirect goods and services; growing Neoris, a business solutions provider; and developing important new businesses in the logistics industry.

CEO Zambrano firmly believes that the Internet can do more than just save costs: "Our goal with CxNetworks is to become the leading provider of Internet-based business solutions for the construction industry—as well as to create new, profitable opportunities in other areas, leveraging our assets and our experience" (Zambrano 2000). CEMEX is using its leadership in IT to enter new businesses. Technology continues to be core to CEMEX's future.

Wanted: Ambition and Innovation

The overall measures do not look very promising for developing countries with respect to technological innovation and the diffusion of old and new technologies. The numerical data presented in other parts of this report only serve to emphasize the enormous challenges facing developing nations. It is obvious that a lot more must be achieved on multiple fronts, including the:

- Accelerated adoption of conventional technologies such as the telephone and PC;
- Increased penetration of the Internet and related new technologies in society;
- Reduced regulatory burdens with respect to IT import and export;
- Investment in IT education at all levels—schools, vocational colleges and universities;
- Creation of appropriate research and development facilities for IT innovation; and
- Provision of incentives for technology adoption to corporations and SMEs.

The benefits of changes championing the above are well documented, both in developed and developing nations. Countries such as the U.S. and Finland, which have the most supportive regulatory and macroeconomic conditions for technology, benefit from the highest levels of IT innovation and adoption. India, after adopting a package of technology-friendly reforms at the start of the 1990s, saw the local software industry grow rapidly. A cluster-based strategy of creating local regions of high technology within favorable regulatory contexts has worked successfully in India, and to a limited degree in Malaysia and other developing countries. Such clusters should continue to be encouraged and the lessons and benefits from these clusters should be passed onto the broader national contexts.

Despite a high level of awareness about the need and benefits of the changes noted above, it is quite likely that progress will be painfully slow for most developing nations. Countries such as India and Mexico that need to go up the technology adoption curve the fastest, are often hampered by poverty, natural calamities, poor infrastructures, high rates of illiteracy, corruption, and political turmoil—complex factors that are difficult to change rapidly.

However, the examples of Motorola in India (MIEL) and CEMEX in Mexico provide hope. They give concrete evidence that it is possible to achieve business leadership enabled by world-class IT excellence in developing nations, despite having a less-than-ideal regulatory and macroeconomic environment. Note that this is not simply a question of using IT well or adequately. Both MIEL and CEMEX are true innovators and are at the leading edge of IT-enabled business value creation. How does one explain the successes of MIEL and CEMEX? The answer surely cannot be the companies' national IT environments, which are far below best-in-class global standards. The explanations are to be found to a large degree within the corporations themselves, in the organizational context in which these companies have chosen to deploy technology. Organizational leadership is critical for success in both of these firms.

Simple but Important Lessons

Despite their differences in country and industry domains, the critical success factors of MIEL and CEMEX are refreshingly simple and similar. At the core both firms share a burning ambition for excellence and achievement. MIEL was challenged to achieve level 5 software process maturity in 1991, a time when most software experts doubted whether any firm could *ever* reach level 5 maturity. Motorola has constantly challenged MIEL by assigning the most challenging mission-critical projects to its engineers. Contrast this to most other firms from developed nations who treat their outsourced software centers in developing nations with trepidation and assign only low-risk "code-conversion" projects to them. Like the managers of MIEL, CEO Zambrano has infused a unique global ambition into CEMEX. The company has grown from its humble Mexican roots into one of the most admired corporations worldwide. CEMEX brought IT into an industry that traditionally did not use technology strategically and fundamentally transformed the way the cement/construction business is run and customer value is created.

But ambition alone is not enough. Both MIEL and CEMEX demonstrate how top management leadership is vital for making that ambition come alive in the corporation. One of the first hires of MIEL described the role played by George Smith, the first managing director of MIEL (Dutta and van Wassenhove 2000), "George Smith had a tremendous impact on us. He taught us. I've not seen anybody else pursue a goal with the same level of dedication. He used to come to every one of us almost every day and have a chat with us on software engineering practices. I don't think that any one of us had even an inch of doubt that this would not be a success." Similarly, but for the leadership of Lorenzo Zambrano, CEMEX would still be a local Mexican cement company doing business much as it did in the 1980s. CEO Zambrano has made it possible for CEMEX to think the unthinkable: that it could be a global leader. Thanks to the innovative use of IT spearheaded by Zambrano, CEMEX is today one of the largest and most profitable cement companies with a global reach.

Also common to both leaders is the fact that they succeeded in creating the right environment to stimulate innovation and individual creativity. Despite the presence of a traditional hierarchical society in India, MIEL created an open learning culture where even junior twenty-year-old engineers felt comfortable criticizing "older" more experienced managers. This culture did not appear naturally. An engineer at MIEL recalled one of the early open project review meeting: "There was literally a fight because the project team being reviewed could not accept the comments given by others. It required a certain degree of openness to accept the different views of your colleagues, many of them junior to you. But we have come a long way from that today." As technology permeated the processes of CEMEX, "there was resistance to the changes, especially to the e-mail; but open information and easy communication together brought about a shift in the corporate culture. Knowing that they were being watched, employees began to strive for improvements. At the same time, Mr. Zambrano sought to make his managers receptive to new ideas from below. "IT frees up everyone's imagination," he [Zambrano] says. (Economist 2001)

Finally, both firms demonstrate disciplined execution and a razor-sharp focus on business value creation. MIEL collects and analyzes volumes of data on its software processes. Its dissection of operational data has become so sophisticated that it is able to predict accurately how many bugs may appear in a software project and when projects may go astray—all to ensure that appropriate corrective measures are taken well before the problems actually occur! The goal is to guarantee high quality project delivery on time and within budget. CEMEX has used IT to transform the ultimate commodity product—cement—into a differentiated service. "It isn't so much the product or the industry, it's rethinking what the customer wants and how you can respond to it in a way that's economical for the company." Discarding the traditional constraints of its sector, CEMEX has embarked upon an ambitious plan to create new businesses by leveraging new technologies: CxNetworks aims to "leverage CEMEX's knowledge, including its industry expertise and customer focus, and to extend the company's reach into areas that complement its core business" (CEMEX 2000).

Conclusion

For the foreseeable future it is likely that developing nations will lag behind developed nations in terms of overall technology adoption and use. Notwithstanding isolated cases of rapid adoption of certain new technologies the overall lag will continue to pose challenges for governments and societies in developing nations. Significant macroeconomic and regulatory reform needs to be undertaken to improve technology infrastructures and IT adoption. Creating clusters of high technology can help to jump start and speed up the process. This is happening today, slowly but surely, in most developing nations. However, technology is also moving forward at a fast pace, and technology adoption gaps between developed and developing nations are sometimes increasing rather than decreasing.

An interesting question is why the majority of firms in India, Mexico, and other developing nations are not able to emulate the examples of MIEL and CEMEX. Surely, the explanation cannot lie in the general underdevelopment of the respective national infrastructure and technology environments. After all, both MIEL and CEMEX faced and continue to face those same challenges. The answer lies to a large extent within the firms and their respective networks of business partners. If the top management of firms in developing nations do not develop the ambition to become world leaders, they are condemned to follow in the steps of others. If firms continue to see technology as a support function, they will lag behind others who are able to grasp and exploit the strategic potential of technology. If intrafirm and interfirm business processes are not moved online and redesigned appropriately, productivity will lag behind others who aggressively move to e-enable their processes.

Competitiveness in the global arena is the result of multiple attributes, technology excellence being one of them. The examples of MIEL and CEMEX serve to emphasize the point that business leadership supported by world-class technology excellence can be found in developing nations. The critical success factors for both MIEL and CEMEX lie not in the technology used per se, but rather in the leadership and organizational context supporting the application of technology. It is the quality of the latter that contributes the most to the development of business excellence. It is important to note that there are domains where business initiatives will be hampered by low levels of technology adoption in society at large. For example, low penetration of the Internet in developing nations will make it difficult for local online retailers to become global leaders. However, the greater challenge for corporate leaders in developing nations is to be ambitious, and to create the right organizational context for technology excellence.

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CHAPTER 7

Information and Communication Technologies, Markets, and Economic Development*

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There is great optimism over the potential for information and communication technologies (ICTs) to promote economic development and alleviate poverty. Currently, however, there is neither a solid theoretical basis nor convincing empirical evidence to support such optimism.

This chapter identifies the economic underpinnings of the argument for a significant role for ICTs in the development process. The basic premise is that information and communication are valuable commodities that can enhance the functioning of markets critical for the well-being of the poor. Recent advances in ICTs can bring these benefits to even the poorest of the poor in the developing world.

This chapter is organized as follows. We begin with a theoretical discussion of markets and economic efficiency, highlighting the desirable outcomes that result from well-functioning markets. Next, we discuss the critical role of information in generating efficient market outcomes. We then examine the extent of information flow, or lack thereof, in developing countries and the consequences for market functioning. In doing so, we pay particular attention to the benefits well-functioning markets bring to even the poorest persons in the poorest nations. Finally, we evaluate the limited evidence to date on how bringing ICTs to information-isolated communities can promote welfare, and provide new evidence based on an analysis of household data from China.

Markets and Economic Efficiency

What markets are and what they do

In the broadest sense, an economy is a group of individuals (consumers) who need or want various things, such as different kinds of food, clothing, shelter, or entertainment. The most important task, and the biggest challenge, for an economy is to take its limited resources—land, labor, capital, natural resources—and convert them into the things people want. This problem, which is fundamentally how to allocate resources to match production with consumption desires, is the core of economics. Markets are the key instruments with which to meet this challenge.

Markets are a set of transactions by agents over a range of goods and services. Such transactions allow for mutually beneficial exchange. Taken at this fundamental level, markets perform the important task of freeing individuals from self-reliance. In a modern economy, all economic activity, from the production and sales decisions of the smallest farmer to those of the largest corporation, rely on markets.

When markets perform well, consumption desires guide the production of all participants. Under these conditions the economy is said to be performing efficiently, meaning that there is no opportunity to make one person better off without making another worse off. This implies, for example, that there is no scope for readjusting production to produce more X and less Y, assuming consumers would value the gained X more than the lost Y. In other words, efficiency assures that resources are deployed to their highest value purposes.

The role of information in market coordination and efficiency

The coordination problem involved in allocating resources to their best uses is enormous. How can millions of independent, dispersed consumers communicate to millions of independent, dispersed producers exactly how much of each of the enormous variety of goods and services they want? Similarly, how do producers know how they can make the most money, usually without ever meeting more than a fraction of the people who buy their products? How do they know to supply the exact combination of goods that consumers want to buy, so that collectively there is not too much bread and too little clothing, or too much rice and too few onions? Prices, and market signals more generally, are the key instruments that facilitate this coordination.

In a market-based economy, prices transmit all of the information that participants in the economy require to make effective decisions. Producers need to know the prices of inputs they must buy and the prices of the outputs they wish to sell in order to decide what and how to produce. Consumers need to know the prices of the goods and services they might buy, and the going rate for their labor skills and other services they wish to sell, so that they can make appropriate decisions about household consumption and labor force participation. On both the production and consumption sides, market prices act as coordinating signals.

In the classic textbook version of a market-based economy, the price of a good will rise when many people value that good more than its current price. As consumers compete to buy the good, they will bid the price higher. Producers respond to the higher price by supplying more of the good. Thus, in a well-functioning economy, when there aren't enough eggs to meet demand (in a given region), the price of eggs increases, and farmers, seeing opportunities for profit, breed more hens to produce more eggs. People want more eggs and, like magic, more eggs appear. Consumers and producers react to the evolution of prices through multiple iterations of this sequence.[1] When quantity demanded at a given price just balances the quantity that producers want to supply at that price, the market reaches equilibrium. Whether Wall Street or West Africa, information makes markets work.

When markets do work, consumers benefit alongside producers. Only a consumer whose value for the good exceeds, or at least equals, the going market price will end up buying it. Therefore, in market-based economies, those who want a good the most ultimately get it. This allocation process might seem to disadvantage the poor, but that is not the case. Even the poor get staples, such as food, because staples are cheap to provide, and the rich want only limited amounts of such goods. The market allocates scarce resources in a way that fosters the welfare of both rich and poor.

The challenge of providing information

How challenging is the task of providing the information that enables markets to work? Little information would be required if prices stayed relatively constant from year to year. Farmers would know what to plant, laborers would know where to work, consumers would know what to pay for goods and farmers for inputs, just by relying on prices from the previous period. However, even in relatively underdeveloped economies, prices move considerably in response to such forces as weather, changes in taste and technology, and variation in supply and demand from outside the region.

Might there be alternatives to market signals for coordinating production and consumption? The multidecade experience of centrally planned economies (e.g., the pre-1990 nations of Eastern Europe and the former Soviet Union), the most ambitious experiment to supersede the traditional role of prices, indicates not. Severe coordination failures proved to be unavoidable when prices were not used to coordinate economic activities. Rather than let producers and consumers communicate through prices, the governments in these economies set prices administratively and directly allocated inputs and output quotas to manage the economy. The amount of information needed to ensure that the production of every good and service even roughly matched the desires of consumers could not be achieved. Often production was grossly inconsistent with demand at the prices set. The result was that many goods that consumers wanted either could not be found or were available only by waiting in long queues, whereas many other goods were badly oversupplied, and sat unwanted on shelves. Further, because prices and production activities were set by planners, the opportunity for corruption or the prospect of private financial and political gains to guide decision making, rather than efficiency, was great. Experience with socialism underscores the great advantage of markets as coordinators of producers and consumers.

Table 1: **Access to Telecommunications in 2000, by World Region**

Region	Mobile Telephones (per 1,000 people)	Radios (per 1,000 people)	Telephone Mainlines (per 1,000 people)	Waiting Time for Telephones (years)	Television Sets (per 1,000 people)
Low Income	6.0	157.3	17.6	5.9	85.5
Middle Income	90.0	359.4	153.2	1.1	279.2
High Income	615.3	1288.5	557.2	0.0	692.8
East Asia/Pacific	179.5	302.3	200.6	1.2	252.5
South Asia	7.5	112.7	27.8	1.6	71.0
Sub-Saharan Africa	27.7	201.5	24.4	6.0	43.2
Europe/Central Asia	329.5	446.0	323.5	2.0	369.6
Latin America/Caribbean	88.7	418.6	241.9	0.5	271.8
World	156.7	420.1	202.5	1.4	268.3

The data on mobile telephones and telephone mainlines are for 2000, based on authors' calculations from International Telecommunications Union (October 2001 update) using regional fixed factors from Easterly and Sewadeh (2001). The data for radios, waiting times for telephone mainlines, and television sets are for 1999 as reported in the World Bank World Development Indicator Database (available at www.worldbank.org).

Information and markets in developed and developing nations

In the developed world, markets perform well because the prices of goods are known or can be found with minimal effort. However, in developing nations, especially in rural areas, such signals flow sluggishly, if at all. As a result, farmers often produce the wrong mixture of crops, often using inefficient technologies, and consumers do not receive goods even though they are willing to pay the market price. The result is inefficiency.

Efficiency failures reveal themselves as deviations from the "Law of One Price." The Law is an important economic principle that holds that prices for homogeneous goods sold at different locations should be equal, net of transportation costs. "Price dispersion is a manifestation—and, indeed, it is the measure—of ignorance in the market" (Stigler 1961:214).[2] As markets become better integrated, the Law tends to hold for more and more goods and services, so that consumers and producers in different locations are tied together in an information network summarized by one critical piece of information: the prevailing market price.

In poor countries, the coordination of economic activity rarely works well. In isolated rural villages in most developing countries, there are virtually no sources of information regarding market prices and other production-related information. For them, "information is poor, scarce, maldistributed, inefficiently communicated, and intensely valued" (Geertz 1978:29). The main reason is that many people lack access to even very basic communications infrastructure. As shown in Table 1, in low-income countries as a whole, there are only eighteen telephone mainlines for every thousand people, and the average waiting time for a telephone is almost six years. Access to more advanced forms of ICTs is generally even more limited. Barely 6 percent of the world's people have ever logged onto the Internet (International Labor Organization 2001). A household survey in Peru showed that 77.2 percent of households lacked telephones, including 99.8 percent of poor rural households (Torero, 2000:11).[3] With no way to communicate across distances, many rural poor are removed from the flow of information required to make markets work. In particular, price signals are faint or absent.

A vivid symptom of poor information flow is that prices vary widely within a geographic area, even for goods that are readily transported. A few empirical studies document the spatial dispersion of prices and how effectively or ineffectively price information is transmitted across markets. For example, Badiane and Shively (1998) studied monthly maize prices in Ghana from 1980 to 1993 and found that "the estimated time to fully transmit a price shock [from the central market to each of two outlying markets] is about four months."[4] Price adjustments may also be asymmetric; in Ghana, wholesale maize prices for producers in local markets respond more swiftly to increases than decreases in central market prices (Abdulai 2000).[5]

Not surprisingly, therefore, many studies have shown that market integration fails for important products in a variety of countries. Examples include rice in Bangladesh (Ravallion 1986), rice, sorghum, and oil in India (Palaskas et al. 1997), grains in Nigeria (Delgado 1986; Heytens 1986), livestock in Niger (Fafchamps and Gavian 1997), and rice in China (Zhou et al. 2000).

We can examine these issues further using the interesting case of rural China. Despite decades of urban growth, China remains largely a rural country; over two-thirds of the population resides in rural areas, and nearly three-quarters of employed men and women are engaged in the agricultural sector. To explore the nature of market efficiency and price dispersion, as well as to later show the potential role of ICTs for promoting income growth among the poor, we make use of household- and

Table 2: **Prices (per kg) of Various Commodities in Chinese Villages, 1991**

Commodity	Mean	Standard Deviation	Highest	Lowest
Fish	6.5	2.0	14.1	5.2
Pork	5.9	1.4	8.0	3.8
Eggs	4.6	1.5	7.0	1.9
Vegetables	0.64	0.61	4.5	0.35

village-level data from the China Health and Nutrition Survey (CHNS).[6] The CHNS is a stratified random sample of thirty-eight hundred households across two hundred villages in China. In addition to information on employment, income, and expenditures, the survey gathered information on the market prices at which various goods can be purchased, for each village in which the survey was conducted. Table 2 provides data on the distribution of prices across areas in 1991 for several of the most commonly consumed foods. Columns one through four respectively show the means, standard deviations, and highest and lowest prices recorded (in RMB yuan) across the villages sampled in the survey.

The table reveals that that the Law of One Price is strongly violated. For most commodities, the standard deviations are quite large relative to the means, indicating a great deal of price dispersion. In every case illustrated, the highest price is at least two times greater than the lowest price. Such gaps in price greatly exceed possible transport costs for the commodities (for which some data in the CHNS are available). These results roughly indicate how far these markets are from being integrated, which implies severe underlying inefficiencies.

There may be other factors that could explain why a given village would have a high price for commodity A or a low one for commodity B. For example, if the village imported A and exported B and residents were being exploited by middlemen, price dispersion would also arise. Therefore, to test for integration, we must look further. With integration, even if there is exploitation or transport costs are steep, prices for these commodities in the village would tend to move in concert with urban prices. Thus, finding that prices move in different directions across different areas (i.e., the price for a given good is rising in one area while falling in another) would indicate poor integration. Figure 1 shows the prices of pork, vegetables, eggs and fish in 1989 and 1993 graphically, the horizontal axis representing the price in 1989 and the vertical axis the price in 1993. The 45-degree line represents the set of points where (deflated) prices are equal in both years. Prices move substantially over this time for all of these commodities. Tracing up from any given price in 1989, there are cases where the price goes up in many villages and down in many others. Prices are not moving in tandem across areas.

Figure 1: **Price Changes Across Chinese Villages, 1989–1993**

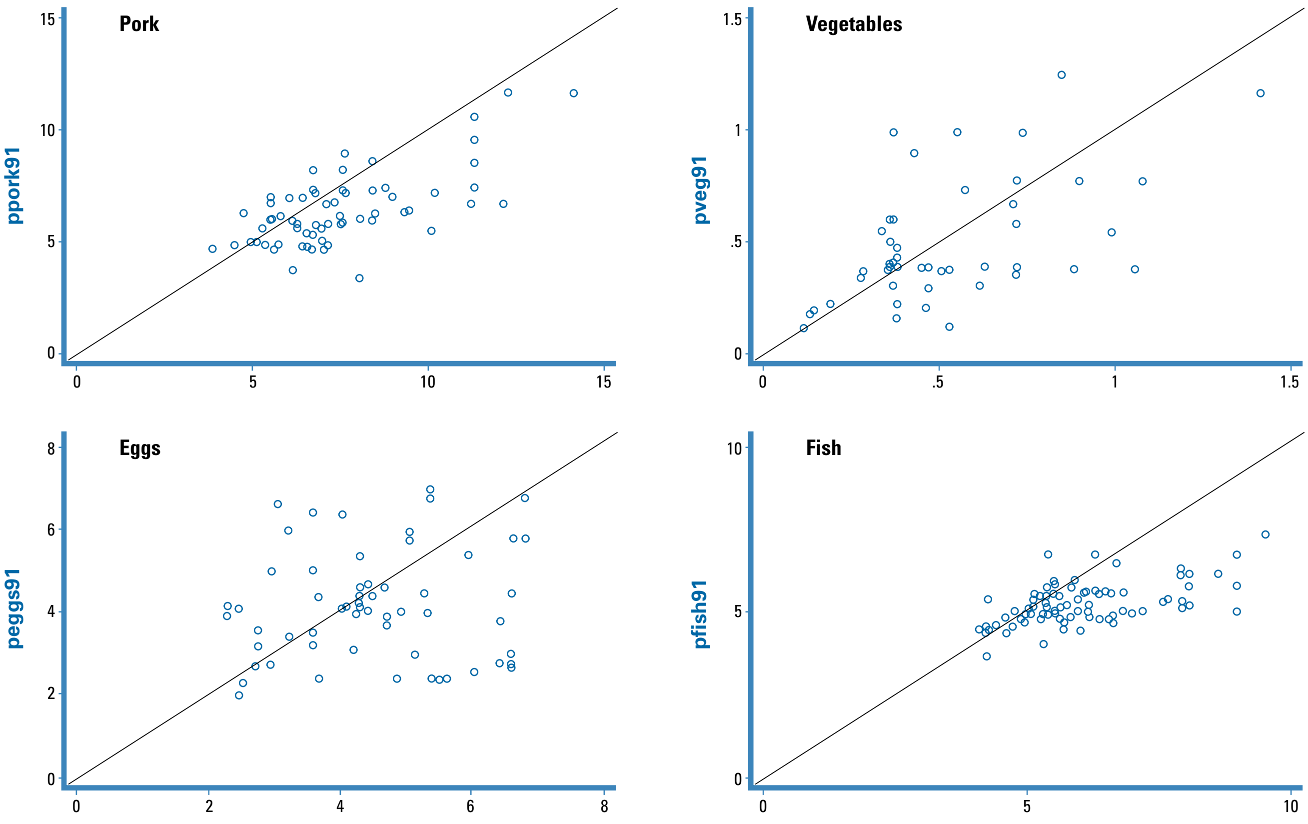


Table 3: **Prices (per kilo) of Various Commodities, Telephone vs. No Telephone**

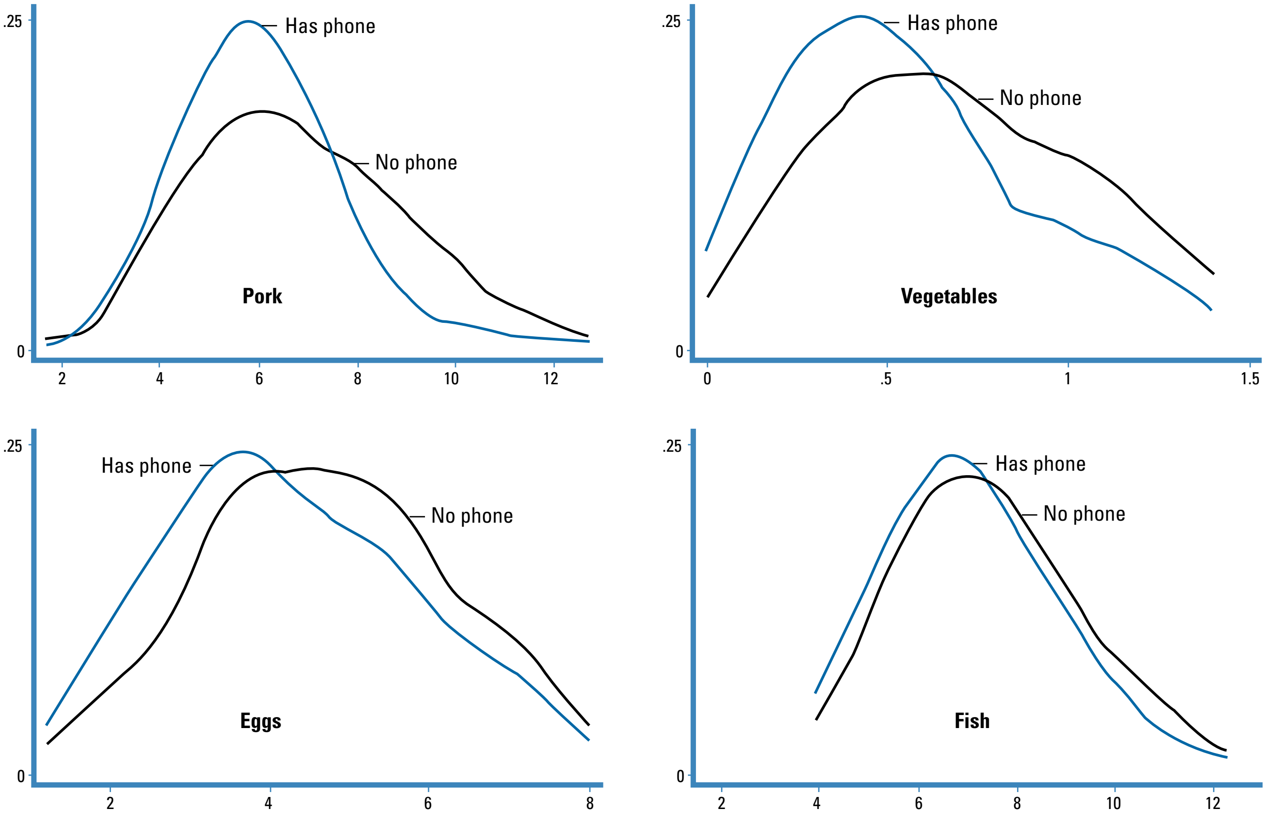
	WITH TELEPHONE				WITHOUT TELEPHONE			
Commodity	**Mean**	**Standard Deviation**	**Highest**	**Lowest**	**Mean**	**Standard Deviation**	**Highest**	**Lowest**
Fish	6.2	1.8	9.0	6.2	6.8	2.0	14.1	5.2
Pork	5.8	0.71	7.0	4.6	6.0	2.1	8.0	3.8
Eggs	4.3	1.2	7.0	1.9	4.8	1.6	7.0	1.9
Vegetables	0.64	0.50	4.5	0.39	0.64	0.67	4.0	0.35

Our guiding premise suggests that price dispersion will be diminished by the presence of communications infrastructure. Greater information flows should reduce the variation in prices; as markets become more integrated, trade should push toward price equalization. Telephones offer a very basic means to communicate prices. Table 3 provides the same information as Table 2, but is disaggregated by whether the village has a telephone.

Several striking features are apparent in this table. For three of the commodities, the mean price is lower in villages with telephones. In villages lacking telephones, as the "information promotes market integration" theory would predict, the standard deviation is much higher for all the goods. So, too, is the spread between the highest and lowest prices. The greater price dispersion can be seen more clearly in Figure 2, which shows estimates of the densities of the prices of pork, vegetables, eggs, and fish.

Of course, there may be other differences between villages with and without telephones that may also influence prices and market performance. For example, villages with telephones may be closer to cities and have better access to roads or lower transportation costs. The CHNS data provide information on such factors, which do in fact differ slightly across villages. However, even after statistically controlling for these various differences, we still conclude that the means and standard deviations are lower in the villages with telephones. Further, since the CHNS visited the same villages in several rounds over the course of eight years, we can examine the *change* in prices, and change in price variance, for villages that added telephones

Figure 2: **Densities of Prices**



during the course of the survey. This will allow us to control for any fixed differences across villages, as well as changes in other factors that may affect prices. Making use of this strategy, the results yield similar conclusions; villages that add even the most basic communications technology, the telephone, experience declines in the purchase price of various commodities and lower future price variability.

The Importance to the Poor of Information and Markets

We have detailed the benefits of market coordination, the role of information in enabling market coordination, and the widespread lack of such coordination in developing countries. We have also hinted at, and will provide evidence in the next section, on the ways ICTs can foster market integration. We now describe how such information and integration can help the poor by promoting the alleviation of poverty and fostering economic growth. The vast majority of the poor in rural areas of low-income countries are either farmers or surplus laborers. Each group depends heavily on markets, and thus can be assisted through better functioning markets, as outlined below.

Productive efficiency

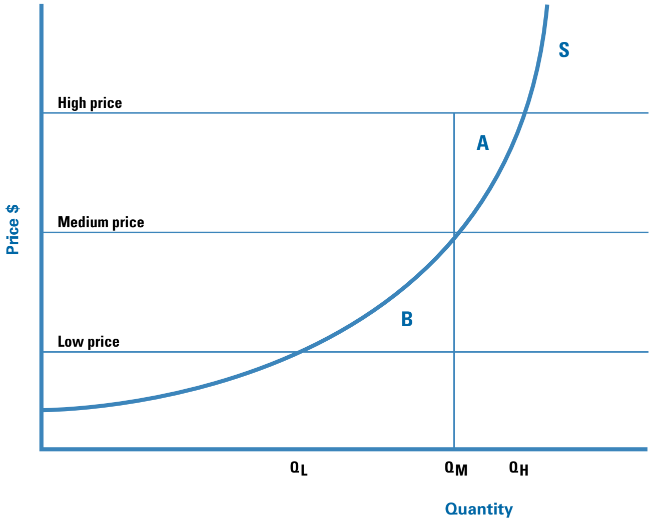
The farmers' primary interest is to maximize the profits they earn from their farms. To achieve this goal, farmers need price information for four important purposes. First, relative prices allow the farmer to make decisions on the mixture of crops to produce. Even if conditions restrict him to one crop, its price tells him how much to produce. Second, prices enable him to produce in a more efficient manner. He is able to purchase inputs (e.g., fertilizer, irrigation equipment) when and where they are cheapest. Prices may also alert him to the existence of inputs that would profitably boost his production. Third, price information allows him to know where to sell his output and the appropriate price to accept. For example, while prices often differ across villages, the farmer typically knows only the local price. So even if, say, the urban price is higher, he doesn't know to send his output to the city. Nor does he realize that it is profitable to produce more of that output (and perhaps less of another). He misses opportunities to earn more income, and urban consumers face excess prices. By not being able to pursue the highest price, farmers are not sending their output to where they are valued most, and lowering the price there for consumers. The same principle applies if there are multiple cities, and the farmer does not know which one will offer the highest price. He could search for the best prices for his crop or for his inputs, but each price-seeking foray could take considerable time. In response to high search costs, farmers may just choose the same market year after year, which would imply that prices across markets could be highly variable, as we have seen they are.

Another possibility is that middlemen or dealers will enter the picture. As Geertz (1978:30) pointed out, one of the most common responses to high search costs due to poor information is "clientelization," to establish long-term trading relationships. Although trust may develop over multiple transactions, the paucity of information continues to handicap the farmer since he cannot independently assess the integrity of the dealer, or the reasonableness of the prices he offers, by comparing purchase prices across many markets and many dealers. The fourth purpose of price information for farmers is to prevent their exploitation by middlemen, a matter we take up below.

Production given price uncertainty

We are not suggesting that price information never arrives at the isolated village, just that it arrives when it may no longer be accurate or relevant. Consider a farmer in an uncertain world; he knows prices on average, but not the actual price at the time he must make production decisions. Even if he produces only a single crop and ultimately gets the market price, he will produce the wrong amount. The curve labeled *S* (Figure 3) is a supply curve, telling how much the farmer can produce at any price. The curve slopes upward because beyond some minimum, each extra unit of output costs more in terms of hired labor, fertilizer, better seeds, and so on. The farmer knows that the likelihood that the price is high is 50 percent, and that it is 50 percent likely to be low. If he does not know the price, the best he can do is assume the average (medium) price. He will produce amount Q_M. (The subscripts H, M and L refer to high, medium, and low.) If he knew the prices, he would produce Q_H if they were high and Q_L if they were low. As opposed to producing Q_M, he would earn more than he was before—the amount indicated by area A—if the price was high,

Figure 3: **A Farmer's Loss from Price Uncertainty**



and would avoid losing area B if the price was low (when he incurs production costs above the price). On average, the farmer would be (A+B)/2 ahead if he knew prices before making production decisions.[7] To be fair, even farmers in the information-suffused environments of developed nations do not know ultimate sale prices before they produce, but price projections and futures markets usually give them a reasonable idea. Further, the absence of futures markets is in itself an indication of the weak flow of information in developing countries, and the potential benefit better information flows could bring.

Laborers and markets

Landless laborers, who together with farmers comprise the overwhelming majority of the population of poor rural areas, are hurt in a somewhat different fashion when price information and effective markets are not available. Their productivity suffers, since they often stand around waiting for work. In rural villages, and in neighboring urban areas with informal sectors that draw workers from villages, most employers' labor needs are unpredictable and vary greatly from day to day. Hence, permanent employment relationships are rare. For example, Breman (1996) studies the informal economy in a region of India. He reports that about half the workforce is employed under daily contracts, with little vertical mobility into semipermanent and permanent jobs.

Given this reliance of landless laborers on day-to-day job opportunities, lack of information can severely constrain income opportunities. Often, hours are wasted searching for brief employment opportunities, or worse, workers in one village may stand idle while employers in nearby villages or slightly further removed urban areas are unable to find enough workers. Better coordination would mean that there would be many fewer idle workers and wasted opportunities.

Middlemen: too many, or too few?

Middlemen often act as intermediaries between agents (e.g., between farmers and consumers, or even between laborers and employers in a distant locale). Middlemen may travel from cities to villages to purchase crops and sell inputs, or they may just have an outpost in a town market. Anecdote and speculation around the ways ICTs can help the poor has frequently involved discussions of the role of middlemen. The common perception is that middlemen gouge both buyers and sellers and that ICTs can therefore help farmers, either by improving their bargaining position or by enabling direct sales, remove the middlemen.[8]

However, the presence of middlemen is not necessarily a symbol of an information-starved market. Even in advanced economies, middlemen, wholesalers, and retailers play a major role by performing many valuable tasks of intermediation (e.g., sorting for and attesting to quality, storing and transporting goods, organizing sales, assuming or pooling risk, or supplying credit (Li 1998; Van Raalte and Webers 1998; Biglaiser 1993; Stigler 1961). It would be highly inefficient for rural farmers to assume all of these tasks; rather, they should focus on what they do best, namely produce agricultural commodities. Theoretical work confirms that under most circumstances, the optimal amount of intermediation is positive (e.g., Biglaiser 1993). For example, in a model with endogenous middlemen (who invest in quality-verifying technology), even though the middlemen are not engaged directly in production, when "people do not execute trades because they cannot recognize the true quality to goods, expert middlemen can improve welfare." (Li 1998)

The big difference between middlemen for an isolated farmer in the developing world and, say, producers in Europe, is that the European middlemen face competition that assures that they get an appropriate (but not excessive) price for their services. In information-isolated settings, the problem with middlemen is often not that there are too many of them, but too few. Middlemen can only price gouge if they have few or no competitors. If a farmer has many traders or middlemen available, no one can exploit him by paying inadequate prices for his crops or charging too much for farm inputs or consumption goods. If one middleman refuses to pay a reasonable price, a farmer can follow the strategy of the European producer and refuse to sell to him, instead marketing to another middleman who pays a better price. Similarly, if a middleman demands too much for inputs sold to farmers, another middleman can lure away his customers by offering more favorable prices. Competition among middlemen constrains their ability to exploit information asymmetry in order to reap excessive profits. Middlemen often have a monopoly because of well-developed relationships or the high costs of search and information. If information were available through ICTs, however, even if it were merely the identity of farmers and middlemen, it would be easier for others to enter the market as traders or middlemen and thus increase competition.

Many studies find that competition among middlemen constrains the exploitation of customers. For example, Hayami et al. (1999) report data from a survey indicating that rice marketing in the Philippines (at least in the area studied) is highly competitive, preventing middlemen from exploiting peasants and consumers through monopoly/monopsony pricing. The authors estimate that 50 to 70 percent of the consumer price goes to farmers, with the remaining 30 to 50 percent marketing margin split among collectors/middlemen (about 5 percent), rice mills (15 percent), and retailers (10 percent). In other countries, such as the former Zaire, producers receive only 35 to 41 percent of the wholesale price of several main commodities, although transportation costs account for most of the balance of the price (Minten and Kyle 1999). Middlemen operating in areas of the Brazilian Amazon rainforest receive 40 to 50 percent of the final prices of fruit and vegetables (Roberts 1995). Some socialist countries such as

Maoist China illustrate the impact of a monopoly middleman, the government. By imposing a "price scissors" on farmers—paying a lower-than-market price for agricultural output and charging a higher-than-market price for nonagricultural goods—the Chinese government raised implicit tax revenues. Imai (2000) estimates the real income loss for farmers to have been equivalent to a 16.7 percent labor income tax during the 1964 to 1978 period.[9]

Information and productivity

Making information available, including information other than price, can enhance production in isolated villages in other ways. At the most basic level, the ability to monitor weather expectations could enable farmers to plant and harvest at appropriate times. It may also allow important information flow in the opposite direction. For example, a greater flow of information could allow farmers to gain trust and build reputations, which could enhance the functioning of credit markets. Information flows and monitoring by creditors could help farmers receive access to loans and other financial resources, which in turn could enable them to implement new production technologies.

Over the long run, one of the significant gains from information may come through the transformation of production processes. New technologies diffuse slowly in developing nations, often passing from producer to producer by word of mouth. Effective markets change this pattern, and create a world where information flows in all directions. For example, sellers of inputs, attentive to the possibility of new sales, learn about farmers' practices. They then purvey products, and sometimes call for new products, that boost agricultural productivity. At the same time, farmers scan the market to learn about potentially more profitable crops or new farming techniques. Thus, better information flows could promote technological adoption and innovation.

Overall, then, it is possible that basic information and communication technologies could provide a higher path of income growth, not just a one-time income gain. This optimistic prediction has empirical support. Research shows that productivity flows from the development of marketplace infrastructure and integration. Studying developing countries, Antle (1983) shows that poor transportation and communication infrastructure constrains agricultural productivity. When markets function well, trade is abundant, and farmers reap the rewards of specialization (e.g., producing a profitable cash crop rather than growing the main crop and others for their own subsistence). Additional gains from specialization include developing product-particular skills and knowledge, purchasing inputs in bulk, or reaching economies of scale. A whole region or economy benefits when improved information flow leads to more integrated markets that widely disseminate new techniques, fertilizers, and other inputs to agricultural production.

Evidence on the Transformative Role of Information Technology

We have argued that integrated markets can significantly help the rural poor of developing nations, and that ICTs, even basic communications technologies, can play a major role in creating such markets. Moreover, we have posited that ICTs have the potential not just to provide a one-time lift to income in poor regions, but to accelerate the entire growth process by generally making it easier for isolated producers to improve their practices In effect, ICTs speed innovation. What can we learn from the historical record?

Evidence on the impact of ICTs on economic growth mostly comes from study of high-income countries. Early studies, such as Hardy's (1980) examination of the role of the telephone in economic development, although pioneering and suggestive, are nevertheless plagued by problems of reverse causality. In other words, does a positive correlation between improved ICTs and economic growth reveal that (1) ICTs bolster growth, or that (2) growth nourishes improved ICTs, or does it suggest both? Several researchers have attempted to disentangle these effects (e.g., Greenstein and Spiller 1996; Norton 1992). In a careful recent study, Röller and Waverman (2001) analyze twenty-one OECD countries over twenty years, finding evidence of a significant positive causal link between telecommunications infrastructure and economic growth.

Evidence on how advances in and the spread of ICTs spurred economic development in nineteenth century America is perhaps more germane to the world's poor today. Garbade and Silber (1978) find strong statistical support for the hypothesis that two innovations in communications technology—the telegraph (1840s) and trans-Atlantic cable (1866)—led to significant and rapid narrowing of intermarket price differentials. Du Boff (1980) chronicles the growth of the telegraph in the United States from the mid-1840s to 1860. In 1840, 63 percent of the American labor force worked on farms and only 9 percent in manufacturing, much like many developing countries today. After initial skepticism regarding the new communications technology, the telegraph industry grew dramatically as the railroads, the press, and other businesses and consumers began to capitalize on the advantages of instantaneous communication. Consistent with our argument on the high value on market integration through the flow of price signals, Du Boff reports that among the earliest and highest volume telegraph dispatches were communications of market prices in different areas to press outlets for wider dissemination. For example, a Pittsburgh newspaper in January 1848 announced "the lightning brought us quite a budget of news last night," listing the "going prices for cotton, flour, breadstuffs, wheat, rye, pork, southern oats; money market conditions in England; and railroad service connections for freight shipments"; "other newspapers in 'Telegraph Dispatches' showed the same

Table 4: **Sources of Income**

	NO TELEPHONE 1991 NO TELEPHONE 1993			NO TELEPHONE 1991 TELEPHONE 1993		
	1991	**1993**	**% Change**	**1991**	**1993**	**% Change**
Income from wages	326	342	.05	366	394	.08
Income from agriculture	1035	990	-.04	929	1091	.17
Income from business	332	351	.05	355	412	.16
TOTAL	1693	1683	-.01	1650	1897	.15

Note: All values deflated to 1991Rmb.

predominance of financial and commercial items."[10] Moreover, better communications propelled efficient production and reduced myriad transactions costs. The advent of the telegraph and the associated growth in networks of exchanges, "ensured the price differentials among markets would tend to narrow to the costs of transportation and transactions between places. These differential costs too were slashed through use of the telegraph. After the Civil War, impediments to direct transactions between producers and final consumers were removed as retailers, farmers, and manufacturers discovered that they could now bypass the complex of intermediaries and save on commissions paid to wholesalers….Steadier and more dependable prices and faster communication with suppliers also reduced both 'search' costs and the need to carry heavy inventories with attendant financing costs." (Du Boff 1980:477)

Thus, ICTs did not merely improve prices for producers; they changed the whole nature of economic transactions. If anything, the potential for developing countries to utilize ICTs today is greater than it was for the U.S. then, since today's developing nations can draw on the models and technologies of more developed nations, and can sell outputs to those wealthier entities.

Will that potential be realized? Unfortunately, evidence on how ICTs affect development in poor nations is quite limited. Disentangling the impact of ICTs from those of other changes can be difficult, requiring good data (which are scarce) and careful attention to issues such as reverse causality. Torero (2000), concerned with poverty in Peru, finds that "access to a telephone is important in explaining why low income households do not drop into poverty, but it is not significant in explaining the transition between poor and nonpoor status." Peruvian households that acquired a telephone between 1994 and 1997 also increased their incomes and their access to financial savings and credit, although causality here is not clear.

The Grameen Phone Village Pay Phone project in Bangladesh provides intriguing evidence on how ICTs provide benefits. This project leases cellular mobile telephones to low-income women, who essentially provide a village pay phone. According to one study (Bayes et al. 1999), close to half of all telephone calls involved economic purposes such as discussing market prices of commodities, employment opportunities, land transactions, remittances, and other business items. Bayes et al. also noted that, moreover, "the average prices of agricultural commodities (especially [rice] paddy and eggs) were higher in target villages (with phones) than in control villages (without phones)." Vegetable growers said that access to telephones helped them to make more appropriate production decisions, and users of agricultural inputs benefited from a smoother and more reliable supply. Better information also improved some sellers' perception of their bargaining position vis-à-vis middlemen. Finally, village telephones facilitated job searches, access to emergency medical care and the ability to deal with natural disasters, lowered mortality rates for livestock thanks to more timely advice from extension workers, and improved rates in foreign-exchange transactions.

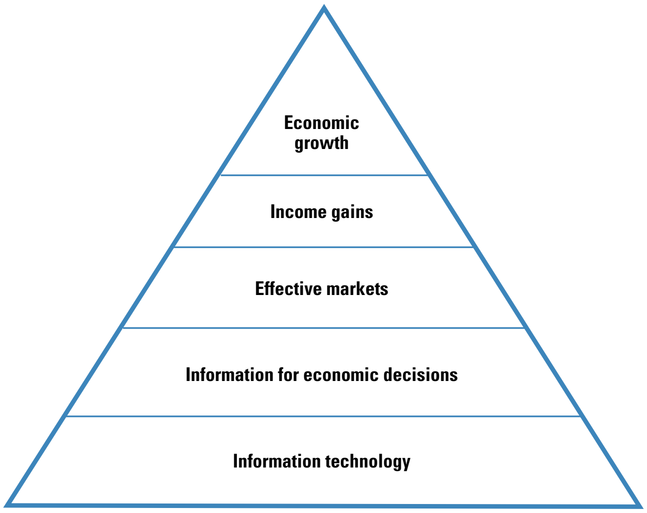
Additional evidence on the effects of basic communications technologies can be obtained from an analysis of the CHNS data for China. During the period of market-oriented economic reforms covered by the survey, telephone service was expanded throughout rural areas in China. In 1991, approximately 40 percent of rural villages in the survey had telephones. By 1993, however, that fraction had increased to more than 60 percent. The household survey gathered information on a variety of economic activities, including agriculture (output and sales prices), wage labor (i.e., wage or salary received, and time worked in hours per day, days per month, months per year), and household businesses/enterprises. The hypotheses developed above predict that as information flows better and markets become more integrated, farmers or enterprise owners might, for example, receive more for their output or sell more output, and hours worked may increase due to better coordination of labor. We followed households over time to see what happened to incomes when villages add telephones. Villages that did not get telephones are the comparison group. Table 4 provides data on income for households from various sources.

In the initial period, households in the villages that received telephones between 1991 and 1993 had slightly higher incomes from wages and businesses and lower incomes from agriculture, than villages that were still without telephones in 1993. Overall, however, households living in villages that received telephones in 1993 had incomes that were slightly lower in 1991 (about 2 percent). But between 1991 and 1993, there were dramatic changes in income for households in villages where telephones were added. In particular, overall average household income grew 15 percent, with the largest increases in agricultural and business income. By contrast, households living in villages that did not add telephones experienced slightly lower incomes in 1993 compared with 1991. This pattern is consistent with the predictions regarding information and markets discussed earlier. As with the analysis of prices above, there is concern that villages that received telephones may be different in other ways that affect household income. However, statistical analysis that controls for differences (or changes) in numerous other factors, such as access to roads and transportation services, distance to nearest city, and a variety of other factors, yields similar conclusions (results available from the authors). We also make use of the longer series of data, and find that there was no differential trend in income between 1989 and 1991 for villages that would receive telephones in 1993, compared to those that would not receive them. Finally, we make use of a statistical technique that exploits the fact that telephones were in part "pseudorandomly" assigned across villages in these years, so we can eliminate concerns about reverse causality or differences between villages that received telephones and those that did not.[11]

Conclusion

The theory of information and market signals and the available evidence on the relationship between market integration and economic development suggest that greater access to ICTs, starting with basic communications infrastructure, could significantly improve the living standards of the world's rural poor by enhancing the functioning of relevant markets. The only sustainable way to end deprivation is to enhance earning possibilities. Appropriately designed ICT interventions can help do exactly this, using the invisible hand of the market as a helping hand to the world's poor. But it is important to emphasize that the greatest value of ICTs derives from the *I* and the *C*: Information and Communication. The kernel of our argument is presented in Figure 4, which shows how ICTs can create a "Digital Provide" that boosts incomes and ultimately leads to economic growth. ICTs have the ability to disseminate information to isolated, information-deprived locales. Those receiving this information (predominantly farmers and laborers), as both producers and consumers, will be, for the first time, able to participate in effective markets. The immediate consequence should be income gains for participants, and the ability to better spend their incomes. Over the long term, enhanced access to information should enable producers to significantly improve their practices. Such improvement lays the path to economic growth.

Figure 4: **The Digital Provide**



Of course, there are other barriers to market functioning, such as transportation infrastructure, and at times counterproductive government interventions (e.g., price controls and granting of monopolies). But, by emphasizing the importance of markets for helping the poor, market-oriented ICT interventions and applications help identify the costs of these barriers.

Our analysis has largely made use of references and examples using the telephone. More advanced technologies, such as Internet-enabled kiosks, could provide even greater benefits. For markets, a single mouse click could instantaneously and simultaneously reveal market prices in numerous locations, removing the need for contacting each directly, as with a telephone. Further, technologies such as Internet kiosks could provide numerous additional benefits. While our argument has been to show the role of markets for improving living standards, the poor need more than just markets. Health and education, for example, are important priorities. But it need not be not an "either-or" proposition, because ICTs can provide in these areas as well. For instance, many public health problems can be prevented or treated through information dissemination (e.g., through remote diagnostics), often at lower cost than treating the problem afterwards. There are equally valuable potential applications for education, including distance access to libraries, textbooks, and instruction. ICTs are the gift that keep on giving; once in place, they can be used to transmit information for a variety of uses, at little additional cost.

Recent advances have dramatically lowered the costs of providing access to a range of information technologies. These advances, plus the perceived benefits they have brought to the developed world (though still difficult to quantify, and subject to debate), have fueled optimism for the potential of ICT to help the world's poorest. The goal of this paper was to provide a theoretical argument for such optimism, as well as provide what empirical evidence can be mustered. Policymakers in developing countries face the daunting challenge of deciding how to allocate often extremely limited resources among many important alternative priorities. When selecting which set of projects will yield the greatest benefit for citizens, decision makers need information about the relative cost effectiveness of various proposed projects. Will better transportation infrastructure yield greater development outcomes than better access to telecommunications, or is a basic level of both necessary for significant progress? Unfortunately, not enough careful analysis of ICTs in developing countries has yet been done to answer these pressing policy questions. While there have been numerous studies of the benefits and cost effectiveness of other infrastructure investment projects, such as road building or dam construction, similar studies on ICTs are only now just beginning.[12] What is clear, however, is that the potential for ICTs to alleviate poverty and promote economic growth in developing countries justifies greater attention and systematic analysis.

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Endnotes

1 Meyer et al. (1992) study the role of historical prices in coordinating decentralized allocation decisions.

2 Isard (1977) asserts that “in reality the Law of One Price is flagrantly and systematically violated by empirical data.” Of course, there are other frictions that lead to divergence from the Law of One Price, including the cost of buyers’ search; the fact that knowledge quickly becomes obsolete as supply and demand are constantly in flux; the entrance of new, inexperienced buyers and sellers into the market; the costs to dealers of ascertaining rivals’ asking prices; and various indivisibilities (Stigler 1961). Engel and Rogers (1996) studied deviations from the Law of One Price for U.S. and Canadian cities. They found that “the distance between cities explains a significant amount of the variation in the prices of similar good in different cities,” and note “the failure of prices of similar goods to equalize between sites is a sign that the markets are not completely integrated” (Engel and Rogers 1996:1113).

3 Many Peruvian households do have access to public telephones, however, so reported rates based on residential telephones no doubt understate access to services (Torero 2000:15).

4 One outlying market, closer in proximity to the central market and characterized by “high intensity of trading activity,” seemed to be well integrated with the central market in the sense that central market price history was more important than local price history in explaining price changes. In the second, geographically further outlying market, “local market history was the predominant determinant of prices” (Badiane and Shively 1998:429).

5 The price transmission mechanism also affects the variability of prices across regions. This may occur because high prices entice inventory holders to sell, leaving less of the good available to cushion later changes in demand. Lower inventories then produce higher future price variance. In contrast, lower prices lead to higher inventories and lower future price variance. Badiane and Shively (1998:430) identify such an effect in Ghana: “a 1 cedi decline in the [central market] maize price led to a 0.5 cedi reduction in price variance in the relatively well-integrated [outlying] market, but only a 0.1 cedi reduction in price variance in the relatively isolated [other outlying] market.”

6 This survey was a panel study conducted in eight provinces in China between 1989 and 1997 by the Carolina Population Center at the University of North Carolina at Chapel Hill, the Institute of Nutrition and Food Hygiene and the Chinese Academy of Preventative Medicine. The data and additional information can be found at <http://www.cpc.unc.edu/projects/china/home.html>.

7 Areas A and B in Figure 1 illustrate the loss to a supplier when the alternative to ignorance is precise knowledge of the prices PL and PH, assuming the supplier is risk neutral. The loss in expected value of (A+B)/2 is itself an expectation for a supplier with only imperfect knowledge of future prices—as is usually the case even for well-functioning markets in developed economies.

8 There has also been great optimism over the prospect of developing country craftsmen selling their quality wares directly to developed country consumers. However, such an approach, even if successful, probably would not account for more than a small share of total of production by the rural poor in developing countries.

9 Imai (2001) estimates the total resource transfer from urban and rural households to the Chinese government from price and wage controls to have amounted to 10.4 percent of GDP during the fifteen-year period before 1979.

10 Statistics from a telegraph company for one month in 1856 confirm the salience of market information signals via the new communications technology: "Of the 20,400 messages transmitted, at least 57 percent were unmistakably commercial in nature ('messages to buy and sell goods,' 'instructions to pay money and notes,' 'reports of markets,' 'messages respecting freight and shipping,' and 'general mercantile matters')" (Du Boff 1980:470).

11 In particular, we undertake a limited instrumental variables strategy; under such a strategy, if we can find a factor that predicts whether a village receives a telephone, but is uncorrelated with *changes* in income, or other factors that affect income, then this factor can be thought of in some way as pseudorandomly allocating phones across villages (as far as income is concerned). If we can statistically exploit this pseudorandomization in telephone allocation, we can in effect purge the results of unobservable factors, and overcome the problem of reverse causality, because we are only looking at differences in receipt of telephones that is uncorrelated with income changes. As much of the spread of the telephone in China during this time was based on fixed-line technology, the spread was generally radiating out from major cities; thus, the distance to the nearest city, for which we have data in the CHNS, is a good predictor of whether the village received a telephone during the survey, but in general should be uncorrelated with *changes* in income over this time. Results from this limited strategy yield similar results to those shown in the main text; again, this allays concerns about reverse causality or differences between villages that receive telephones and those that do not receive them.

12 For one example, see the Sustainable Access in Rural India (SARI) project, which the authors are involved with, at <http://edevelopment.media.mit.edu/SARI/mainsari.html>.

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CHAPTER 8

Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle

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Introduction

Telecommunications companies, entrepreneurs, and policymakers have regarded rural and poor markets with some combination of too-complex-to-serve and not-interesting-enough (politically or economically) to be worthy of sustained attention. But times—and technologies—have changed, leaving what have been perceived as backwaters poised to become significant growth areas in the next decades.

Stakeholders are beginning to recognize the political and economic significance of the more than half of the world's population that lives in largely untapped rural markets. Governments and nongovernmental organizations are increasingly concerned with addressing economic development goals and stability, stubborn deficits in rural health and learning, urban migration, environmental degradation, and other related trends. The private sector craves new consumers, producers, ideas, and synergies in our rapidly globalizing environment. What most have yet to understand, however, are the tremendous opportunities to address these challenges through new information and information communication technologies (ICTs). Increasingly powerful, flexible, and economical, ICTs present staggering new opportunities for social and economic integration. Achieving the promise of ICTs does not require sacrifice on the part of business, government, or civil society, but it does demand their vision, cooperation, and action to create the environment and mechanisms necessary for ICTs to flourish in the rural areas of the developing world.

One force necessary—albeit insufficient—for the establishment of pervasive and sustainable readiness for the Networked World, especially in developing and rural areas, is the *market*. It is commonly assumed that effective rural ICT access requires economic subsidy and financial loss; however, ICTs should be economically viable if they are to gain wide, robust, and long-lived usage. While the path to realizing such economics will vary across countries, settings, cultures, and technologies, we consider one critical issue: Internet for rural regions of developing nations.

In researching and studying the economic self-sustainability of the Internet in rural areas (particularly in India), we have identified some criteria for success—something of a laundry list. This list suggests that there are at least six broad categories[1]

Figure 1: **Nature and Level of Interactivity Between Factors Affecting Rural Internet Sustainability**

	Costs	Revenue	Networks	Business Models	Policy
Capacity	LOW: Unless access to computer maintenance is limited	HIGH: Business, IT and outreach skills key for new industry	MEDIUM: More users ease awareness raising and training	MED/HI: Capacity suggests limits of model	MED/HI: Education, training opportunities
Policy	HIGH: Competition, taxes and tariffs, requirements for entry, spectrum, interconnection	HIGH: VoIP alone is significant	MEDIUM: Policy broadly affects Readiness, users become political constituency	HIGH: Decides potential for RSP and franchisees, public sector as network client	
Business Models	MEDIUM: Appropriate models reduce costs	LOW: Location guides clientele and applications	LOW: Little direct connection		
Networks	HIGH: Metcalfe Effect costly to leverage (or else it would be done), scale economies grow with network size	HIGH: Size and scope drive content, utility of medium			
Revenue	LOW: Except specialized services requiring extra investment (copier, camera), assuming always on connection				

Source: Information Technologies Group, Center for International Development at Harvard

that must be considered for economic self-sustainability: costs, revenue, networks, business models, policy, and capacity. The groupings are imperfect due to the interrelationship and interdependence among categories, which make consideration of any one category ineffective. A more accurate way to think of the categories might be to imagine them as a balloon, which when pushed in one area, bulges in others. For instance, policy will affect cost, which in turn influences business models and therefore revenue and on down the line; this leads us to the not-so-profound conclusion that everything affects everything else.

In Figure 1 we have artificially isolated the relationships between some of the diverse factors affecting economic sustainability for rural Internet, but it should be noted only when the system is taken as a whole can we describe it accurately. We are only beginning to understand the complex nature of these relationships, but have attempted to suggest the level of interaction and provide an indication of the type of effects we might expect to see.

One important assumption underlying many issues in the effort to achieve self-sustainable Internet service is that, in a poor rural setting, the Internet is likely for some time to be delivered as a community resource, rather than a personal one. In other words, rather than each individual having a network-enabled digital appliance for himself or herself, each village or community might have shared resources that are financially sustained through some combination of user fees and outside revenue. This basic model is often realized through some form of community access point for information and communications services, often known as a community telecenter or telekiosk.[2] While community computer facilities (also known as shared models) are discussed most directly in the business models section below, their basic structure and resource needs underlie many of the arguments made here. This paper gives primary consideration to existing models, but telecenters will certainly evolve in the coming years to include mobile and wireless access via handheld devices, thus offering a new set of opportunities to enhance sustainability and value. The shared model has been applied to ICTs in recent times and to other resources in the past, and we feel that, in many settings, it is not only financially appropriate, but also culturally acceptable.

Telecenters in the developing world have, thus far, been primarily sponsored and undertaken by governments, multilateral institutions, and nonprofits. Because of the desire to create what is essentially a public good (access to information and communications services), only secondary attention has been paid to entrepreneurism and sustainable business. There have been significant achievements under challenging circumstances, but generally we have been better at learning about and making mistakes with telecenters than we have been at creating economically sustainable models and universal access to ICT in rural areas. While we agree that access to ICTs is important and that it can, and should be, supported by the international development community, we suggest that collective support for it should come in new forms that focus more on enabling others, rather than on sustaining them. We also suggest that the private sector, from large corporations to grass roots entrepreneurs, has the most significant role in creating and broadening effective use of ICT.

This paper offers early thoughts on some of the challenges policymakers, the private sector, the international development community, and others face in unleashing the power of markets to better serve information and communication needs in rural and poor areas. It is our firm belief that the diverse interests of all the stakeholder groups converge around sustainable rural ICT, and that a market approach driven by the private sector and entrepreneurs is the fastest and most efficient way to include rural communities of developing nations in the Networked World.

Keeping Costs Low

It goes without saying that one of the keys to achieving economic self-sustainability is keeping capital and recurrent costs low. Capital costs include hardware, software (if purchased), network equipment, the physical premises, setup license and connection fees, and the like. Recurrent costs lie mostly with Internet and telephone usage fees, electric power, rent, maintenance and repair, and salaries.

Reducing capital costs with new devices and wireless

At present, the most significant capital costs in offering community Internet are for hardware and network access equipment.

A range of low cost Internet-enabled digital appliances have been developed, and these can be far cheaper, and indeed, better adapted to the developing world context in their form and function, than traditional desktop computers. While they remain the dominant access device, personal computers (PCs) are inappropriate for the developing world across many dimensions, due to relatively high cost, low reliability, unsuitable user interface, environmental sensitivity, and high power consumption. Handheld appliances such as the Simputer (http://www.simputer.org) or Pengachu (http://www.media.mit.edu/~rehmi/pengachu/v3_ document.htm) have shown that network-enabled computers can today be priced at under US$300. Longer-term research, at the Massachusetts Institute of Technology (MIT) Media Laboratory and elsewhere, prices next generation appliances at dollars or even pennies.

Additional high fixed costs are due to the network infrastructure. Connections achieved via the public switched telephone network (PSTN) often carry high fixed costs.[3] Both fixed and mobile wireless technologies fundamentally change cost structure because they reduce the time, effort, and expense of last mile service delivery, which typically comprises the majority of all infrastructure costs.[4] Moreover, wireless allows new entrants to compete against incumbent providers with their own facilities, and the operator has an increased incentive to maximize the number of users because the marginal cost for each additional user is lower than with wireline networks.

New low-cost network technologies are fundamentally rewriting equations of economic self-sustainability for rural Internet connectivity. Those rural communities within microwave radio reach of existing fiber optic cable links can effectively make use of Wireless Local Loop (WLL) last mile solutions (Kibati and Krairit 1999). At today's price of under US$300 per subscriber line, WLL solutions such as the corDECT technology can provide both telephone and Internet connectivity up to 10 km away from the base station, and 25 km from a relay base station. The corDECT system is engineered primarily for low price, rather than added (and often unnecessary) features, and is therefore designed for developing world needs. The system offers 35.5/70 Kbps simultaneous voice/data transmission (http://www.tenet.res.in).

For rural communities too distant from fiber backbones or in terrain too rough for the line of sight required between terrestrial microwave antennas, Very Small Aperture Terminal (VSAT) satellite is a common approach for connectivity. Today's prices for send/receive units range from about US$4,000[5] to over US$10,000, thus making this approach inappropriate for many poor or small communities.

VHF or UHF wireless solutions are a potentially compelling option for narrowband connectivity that can also function in remote and rough terrain (e.g., see http://www.arrownetworks.net), or relatively depopulated, settings. These can cost under US$800 per subscriber line, transmit over 200 km distances, and provide upwards of 9.6 Kbps connectivity.

Using appropriate technologies to reduce recurrent costs

The main factors contributing to recurrent costs include telephone, Internet access, power, and personnel costs. These costs are primarily related to issues of government policy and competitive environments, and we will only address them to the extent that they directly affect economic sustainability.

Telephone toll charges can make up a heavy percentage of recurrent costs if a regular telephone call is necessary to connect to the Internet, particularly given the prevalence of time-metered calling and Internet Service Providers (ISP) that require long-distance calls. Telephone and Internet access technologies that separate voice and data, such as the corDECT system, can reduce costs by handing voice off to the PSTN while switching data directly to an ISP (Jhunjhunwala 2000). Such a simple technological accommodation that does not bill Internet access as a phone call can allow substantial savings in telephone toll charges, and does so in the absence of a policy decision that bills Internet at a different rate or offers flat rate calling.

Research suggests that for both power and Internet charges, costs for solar photovoltaic (PV) power and wireless connectivity will incur lower recurrent operating costs as compared to grid power sources and wireline connectivity. Indeed, when amortized over a period of years, the savings in operating costs will make up for the added capital costs (Best et al. 2001). In other words, being off the electricity grid does not necessarily imply higher net present valuation. Moreover, due to the fact that grid power is commonly unreliable in the developing world, backup power supplies and batteries imply additional costs and frustration that can be reduced under systems such as solar PV. It should be noted that alternative energy supplies may have implications for related electrical infrastructure, such as air conditioning or photocopiers.

More compelling than PV power or other renewable sources, however, are new advances in very low-power consuming digital appliances. The Pengachu device, mentioned above, consumes roughly 50mW of power, and has been fitted with a hand winder that can provide all of its power needs. Similar to the well-known wind-up radio (http://windupradio.com/freeplay3.htm), wind-up Internet appliances are genuine technological options.

Finally, in an assessment of rural Internet services for Tamil Nadu in India, McKinsey & Company-Delhi (Davies et al. 2001) has argued that recurrent costs can be reduced by 30 percent in rent, electric power, and salaries if the service is provided within an existing business. Commonly observed examples include telephone call centers, temples, small grocery stores, schools, post offices, and government offices.

Depending on the local labor market, availability and competitive remuneration for qualified employees varies widely. One commonly observed strategy for telecenters is to hire secondary and tertiary students at low wages to serve as facilitators and perform other tasks such as repair and research, and to make the position more appealing by offering free Internet access.

Summary

With today's technologies, a village in India can be brought online and provisioned with Internet, telephone service, a computer, and so on, for under US$1,000 in capital costs and with ongoing recurrent costs approaching US$60 per month (Davies et al. 2001). It is likely that these figures can be reduced by an order of magnitude over the next decade. It goes without saying, however, that costs are intimately related with other aspects of the community and business model, including culture, geography, population density, services, technologies, and other factors, and that their interaction will dictate observed cost.

Generating Revenue from Diverse Fees and Services

If equipment, connections, rent, and salaries, are the economic pains needed to offer rural Internet service, user fees for applications and remote services, and income resulting from the aggregation of many users are the economic gains. Given that the technology components and public access business model is essentially a platform capable of facilitating a wide range of activities, more applications and content will allow revenue generation from a greater variety of sources and effectively lower the level of income necessary for the sustainability of each unique application. There will also be associated benefits arising from the wider and deeper integration of the telecenter and ICTs within the community, as suggested in Chapter 7 by Eggleston, Jensen and Zeckhauser.

User fees are particularly difficult to generate in some cases, but as we will later suggest, they are not the only source of income. User fees, however, yield other benefits besides the generation of financial support; they also ensure economical use of the infrastructure and offer a market incentive and feedback for content, applications, and services that are appropriate to the users in that community. User fees generate challenges, however. We note that a market mechanism may lead to externalities that some consider negative, including the development and diffusion of games, adult content, and other potentially controversial applications. It may result in unequal access for different members of the community, such as children and (particularly) poor people, who may require subsidies or discounts to address their needs effectively.

We believe that there are three main classes of revenue production for rural Internet services. First is fee-for-services such as core communications, education, commerce, government applications, entertainment, training, and so forth. Second is a variety of remote services and back office activities. Finally, the aggregation of services and users provide opportunities for revenue (described below).

Focusing first on core communication applications

Core communication services are the *killer applications,* acting as a pathway to other uses of information and communication technology. This was true in the nations of the Organisation for Economic Co-operation and Development (OECD) and in urban areas, and it will be true in the rural South. In other words, the core revenue generators are information systems that connect people to each other despite barriers of time, distance, written literacy, and ownership of a telephone or computer.

Synchronous and asynchronous text and voice services such as e-mail, voice mail, chat, and Voice over Internet Protocol (Internet telephony or VoIP) are particularly relevant in many developing world contexts. This is due to commonly observed characteristics such as high call charges (relative to both income levels and comparable rates in the OECD), high rates of national and international migration, weak postal systems, and limited direct access to communications devices (i.e., like a telephone in the home). With public Internet access sometimes costing less per hour than a local telephone call (and much less than the exorbitant long distance rates), e-mail, chat, voice mail, and VoIP are appealing cost savings measures. In Peru, for instance, rates for public Internet access are often less than US$0.50 per hour, while telephone card rates for local calls are approximately US$0.60 per hour; long distance costs US$0.80 per minute and upwards, as compared to less than US$0.20 for VoIP calls. Note that VoIP is illegal in many countries (more information in the policy section.)

These text and voice services have been shown to be strong revenue sources for those providing access to Internet services in rural areas. In rural Bangladesh, for instance, International Telecommunications Union (ITU) models argue that *not less* than 1.5 percent of Gross Domestic Product (GDP) per capita will be spent on core communication services (Kayani and Dymond 1997), while estimates for India suggest communications spending of up to 5 to 6 percent of GDP per capita (Jhunjhunwala 2001). Early Internet trends in Bangladesh show that 82 percent of the online traffic is going to e-mail. Thus, in Bangladesh, there is both the demand and willingness to pay for communication services and these services seem to comprise the majority of Internet usage. Moreover, in the previously cited McKinsey (2001) study, a survey of cybercafés in urban India has shown that upwards of 50 percent of usage time is spent on e-mail and in chat rooms. As trends toward increased labor mobility continue and agricultural production becomes more linked to urban markets, rural “organic communication networks” (Heeks 1999) and and their communication demands will only expand further.

Communication is both a core desire of most communities and a relatively straightforward process to support with the use of ICTs. Whereas, for instance, designing a Web interface to manage a supply chain and integrate it into business can be quite complex, voice and text communications applications, being fairly simple and requiring minimal localization, can quickly begin running in communities.

While many applications are already available, additional innovations in core communication applications are required if user demands in rural areas are to be fully satisfied. The MIT Media Lab, for instance, has been exploring new multiliterate keyboardless systems that support threaded voice discussion for new VoIP systems particularly suited for rural areas in developing countries. These new technologies, and business models to deliver them, are designed to flourish in rural developing areas by fulfilling the unique needs of their communities and networks.

Promoting gradual growth of other revenue sources

In our estimation, at least 50 percent (and possibly much more in the early stages of connectivity) of revenue from user fees for rural Internet services will arise from the provision of core communication services. These services will enable people to better address their basic needs to communicate with family, with remote trading partners, with their government or others. E-commerce, e-government, entertainment, education, and health show promise for additional specific applications and services that reach beyond basic communication. We will now discuss these areas only to evaluate how they might provide additional services based on user fees.

E-commerce for rural developing areas has often been seen as a problem of porting the existing e-commerce models of the OECD, framed by concepts such as “B2B,” electronic payment systems, and so on. Just as *konbini*, the Japanese convenience store, recognized the opportunity to allow consumers without credit cards to order online and pay upon delivery, we argue that e-commerce needs to be newly conceptualized for this new context. E-commerce environments must offer different services and employ alternative delivery and exchange mechanisms, and they must provide relevant and worthwhile support to the agricultural, informal, and micro- and small business sectors. Private sector groups are also interested in other potential commercial applications including insurance sales, remittance transmission, and other financial services. These groups pursue their goals in the face of subsistence economies, little access to capital, no credit cards, and the absence of effective tools for consumer protection and dispute resolution.

The case of agribusiness and agricultural management support systems has been given considerable attention in the ICT and development community. And indeed, there appears to be scope for agricultural services based on user-fees (in addition to aggregation approaches as defined below). However, although market price information for the agricultural sector is often touted as a substantial value addition of rural Internet services, the promise and economic self-sustainability of such a service has recently been called into question (Aral et al. 2001). Market prices can be valuable, but their importance will depend on other community characteristics including availability of transport, credit, and alternative markets.

E-government services can also support economic self-sustainability via user fees (in addition to aggregation approaches discussed below). In the Gyandoot project of Dhar district, India (http://gyandoot.nic.in/), a collection of telekiosks run by local operators offer e-government services to consumer-citizens. A study of one such telekiosk showed that the grievance system, a facility for citizens to lodge complaints against the government with a guaranteed response within one week, was the third most popular information service of the program. (The most sought-after information was around market prices and job availability.)

Entertainment, as it relates to rural Internet service, is a fundamental application area that has not been sufficiently studied. One indicator of the power of entertainment content, however, is the penetration of cable television into rural India.[6] In India there are roughly 32 million cable television subscribers as compared, for instance, to 26 million fixed telephone subscribers. In rural India there are at least 10.5 million cable subscribers, making up 32.5 percent of the country's total subscription base and 8 percent of all rural households (note that it is possible that the total number of subscribers is underestimated by up to 50 percent). Small, independently operated businesses provide cable television in rural villages at a cost of only dollars per month. Clearly, rural cable TV is economically self-sustainable, indeed is flourishing, given the large demand and willingness to pay for entertainment products in rural and poor India, and the reasonably low costs. Furthermore, the entire existing cable network was rolled out in less than a decade.

Education and health are critical application areas if the Internet is to directly address core development objectives in rural areas, and they also can help with economic self-sustainability through powerful public-private collaborations. The World Links project (http://www.world-links.org/), for instance, has been developing an after-school community telecenter program in Uganda. Under this program, schools in rural Uganda that are equipped with computer labs and VSAT-based Internet connections are opening up their labs to outside clients in the afternoons and evenings on a cost-recovery basis. Funds are then used to cross-subsidize daytime educational use. In other words, educational use of the Internet has become economically self-sustaining by leveraging the existing school infrastructure, all the while allowing the surrounding community to benefit from ICTs; the outside community, in turn, supports the educational mission of the computer laboratory. Similar creative partnerships with rural health clinics have been envisioned.

Furthermore, delivery of training, in particular computer training, is increasingly in high demand for rural Internet centers. NIIT, a multinational computer training and service corporation, has franchised five hundred thirty rural ICT training facilities situated in villages throughout India. These facilities offer mostly basic and short-term training in computer literacy, Microsoft products, and so forth. These rural ICT training facilities educate forty to fifty students per year in small laboratories, and are operating as financially viable businesses.

Creating jobs and revenue with remote ICT-enabled services

A variety of remote services and back office activities may be performed anywhere and delivered anywhere, given adequate Internet connectivity and available people with the relevant communications capacity (primarily literacy in the appropriate language) and skill set (ranging widely from accounting to medicine to ICT problem solving).

Spryance, an India-based remote services company with headquarters in the United States, has developed a pioneering home and rural medical transcription program that allows people with an adequate connection to the Internet in any part of the globe, to participate in the knowledge economy. Spryance employees, mostly women, work out of their own homes, providing transcription services over the Internet. The program has been growing at a rate of 25 percent per month over the last year and average earnings are more than twice those of comparable "factory-style" environments. While the home-based workforce program started mostly in metropolitan areas, it continues to expand into submetropolitan and rural areas.

Summary

This diverse range of activities and interactions allows the telecenter to become a hub for the rural community; serving existing needs while creating additional business opportunities including ICT training, photograph printing, Web design, computer repair services, research services for businesses and students, book selling, or serving as a shipping location.

Benefiting from Network Effects, Scope, and Scale

A variety of network effects will drive economic self-sustainability of rural Internet. The number of Internet users overall, and particularly those in rural areas and developing nations, are an important factor in its sustainability—not only because they will pay user fees, but because of their effect on others. That is, each additional user increases the value of the network to all other users quadratically, offering more opportunities for interaction, seeding incentives for content, and service creation, all the while sharing the infrastructure cost burden more broadly.

Aggregating markets and leveraging the Metcalfe Effect

Bob Metcalfe, inventor of the Ethernet, has identified a critical type of network effect which now bears his name. The Metcalfe Effect (or "law" [Gilder 2000]) argues that the value of any complete network such as the Internet (where all things connected to the network have access to all other things) grows with the square of the number of users, as opposed to a simple linear growth.[7] Put simply, the Metcalfe Effect tells us two things. One is that the value of the Internet grows very quickly with the number of users, but, conversely, the value of the network is quite small when there are a small number of users connected.

The Metcalfe Effect suggests that the value to users, and thus self-sustaining demand for the network, will only be substantial when a sufficient number of interrelated groups are connected. As long as rural Internet connections are left to isolated pilot projects or small scale efforts—one here and one there—they will never leverage the Metcalfe Effect and the real value of the Internet. When entire rural regions are networked, so as to connect communities to their neighbors, families, friends, governments, markets, and intermediaries, regardless of where they are, true value can be delivered.

In addition to creating value for users, this aggregation of users, their needs, and the integration of their markets, provides another attractive source of revenue. Much as a magazine becomes increasingly interesting to advertisers and contributing writers as its circulation rises, even a rural user community becomes a viable market for outside organizations, in the public, private, and nonprofit sectors. Prahalad and Hart (1999) have shown that fast-moving consumer goods (FMCGs) manufacturers can gain a great deal by attending to rural, poor markets previously thought to provide no opportunity. Because reaching these consumers can be challenging, Indian firms, such as detergent makers Nirma and Hindustan Lever, are interested in and willing to pay for enhanced access to those populations via the Internet.

Agricultural firms are similarly interested. EID Parry is an Indian firm that manufactures and markets fertilizer, among other activities, and has been providing Internet kiosks to their sugar farmer customers in Nellikuppam, in rural Tamil Nadu. These facilities help EID Parry reach out to local growers, offering them technical assistance and information (currently in the form of an online portal), developing new sales opportunities, and providing logistical support and credit services. Their online Cane Management System, which offers farmers a personalized account, including details on their fertilizer needs, outstanding credit to EID Parry, acreage, and so forth, has proven to be their most popular service.

Thus, fee-for-service on applications is not the only possible revenue model for the Internet in rural areas. Access to users can be provided for a fee to outside businesses, while respecting privacy and protecting communities. Agricultural companies, FMCG companies, the government, NGOs, and the like, all have an interest in these aggregations. But the value comes only when enough members of the target community and enough communities are aggregated.

Returning to the magazine analogy, increased circulation, prestige, and certain demographics will motivate contributors. By the same token, a sufficiently attractive userbase can also offer an incentive for content to be generated and applications designed for them, thus potentially creating additional value and revenues for telekiosks.

Exploiting economies of scale and scope

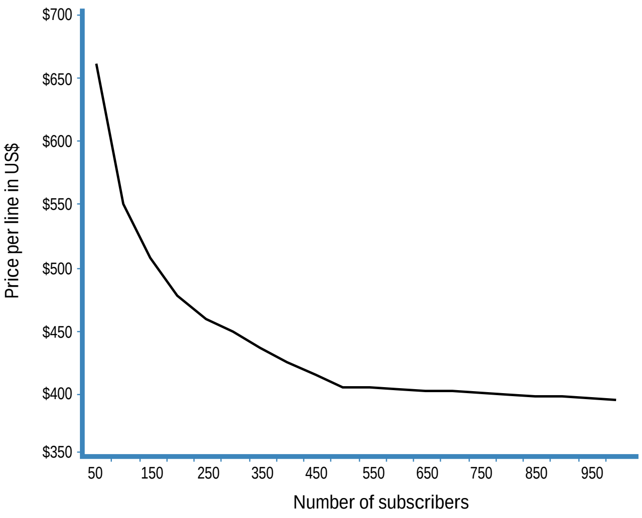
Rural Internet services clearly enjoy certain economies of scale and scope: significant numbers of users lower production and distribution costs, and awareness and breadth of use offer increasing returns. This suggests that while some small, boutique telecenters may be able to realize economic self-sustainability, most will be hard-pressed to leverage any economies and will suffer from higher costs and less content.

As PCs become more and more like commodities and profit margins go towards zero, economies of scale associated with purchasing PC hardware begin to vanish. (Most scale economies are built into the price to begin with.) However, infrastructure, particularly for the Internet, benefits significantly from economies of scale. For satellite-based connectivity, savings are realized in particular when scale is achieved in the space segment (i.e., the use of transponder space on the orbiting satellites). Here also, however, such scale economies are diminishing as new technologies and business models support smaller deployments (Lusignan 1999).

For terrestrial systems, economies of scale are enjoyed as the number of subscribers increase per radio access tower erected, or copper or fiber cable laid. The corDECT system, a Wireless Local Loop (WLL) technology manufactured by the Midas Corporation, is an example that demonstrates these scale economies.

In Figure 2 we see that the price, in U.S. dollars, per subscriber for the corDECT WLL system plummets as the number of subscribers increases.

Figure 2: **Price per Subscriber for the corDECT Wireless Local Loop System**



Source: Midas Communications Technologies Private Limited, "CorDECT Wireless Access System," December 2000

Economies of scope allow revenues and risks to be spread over a variety of potential sources. One of the strengths of the community computer center model is that it easily allows for such economies of scope. The costs for power, rent, salaries, and so forth are all shared across a variety of services, such as entertainment and communication. The cost to the operator to deliver each additional service approaches zero, yet it may attract additional users. As service offerings become more diverse and context-appropriate, use becomes more intensive, and as more users within that society access these services, the need for educating new users decreases, while risks of offering service are distributed more widely across the community.

Designing context-appropriate business models

The creation and implementation of innovative business models that are low cost, dynamic, and responsive to local needs in their delivery of ICTs is at the core of achieving economic viability and creating value for the community. As mentioned in the introduction, economic self-sustainability of the Internet in rural areas over the next few years will depend on one key business decision: making facilities shared, rather than focusing on individual use. For instance, Internet services and facilities are provided at multipurpose community telecenters or telekiosks. These facilities aggregate the demand of an entire rural community, take advantage of economies of scope, and can be situated in existing structures (e.g., temples, schools, government offices, and small markets), thus reducing recurrent costs, while increasing traffic and helping to integrate the facility into the social fabric of the community.

Creating rural service providers

We have been working with Professor Ashok Jhunjhunwala of IIT-Madras (inspired by his original work with Bhaskar Ramamurthi) to develop local Internet and telephone business models in rural India that are small, entrepreneurial, and leverage the informal sector, while also achieving economies of scale and scope. These businesses will look very much like the Indian rural cable television operators described earlier. In this business format, a local entrepreneur is able to quickly and inexpensively receive a license as a Rural Service Provider (RSP). Such providers can offer computer applications, Internet services, and basic telephone services through public access centers (which are effectively franchises) and private connections, and use some combination of WLL, fiber, VSAT, or other technologies to connect to networks operated by an ISP and/or other telecommunications companies. The RSP license would require fair and equitable revenue sharing between the rural provider and a major formal-sector basic service operator such as the incumbent voice provider.

The RSP business model allows small and informal-sector enterprises, operating with extremely favorable cost structures and committed to providing high levels of local service, to offer very economical rural ICT services via telecenters. The combination of the entrepreneur's flat cost structure, service commitment, and understanding of the local market, together with other like entrepreneurs or RSPs who can offer the aforementioned benefits of scope and scale is at the core of this model.[8]

It is also significant that the RSP model will be able to help governments and telecommunications companies achieve universal access by offering voice telephony in rural areas at a cost and level of service that is currently unachievable in many communities. Indeed, many incumbents require or request subsidies to serve these markets, thus squandering scarce resources and opportunities for smaller and local entrepreneurs, and often leading to poor service at a high cost with questionable economic sustainability.

Adding telecenters to existing businesses

Combining telekiosks with existing organizations can indeed lower recurrent costs while sharing capital costs across more users and services. In the case of a school (exemplified by the World Links example described earlier), an administration may offer the computer lab for community use in the school's off hours, thus ensuring more effective use of infrastructure and resources and generating revenues to help pay recurrent costs. Alternatively, an operator may sell blocks of time, instruction, or services in her cybercafé to local institutions such as schools, businesses, and hospitals. These institutions have better resources than individual families, and they can thus be used as a sort of anchor tenant, allowing the establishment of a base level of income in the café while providing a valuable service to the community.

As part of the Schools Program in Tamil Nadu, the government issued a tender to private companies to create computer labs and offer instruction in all twelve hundred public higher secondary schools. Private operators retained ownership of the equipment (and responsibility for its functioning) and were able to supplement the state fees by using the facilities to generate additional revenue outside of nonschool hours (http://www.elcot.com).

Adding businesses to telecenters

Telecenters will also improve viability by delivering an extended suite of services relevant to the community, depending on the available information infrastructure and human capital. In other words, in addition to providing online access to information and communications, they may also offer ICT training, business center services, computer repair, Web design, and back office services such as accounting. The basic premise is that their capacity, both technical and human, should be leveraged fully in order to best use these resources. Capital goods, such as hardware, quickly depreciate, some or all Internet costs are fixed, and employees must be paid regardless of their work level; savvy business owners will, therefore, seek ways to keep their workers and equipment fully employed. Full employment will not only generate additional revenue, but also gradually may help move the business and its capabilities up the value chain. At a community level, the range of services offered creates greater acceptance of ICTs and further embeds them within the social and business culture.

Promoting rural-urban cooperation

Relationships with organizations from outside the community, whether by formal business ties, investment, or grants, can play important roles in financial viability. Private sector supply-side participation is a key component for entrepreneurs' access to capital, equipment, networks, applications, and expertise.[9] Likewise, developing this cooperation improves access to previously hard-to-reach rural markets for these organizations, allowing them to serve new consumers, build networks, and create new economies of scale and scope.

Guarding against potential negative externalities

As with any business, other factors affect the success of the business approaches discussed above, including location, marketing/awareness, and staff composition. These considerations present potential dilemmas from a development perspective, because there may be a tendency to locate facilities in wealthier areas, advertise in the language and location of certain consumer groups, or create an atmosphere that is unwelcoming to particular members of the society. One important safeguard against business owners taking this approach is a genuine potential for competition, which may make them more inclined to maximize their market share. Varied regional experiences and limited relevant data do not allow us to suggest a systemic solution. It is important for development organizations and government to remain vigilant in order to stem increased disparities in access to ICT.

Supporting Rural Access with Policy

Shared access models have been able to operate in many different regulatory environments (sometimes illegally), but have depended on flexibility to address market needs within the existing framework, regardless of whether the framework appeared welcoming. Telecenters exist where there is a state-owned monopoly provider and where there is complete openness and competition. They offer VoIP when they are able, and chat and e-mail when they are not.

The telecommunications policy and regulatory framework as well as the overarching business environment present key opportunities for, and challenges to, rural ICT provision in general, and the telecenter model in particular. These factors affect everything from investment in infrastructure to availability of capital, and directly and indirectly dictate the range and profitability of services. As suggested by Beardsley et al. in Chapter 11 of this report, a government will determine its particular mixture of regulatory policy according to its ICT objectives (i.e., to deepen universal access, increase government proceeds, raise Networked Readiness). We will not enter into a detailed description of the regulatory and business environments here, but will mention some of the significant aspects with direct implications for telecenter operators, RSPs, and similar businesses.

Adapting to dynamics of rural markets and limited competition

The number and nature of the participants in the telecommunications industry affect costs, speed, and service quality and have substantial financial and business model implications for providers. Generally speaking, competitive environments and multiple backbone providers will offer lower costs and higher service quality and range, and be more inclined to create and adapt to a dynamic communications environment.

Large telecommunications companies are attracted to large urban areas, and are reluctant to enter smaller and rural markets where they are less profitable and often lose money. Governments have required and cajoled them to serve these areas through a combination of service requirements and subsidies, but have had limited success in creating competitive rural markets. In much of the developing world, rural access remains limited in scope, consistency, and quality. New entrants typically give priority to the lucrative urban markets, and may meet rural service requirements with infrastructure that is insufficient for effective Internet access.

While Peru's fixed line telephony market is officially liberalized, for instance, incumbent Telefónica del Perú offers the only wireline service outside Lima. Monthly rates for leased lines to telecenters are US$560 for 64 Kbps and US$780 for 128 Kbps, and many operators complain about bottlenecks, delivery at much lower speeds, and slow response to problems. Informal surveys suggest that telecenters in Lima, where there are multiple service providers, were more likely to lease faster connections (128 and 256 Kbps rather than 64 or 128 Kbps), and pay lower rates (US$350, US$620, and US$1,200 for 64, 128, or 256 Kbps, respectively). Some operators outside Lima reported that they were reluctant to switch to satellite service, fearing that it would be inadequate for the needs of their business and that, upon returning to the incumbent, the operators outside would be punished. The results are that line costs comprise nearly half of spending for most telecenters in smaller cities, and that the increasing commoditization of Internet access means service problems result in not only lost business, but also lost customers.

Some Indian private sector Basic Services Operators (BSO) are experimenting with variations of the aforementioned RSP model because of government requirements to serve entire Indian states, including rural areas. By effectively subcontracting a smaller company with a flatter cost structure to deliver service in these less appealing markets, the private sector BSOs hope to be able to meet their service coverage targets more efficiently. For their part, RSPs have a direct incentive to offer a context-appropriate range, cost, and quality of service, are able negotiate their coverage obligation, and would not be required by the central government to post a cash guarantee.

Removing regulatory barriers to rural service

Many regulatory regimes are designed to address for large operators primarily interested in delivering service in urban areas, and certain requirements have negative implications for operators interested in rural areas. The specific regulations governing entry into telecommunications services that have particularly profound cost implications for rural operators include universal service and access requirements (to deliver service to a broad geographic area—i.e., an entire state or country—at a certain level of density), cash deposit requirements (this is particularly harmful for less profitable markets and medium term market development strategies), and wireless spectrum allocation (which may effectively punish rural operators because of the lower user density).

A strong and independent regulator is commonly held to be one of the cornerstones of a competitive and efficient telecommunications market, and while reforms are showing progress, there are still significant deficits related to the size and resources of many monopolies, including their national political and economic significance, and the relative inexperience of many regulatory entities.

In this age of telecommunications convergence, the policies for service classification determine which services operators at any level are permitted to deliver, and the technologies that they may use to do so. The most relevant considerations here are whether or not Internet service provision is considered a value-added service and operators are allowed easier entry (as opposed to the common barriers for basic telephony, for instance), whether VoIP is legal (it is not, in many cases), and if it is legal, whether it is considered a data or voice service.

Promoting universal access policies and supporting incentives

Requirements for universal access can be key drivers for government and telecommunications providers to reach rural areas, but because rural markets are not as appealing as urban ones, providers tend to neglect them. Setting appropriate and attainable target service levels has proved difficult, and enforcing timetables has been equally so. Countries are experimenting with new regulatory approaches that blend rural service incentives and requirements, with many nations instituting telecommunications taxes that reserve a portion of earnings for rural service subsidy. In Bolivia's recent market opening, no-fee licenses were offered in exchange for commitments to rural service and education. Chile created a fund for rural service to attract private operators who, upon closer study of the market, actually determined that no subsidy was necessary.

Requiring interconnection—and enforcing It

Many smaller ISPs must expect uneven regulatory enforcement, and are frustrated by the unpredictability of their environment. One of the central and most difficult challenges facing smaller ISPs is that of ensuring timely interconnection between national carriers, regional providers (if they exist), and telecenters, all at fair rates. Both actual interconnection and rate setting are essential for competition, particularly where one carrier is the primary holder of the infrastructure, but have proved difficult even in developed markets where regulatory capacity is greater, and should be accorded significant attention.

Being wary of time-metered calling charges

While many rural Internet facilities depend on "always-on" connectivity for access to the Internet, some use dial-up connectivity. The negative impact of time-metered calls for Internet access, versus the flat rate used in the U.S. or discounted rates in Chile, Colombia, and elsewhere, cannot be underestimated. Metered rates in many Latin American nations, for instance, effectively double the cost of Internet access (ITU, 2000).

Using VoIP to promote competition

The drastically reduced costs of VoIP represent a significant financial threat to long distance and international service incumbents, and a tremendous revenue source for telecenter operators and RSPs. Many governments are wary of reducing incumbents' overall revenues, whether by diminishing income from outgoing international long distance (often used to cross-subsidize local telephony) or changing the balance of incoming versus outgoing international calls. Developing nations commonly have as much as four times more incoming traffic, and this generates substantial earnings from call termination fees. VoIP can drive communication costs down rapidly, while providing much needed revenue and foot traffic for telecenters.

Ending spectrum allocation regimes that punish rural wireless

The metrics of urban areas are commonly used for wireless spectrum allocation procedures and calculations of rates, and are accordingly inhospitable to rural operators. Rural areas typically have lower population and business densities and higher rates of poverty, and these characteristics likely translate into both lower user density and fewer users per capita. It is important to reconcile these practices in order to take advantage of the opportunities for wider service and more competition in rural areas that wireless technologies present. Spectrum needed for wireless technologies in rural areas may also be allocated for other purposes, and therefore unavailable (or excessively expensive), even if it is in fact unused in the rural areas that require it most.

Improving the overall business environment

Businesses are subject to a series of ongoing interactions with both government and financial institutions. Important broad considerations for new businesses include ease of starting a business registration procedure (registration procedures, time required), ease of running a business (burden of reporting, time spent with government, relevant labor laws), and cost of running a business (import duties, taxes).

Regardless of how positive the business climate may be, new businesses and their clients must be able to access funding on fair terms from banks, the government, private equipment or service providers, or from other lenders. As we have mentioned, telecenter startup costs can be quite moderate, but many will still require outside funding. In some cases, special grants or loans are available to support technology diffusion. In other instances, traditional bank funding can actually be more available for telecenter startups than it is for many other ventures because telecenter equipment serves as collateral. Equipment leasing offers potential for similar reasons. Rural entrepreneurs may face greater hurdles in accessing capital through these sources than those in urban areas, both because of the perceived novelty of their request and because rural entrepreneurs may be unfamiliar with formal financial institutions. Nonprofits, such as India's Dhan Foundation, have developed programs to assist their self-help groups in applying for loans from banks and government programs (http://www.dhan.org).

Mechanisms and legal provisions for billing, settling accounts, issuing credit/smart cards, and transferring funds determine the appropriateness, cost, and quality of certain services (e.g., e-commerce, national and international remittances). This business backdrop is a combination of government policy, the legal and regulatory environment, and practices within financial institutions, and therefore depends on diverse stakeholders to ensure its effectiveness.

Building Local Capacity

There is a clear consensus among development professionals that training and capacity-building are key components for telecenter success. We will not attempt to summarize that growing body of literature here; comprehensive treatments are available from Colle et al. (2001), Jensen and Estherhuyt (2001), World Links, and others. Some of the main elements of capacity-building and effective functioning of telecenters can be broken down into the major areas of business skills, ICT skills, employee management, and outreach skills.

As with any other business, basic techniques for business management and account tracking, some of which may be ICT-enabled, are essential for running a telecenter. Small businesses often operate in an informal way, which makes important processes such as tracking spending patterns and sources, income sources, and costing, difficult. These practices negatively impact available information for managers, and therefore the decision-making and planning process, which is particularly important when offering and developing a new suite of services (and paying associated costs). Poor or incomplete records and substandard management practices adversely affect relationships with existing or potential funders, who expect (and reward) complete and accurate records.

Operators require a sound understanding of the potential and uses of ICT, as well as the skills necessary to explain and deliver services to their users; operators effectively act not only as a provider, but also a champion. To capitalize on their knowledge of the local community and its ICT needs, it is important for operators to understand available ICT tools, identify the resources needed to deliver the level and type of service necessary, and to design the associated business model.

Unlike more traditional businesses in which products are more widely understood, employees may be called on to act as guides and facilitators for those unfamiliar with the technology. Managers must be able to inspire enthusiasm for ICT, as well as teach their employees the skills to instruct users. Secondary school and college students are adept facilitators, and are often willing to either volunteer or work in a telecenter at relatively low wages, in exchange for ICT access. These types of arrangements, however, may generate a new set of challenges to managers.

Outreach, marketing, and interaction with the community are key elements to achieving the economic sustainability of a shared resource; if word of available services does not reach wide enough or is met with resistance, success is unlikely. Outreach efforts will include businesses, individuals, nonprofit and public organizations, as well as civil society groups. Creating awareness, interest, understanding, and acceptance of these new technologies is challenging, particularly in rural areas, and these components have often been closely linked to training. Red Científica Peruana offers an example at the entrepreneur level. The company held training sessions for telecenter operators on a weekly basis at its own telecenters for years, offering free advice and support to anyone who was interested in setting up a telecenter. Similar efforts have been undertaken at the user level.

Conclusion

With more than half the world's population living in rural areas, rural communities promise essential new markets, new producers, and new ideas. Helping them to help themselves develop also offers security for urban areas and the developed world by contributing to the grander goals of social and economic stability (and prosperity) through increased economic opportunity, new channels for learning, better communication with government, and improvements in health and wellness.

Economic self-sustainability for the Internet in rural areas is key if we want to avoid common development failures associated with donor initiatives, empower local communities, use the market to vet demand and interest, and ultimately link to real and legitimate development objectives. Our research has suggested that there are a handful of crucial issues determining the economic viability of the Internet in rural areas: costs, revenues, networks, business models, policy, and capacity. Business, government, and nonprofit institutions have different roles and capabilities in pushing these drivers, and while they may have occasionally competing interests, they have an overriding and common goal in economically sustainable access to ICT in rural areas.

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Endnotes

1 While this chapter uses a narrow definition of sustainability, Colle et al. (2001) offer an excellent list of key themes for telecenter development (gleaned in their "Modules for Telecenter Management Training"). Jensen and Esterhuysen (2001) provide deep insight into the nuts and bolts of telecenter development in their "Telecenter Cookbook," available at <http://unesdoc.unesco.org/images/0012/001230/123004e.pdf>.

2 Telecenters typically have one or more personal computers, and some access to the international telecommunications network. Telekiosks typically have only a single computer. They are often staffed with a facilitator or guide of some sort.

3 Before the 2001 liberalization, some Bolivian telecommunications cooperatives still charged as much as US$1500 to purchase a line (Brian Reale, IFX Networks, interview with Colin Maclay on 9 February 2001).

4 Copper and digging wireline local loop costs are estimated at over 80 percent of the total cost of a telecommunications network (Midas Communications Technologies Private Limited 2000).

5 For more information, see <http://www.gilat.com/gilat/corporate/News/HTML/comsys/Comsysdw.htm or http://www.stmi.com/>.

6 In another example of interest in entertainment, a recent study by IDC found that 45 percent of Chinese Internet users participated in online gaming, and that game fees alone would generate hundreds of millions of dollars per year by 2004 (Ghahremani 2001).

7 This claim comes from the simple observation that in a complete graph of N nodes (in other words, N users) the number of pair-wise connections between each node goes as, $N(N-1)/2$. Multiplying out and simplifying to the prevailing term leaves us with $N2$.

8 The Red Científica Peruana's (RCP) well-documented success involves a central body with varied and context-appropriate relationships (including mixes of service provision, training, and content creation) to telecenters around the country, and has helped create Peru's estimated fifteen hundred telecenters.

9 Compelling arguments and more detail are developed in the National Telephone Cooperative Association's Initial Lessons Learned About Private Sector Participation in Telecenter Development online at <http://www.ntca.org/intl/FINAL.pdf>.

CHAPTER 9

Electronic Commerce, Networked Readiness, and Trade Competitiveness

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The stock markets may have overhyped the potential of the Internet and e-commerce in 1999 and 2000, but the dynamism and changes brought by the new technology are real. Entrepreneurs are creating new markets. Established companies are restructuring with new strategies of production, marketing, and sales. Consumers are interacting with businesses in new ways. Governments are using these technologies to alter what they do and how they do it. All of these activities are taking place both within economies and across international borders.

Policymakers in developing countries hear the hype, see the changes, and are infused with a sense of urgency. Are the gains from the Internet and electronic commerce real? What must be done to enable a country to take advantage of the opportunities? Can everyone benefit? What happens if we delay?

Information, the network of the Internet, the application of these through e-commerce, and the reorganization of activities associated with these new methods and products increase the *efficiency of resource utilization*; this translates into faster productivity growth, which supports higher sustainable GDP. Network effects and reduced economic frictions facilitate the *tailoring of goods and services*. This increases marketplace diversity and leads to greater economic well-being through increased variety and meeting diverse customer demands. Both network effects and gains from variety can be enjoyed by economies that are just starting to use information technologies and e-commerce—benefits accrue not just to first movers such as the United States, but to late-comers as well.

Economies have different policy environments and different patterns of domestic production and international engagement. Since some industry sectors are being transformed more quickly and more completely by the Internet and e-commerce, some countries will be more exposed to the challenges of transformation. Since countries differ in their policy environments, some will be in a better position to take advantage of the opportunities offered by the Internet and e-commerce. A key question is whether the countries that are exposed to the challenges have policy environments that help their businesses to rise to the task.

The paper begins with a short overview of the Internet and e-commerce, including their impact on the globalization of the production process of goods and services. Efforts will then be made to measure the phenomena by reviewing empirical assessments of the degree to which firms in different industry sectors are using the Internet and e-commerce. This review culminates in an "indicator of e-commerce intensity" for selected industry sectors and, by aggregating the aforementioned and other empirical indicators, includes an overall assessment of the potential macroeconomic benefits of e-commerce in an environment of facilitating policies.

The paper then considers the perspective of the individual country. Specific examples from developing economies are given to show how firms in such economies are responding to the pressures and opportunities of e-commerce, and how the domestic environment can help or hinder the effective use of networked information technologies.

Following the individual country assessments, a tool that generalizes from these examples is developed for policymakers. By incorporating sector trade data for selected economies and mapping these data to the indicator of e-commerce intensity by industry sector, the tool shows how exposed an economy might be to the opportunities and challenges of e–commerce. More precisely, this mapping indicates how exposed industry sectors, and therefore the overall country, might be to the forces of the Internet and e-commerce coming through the channel of international trade. The exposure of the economy then is mapped to the indicator of Networked Readiness, providing policymakers with a way to judge how policy readiness can impact international competitiveness.

A decisive determinant of which firms will be able to gain the benefits of e-commerce and succeed in the home market or compete abroad, is the overall Networked Readiness of the country. The readiness of a country, as discussed in an early chapter, relates to its access, economy, learning, policy, and society. The specific stories of success and effort may galvanize the attention of policymakers, but the generalized tool helps them to make the economy Networked Ready with policy reform.

The paper is completed with the consideration of some policy reforms that will help create a facilitating policy environment. Such an environment will enable an economy to achieve the most benefit from the Internet and e-commerce–induced transformations in industry and the international marketplace. Finally, a summary and an agenda for research are offered.

E-Commerce and New Opportunities in the International Marketplace

The term "e-commerce" has come to be shorthand for the whole assemblage of information and communications technologies, Internet infrastructures, and processes and products arising from them. E-commerce runs on the Internet network infrastructure (telecommunications, cable, satellite, fiber optics), links people (via personal computers [PCs], mobile telephones, and personal digital assistants (e.g., Palm or Psion), and depends on a set of applications (ranging from e-mail, to websites, advanced financial payment, and customer monitoring software).

E-commerce depends on three basic elements, not all of which are equally or universally developed in countries around the world. These elements are:

- **Access to the global network** that underpins the Internet marketplace; the Internet marketplace is enabled by institutions and technologies, including communications networks (such as telephone or cable network), end-user devices (such as PCs or cellular telephones), and interconnectors (such as Internet service providers). Access, it has been shown, is strongly affected by private ownership of the network in an environment of competition and independent regulation.
- **Services infrastructures** that connect the Internet marketplace to the traditional marketplace and complete the payment and fulfillment processes enabled by access. These include financial systems and methods (ranging from interbank networks to Smart, debit, and credit payment technologies) and distribution logistics (including customs). These services infrastructures require a supportive fundamental policy environment (including openness to trade and cross-border investment) as well as a stable macroeconomic scene in which business can flourish.
- **A flexible, market-oriented environment underpinned by laws and regulations** that govern conduct and relationships in the marketplace. These include technical communications and interconnectivity standards; the legality and enforcement of contracts and governance; accounting standards; regulatory and policy transparency; and procompetitive market policies for industry and labor markets. What matters most is the rule of law (the belief that laws will be equally enforced for all) and the overall balance of competition and regulation (rather than e-commerce specific regulation).

E-commerce transforms traditional transactions and innovates marketplaces in three ways:

- **Process innovations.** E-commerce simplifies, makes more efficient, reduces costs, or otherwise alters the process by which an existing transaction takes place. (For example, websites can reduce the cost of sending information to potential clients; use of information technology in the back office can improve accounting; putting the supply-chain online can improve inventory control and quality management.)
- **Product innovations.** E-commerce creates or facilitates new industries and products not previously available. (For example, business-to-business [B2B] e-commerce exchanges for products; MP3, a hardware and software product for

music creation and distribution; personally tailored products such as newspapers and blue jeans.)

- **Market innovations.** E-commerce also creates new markets in time, space, and information that did not previously exist because transaction and coordination costs were prohibitively high. (e.g., global auction markets, or sales of artisanship from the Andes mountains.)

E-commerce has the potential to transform all industry sectors and all activities in the marketplace, and is being integrated into the fabric of domestic activity and international trade. The pace of change, however, and the degree to which economies or sectors (even in the leading users) are responding to the forces of transformation, differ substantially.

Estimates of the growth of the Internet and e-commerce are notorious for their hyperbole, and indeed growth rates have slowed from the heady assumptions at the height of the "dot-com" boom. For example, in 1999 Forrester Research (2001b) projected U.S. B2B e-commerce revenues of some US$250 billion in 2000, but the figures appear to be closer to US$150 billion. Nevertheless, this still represents an explosion of revenues compared with revenues of US$43 billion in 1998.

More sober assessments in 2001 reveal that e-commerce is and will be an important force for transformation, efficiency gains, and new opportunity for business. Jupiter (2001) suggests that in 2005, 80 percent of B2B transactions will be e-commerce transactions, accounting for some US$6.3 trillion. Boston Consulting Group (2001) projects a rise from 13 percent of intercompany gross purchases (US$1.2 trillion) in 2001 to 40 percent (US$4.8 trillion) in 2004. While the figures from these two sources differ, it is clear that B2B overwhelmingly dominates e-commerce. In fact, industry analysts argue that soon business will drop the "e" from e-commerce, because transactions will be undertaken no other way.

What about global distribution of activity? Although the U.S. still accounts for about three-quarters of e-commerce activity worldwide, the share is falling, and should drop substantially over the next few years as Internet diffusion continues in Europe and Asia, followed by diffusion in Latin America and Africa. It is clear that now, and increasingly in the future, B2B e-commerce sales will take place across the border and, therefore, increasingly will be between multinational and local firms.

The nature of the production process (comprising both manufacturing and services) is becoming more and more fragmented and spread around the globe. At the same time, members of the supply chain increasingly are connected by the information both going up and down the chain, and between firms at similar stages of the process. It was this web of connections and wealth of information that allowed firms to revise production and delivery schedules and minimize downtime following the disruptions at airports and international borders that resulted from the September 11, 2001 terrorist attacks in the United States.

Going forward, multinational firms and strategic business alliances increasingly will communicate, get price quotes, submit bids, transfer data, offer customer service, create product designs, code software, and basically *do business* using the Internet and e-commerce. Countries that cannot or choose not to work with networked information technologies will be marginalized from the global production process and global economy, at increasingly greater cost to their citizens.

Measuring the Impact of the Internet and E-commerce

The uptake of network and information technologies differs across industrial sectors, varies across countries, and can be measured by cost savings when the technologies are used, or by how extensively these capabilities are being used (e.g., not at all; only with either a static website or an interactive website; with financial exchanges over the Web; integrated supplier information exchange; or fully integrated multifirm operations). There is neither comprehensive assessment across all industry sectors of the extent to which the Internet and e-commerce are used nor, when they are used, the impact of these technologies. Most of the analysis being done today is piecemeal and involves surveys, case studies, and individual firm assessments. This paper reviews several different sources from the U.S. and Europe to derive a summary indicator for each industry sector of how intensively the sector is using the Internet and e-commerce to transform its activities. Specific examples are used to show the relevance of these indicators for developing countries. Finally, this paper reviews macroeconomic evidence on the potential of all economies to benefit from e-commerce and the policy environment in which it is facilitated.

In the developing economies that are the focus of much of this report, we would not expect firms to use the network and information technologies as intensively as do U.S. or European firms. However, the indicator of e-commerce intensity will show which industry sectors are likely to be first to respond to the opportunity to (or feel the pressure to) use these technologies. For example, if a firm in a developing country is currently part of a multinational value chain, it might be expected to adopt e-commerce so as to remain part of that chain. (See the examples below.) Therefore, it makes sense to use the U.S. and European experiences to create a benchmark for developing countries.

Developing an indicator of e-commerce intensity for industry sectors

There are a variety of approaches to measuring or assessing how firms are being transformed or will be transformed by the Internet and e-commerce. (See Appendix Table 1.) Survey research of U.S. industry in 2000 (Brookes and Wahhaj 2000) suggests cost savings ranging from 10 percent in sectors such as aerospace, paper, steel, and communications bandwidth and media advertising, to more than 20 percent in electronic components and machining, forest products, and freight transport. More detailed case studies of manufacturing, automotive, financial services, trucking, retail, and health sectors in 2001 affirm this range of magnitudes (Litan and Rivlin 2001a).

Forrester Research (2001a) assesses sectors along two dimensions: industry readiness and product fit. An industry readiness assessment determines to what extent firms in the industry are using information and technologies inside the firm; a product fit assessment determines to what extent the nature of the product or production process is conducive to intensive application of information. Together, these assessments yield an estimate of the share of business transactions that is likely to be conducted via e-commerce (so-called ultimate marketplace saturation) for different industry sectors. By this measure, 70 percent of the transactions in the computing and electronics marketplace will ultimately use e-commerce because the industry is ready, and the product fit is high. A similar assessment holds for the foods industry sector. In contrast, both the industry readiness and product fit scores are low in heavy industries; this is an industry sector where e-commerce take off will be delayed. In the middle are automotive and industrial suppliers, but for different reasons. In the former case, the product fit is good but the industry is fragmented and dependent on Electronic Data Interchange,[1] making it more difficult to switch to e-commerce; it is therefore less ready, and yields a middling score on ultimate marketplace saturation. For the latter, the industry is ready but the product fit is not as good (perhaps because extensive customization and contract negotiation is common); thus only between 60 and 70 percent of transactions will ultimately be carried out via the Internet and e-commerce. (Scores for the consumer goods, pharmaceutical, papers, heavy industries, shipping/warehousing, utilities, and construction sectors are shown in the Appendix Table 1). The measures of industry readiness and product fit help characterize which sectors are likely to use the Internet and e-commerce most intensively and, therefore, which sectors may demand a heavier use of networked information technologies by their supply chain partners around the world.

The European Information Technology Observatory (EITO) study presents a different perspective for how e-commerce is affecting industry sectors in Europe. This study rates European industries and partners by internal use of the Internet (i.e., whether firms in the sector are reorienting their internal organization and operations toward using the Internet) and external use of the Internet (i.e., whether external relationships and marketing are pursued via the Internet). The two scores, weighted up, yield the overall score for the sector. EITO assesses the textile, pharmaceutical, aerospace, automotive, and shipbuilding industry sectors. By and large, the analysis suggests that U.S. and European firms and supply chains are responding in a similar way to the opportunities afforded by the Internet and e-commerce.[2]

Table 1: **Indicator of E-commerce Intensity**

(1 is least intensive use; 5 is most intensive use)	
Foods	4
Consumer goods/textiles	3
Energy, chemicals, national resources	1
Pharmaceuticals	4
Forestry/paper products	4
Steel/metals	1
Industrial equipment and supplies	3
Electronic components	5
Automotive industries	3

Source: Analysis of Appendix Table 1 and additional research by the author

The National Association of Manufacturers (NAM) and Ernst & Young offer yet a different approach to measuring how industry sectors are using e-commerce. This approach describes stages of Internet usage and adoption, and uses surveys to determine what share of firms in an industry are at which stage of adoption. The stages (from 1 to 4 in order of less to more intensive usage) are no use (zero), using the Internet in a static fashion for information (e-Info), using the Internet interactively, say, for supply requests (e-Interaction), and using the Internet for financial transactions (e-commerce). Firms that are at stage 4 presumably also use the Internet for other activities characterized in stages 2 and 3 (see Appendix Table 1). For example, 42 percent of the textile firms surveyed were using the Internet interactively, and 36 percent were using it for financial transactions. In contrast, 47 percent of the firms in the industrial supplies sector were using the Internet interactively, whereas only 25 percent of these firms were using it for financial transactions. The textile sector appears to have moved further along the stages of adoption than the industrial supplies sector. Overall, as the share of firms that use the Internet interactively and for financial transactions increases, the sector can be said to be using the Internet technologies and applications more intensively.

The foregoing analyses are distilled and summarized in Table 1. The lower the Indicator of E-commerce Intensity, the less intensively an industry sector is using, and being transformed by, the Internet and e-commerce. Not all industries are shown—indeed very few are—because not all industry sectors have been assessed by consulting groups or researchers. Moreover, there is no clear metric for combining the studies that have been done. Accordingly, the Indicator of E-commerce Intensity in the table represents an overall assessment of the research that is summarized in Appendix Table 1 as well as other industry-specific research; it is not derived using a formula. Clearly, an important and fruitful area for researchers is a systematic analysis with measurement of how industries—both in manufacturing and services—are using the Internet. Finally, no service sectors are shown in Table 1 (although there are some in the Appendix

Table 1), because the countries considered later in the analysis have very poor data on international trade in services.

Potential macroeconomic benefits of e-commerce in a facilitating policy environment

Industry analysis points to which sectors are most likely to use e-commerce intensively to generate efficiency gains and to transform how the business operates. How much does it matter for the overall economy whether business in fact uses these technologies? What are the macroeconomic benefits?

There are several ways to take the assessments of transformations of business activities and interpret them in the context of potential macroeconomic benefits. One approach quantifies the macroeconomic benefits from cost savings and the increased economic efficiency associated with the diffusion of network technologies into business. A second approach is built from case study evidence, and a third strategy considers the long-run gain from structural policy reforms in the context of information technologies that enhance efficiency and supply.

Brookes and Wahhaj (2000) apply their evidence on cost reductions in a time-series econometric model ("Multimod," used by the International Monetary Fund). Their simulations suggest that GDP in the industrial countries examined (the U.S., France, Germany, the U.K., and Japan) would be almost 5 percent higher after ten years, and the annual growth rate of GDP would be about 0.25 percentage points higher during this period. This figure is consistent with the overall assessment from U.S. case studies compiled in Litan and Rivlin (2001a) of annualized gains in productivity of some 0.25 to 0.5 percent (Litan and Rivlin 2001).

The United Nations Conference on Trade and Development (UNCTAD) employs the third approach to assessing the benefits from using information technologies. Using the general equilibrium econometric model (the GTAP model),[3] UNCTAD considered the long-run effect on GDP of Internet usage in an environment of facilitating policies in various regions of the world (UNCTAD 2000). Adjusting the UNCTAD simulations so that they are comparable in magnitude to the survey estimates from Brooks and Wahhaj (2000) and from Litan and Rivlin (2001a),[4] yields the result that GDP in the industrial countries would be about 4.9 percent greater (about US$1 trillion) in the long run—strikingly similar to the figure in the Brookes and Wahhaj (2000) study, which uses a very different methodology.

UNCTAD (realistically) assumes that developing countries must reform some of their policies in order to create a facilitating environment. The study assumes that the use of the Internet and e-commerce in the developing world would yield only one-third the gains accruing to the industrial world because of this need for policy reform: GDP would be 1.7 percent higher in Africa, 1.2 percent higher in Asia, and 1.0 percent higher in Latin America and Eastern Europe.[5] If developing countries deepened service sector reforms, creating a more facilitating environment for information technologies to take hold and transform economic activities, and put in place the legal framework to help create an environment of certainty and trust, they could enjoy benefits much greater than that estimated above. The UNCTAD study implicitly shows the need for more comprehensive policy reform to achieve higher rankings of Networked Readiness.

Relevance for Developing Countries

Beyond the macroeconomic evidence from large-scale models on the benefits of Networked Readiness, how is sectoral analysis from the U.S. and Europe relevant for developing countries? Vignettes from developing countries[6] illustrate how firms there are responding to the same set of pressures and opportunities as are firms in the U.S. and Europe. In some cases, firms in developing economies are faced with domestic obstacles that limit their ability to use information technologies effectively. In other cases, they are able to use those technologies even more effectively than their industrial-country counterparts because they have fewer commitments to earlier technologies. Finally, these examples show how the specific nature of the domestic marketplace creates opportunities to use information technologies effectively even when the Indicator of E-commerce Intensity might suggest that there are few opportunities in that sector.

First, consider a domestic producer in an e-commerce–intensive sector that obtains inputs from international sources. This example shows that a country needs to have adequate Networked Readiness, both narrowly in terms of access measures and more broadly in terms of information and communications technology policy, to take full advantage of the benefits of e-commerce. A personal computer manufacturer in Vietnam has a lively domestic business producing computers to meet the price-point of domestic buyers (pricing well below IBM, and somewhat below Acer). The manufacturer uses e-mail to communicate with his suppliers in China and Thailand, but cannot finalize any financial contracts because the banking systems in the manufacturer and suppliers' countries are not electronically linked. Moreover, the manufacturer has to maintain e-mail accounts through two different Internet service providers because service outages are common and his or her credibility as a value chain partner would be lost if e-mail contact was lost or delayed. This producer is responding to the same opportunities to use e-commerce as an electronics producer in the U.S., but benefits are constrained by the Networked Readiness of both the domestic country and the source of inputs.

Second, consider how the domestic environment can affect the potential for effective use of the Internet and e-commerce. A company in Thailand, for example, has developed Internet-based software to increase the efficiency of the domestic gasoline distribution sector. Multiple fax exchanges during the day detailing delivery amounts, times, and prices to local gas stations, have been replaced by an online exchange between wholesale suppliers and retail distributors of gasoline. Greater timeliness and transparency have increased the efficiency of pricing at the pump (including less variation of price over the course of the day), increased the efficiency of local delivery of gas (tankers go directly to the empty stations), and substantially reduced costs of negotiation and transactions (a significant "menu-cost" improvement for both suppliers and buyers.) In contrast to U.S. and European marketplaces, where the energy sector overall is ranked low in usage of information technologies, the specific structure of the domestic marketplace in Thailand created an opportunity to use information and technologies effectively. Of course, adequate access to low cost and reliable communications networks and technologies is key if all parties are to gain from this new information-intensive distribution model.

Third, consider how important Networked Readiness is for international services, such as tourism. Although this sector is not included in Table 1, the Internet and e-commerce are increasingly used for information, arranging and paying for hotels, sightseeing, and so forth. Networked Readiness is crucial, since telecommunications and financial services, as well as human capital, are needed for the tourism sector to effectively engage in e-commerce. For example, the financial sector in Morocco is only slowly embracing secure protocols and secure electronic transactions technologies, in part because the country's capital account remains partially closed (this is seen by policymakers as necessary to protect domestic savings and international reserves). Most (and especially smaller) hotels and tourism-related businesses do not have informative websites, and cannot take reservations by e-mail because of the high cost of telecommunications and because the proprietors lack familiarity with the Internet and the ability to design a website or set up an e-mail account. In the globally competitive tourism market, to the extent that other economies are improving Networked Readiness in all its dimensions, international tourists will be able to find the information they need to go there, and travel to Morocco could suffer.

Fourth, consider how the Internet and e-commerce are being used by multinationals. If a country has a high share of trade in a sector where the Internet and e-commerce are used intensively, then it risks losing its position on the value chain if its firms are not similarly Networked Ready. Importantly, if the infrastructure of the country is lacking, efforts by local businesses to use e-commerce will be thwarted. For example, an industry association for the apparel sector in Sri Lanka knew that they would be able to move "up-market" to higher value-added apparel if they had the ability to network electronically with their buyers, designers, and textile suppliers. They undertook an investment and training program to bring their producers online and up to speed in using the Internet for a broad range of transactions. In a trial for an upscale foreign retailer, they were required to download the design, procure the textile supplies, produce the apparel, and prepare it for shipment and retail sale, all in three days. They succeeded in all these aspects—but still failed the test. Why? Because poor roads slowed the delivery to the border, customs clearance further delayed the shipment, and limited airfreight kept it on the ground. All of these problems were beyond the control of the individual business, but many were the consequence of policy action or inaction by government.

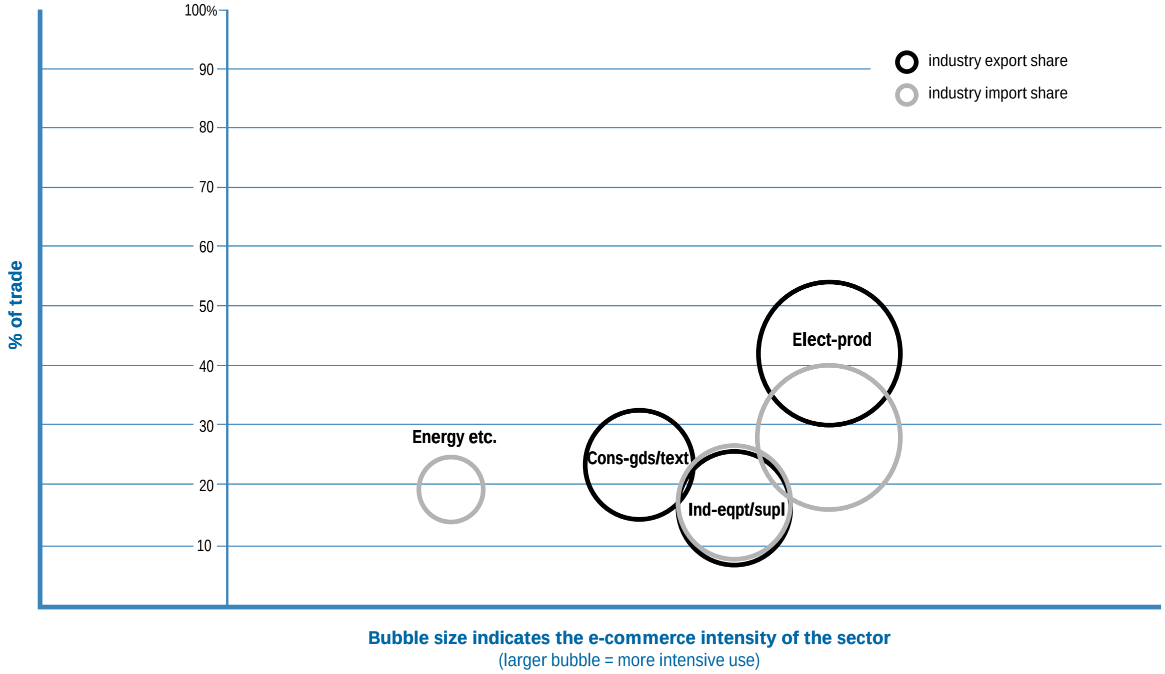
Finally, consider the evolution of e-commerce in the international marketplace, and how that process can change the whole businesses focus of a firm. A Taiwanese firm started out being a producer of integrated circuit chips on contract to large multinational computer producers. Over time, the firm developed internal supply management software, then created software to integrate the buyer-side information to keep the production process moving smoothly and cost effectively. The next step in maintaining effective supplier-buyer relationships was to integrate the design elements from the buyer, so the firm developed information software to do this process as well. Last, building on its core business of manufacturing, the firm has moved into the design process itself, offering new approaches to prototyping and small-volume production. In the end, the chip producer was transformed into a producer of design and process-management software, both of which it uses and also sells to others. A high score in Networked Readiness for the whole environment was a key for this firm to transform itself out of commodity chips into custom software.

These examples give a flavor for how firms in developing economies are using networked information technologies effectively, and also what aspects of the policy environment may stand in the way. While specific examples are valuable, generalizing from them would help policymakers see the overall picture of how Networked Readiness affects the competitiveness of firms and the potential for the whole economy to benefit. Following is a discussion on this general tool.

E-commerce, Trade, and Networked Readiness

One way to generalize from specific examples is to use sectoral trade data[7] to see how much of an economy is in sectors that have high Indicators of E-commerce Intensity. Trade has always been an important channel for changes in global demand and production technology, and these affect economic growth. Moreover, as noted, global e-commerce is transforming production technology, and through this channel can affect domestic productivity growth and trade patterns. We can, therefore, generalize from the specific examples to the overall economy by considering relationships between Networked Readiness, sectoral Indicators of E-commerce Intensity, and trade patterns.

Figure 1: **Taiwan—High Exposure to E-commerce**



Source: SITC trade data, Table 1, author's calculations.

Consequently, this section of the paper presents a tool that policymakers can use to assess how exposed their country might be to the opportunities and pressures presented by e-commerce. The tool has three inputs. These are the:

- Pattern of exports and imports by industry sector of a country
- Indicator of E-commerce Intensity by industry
- Networked Readiness of a country.

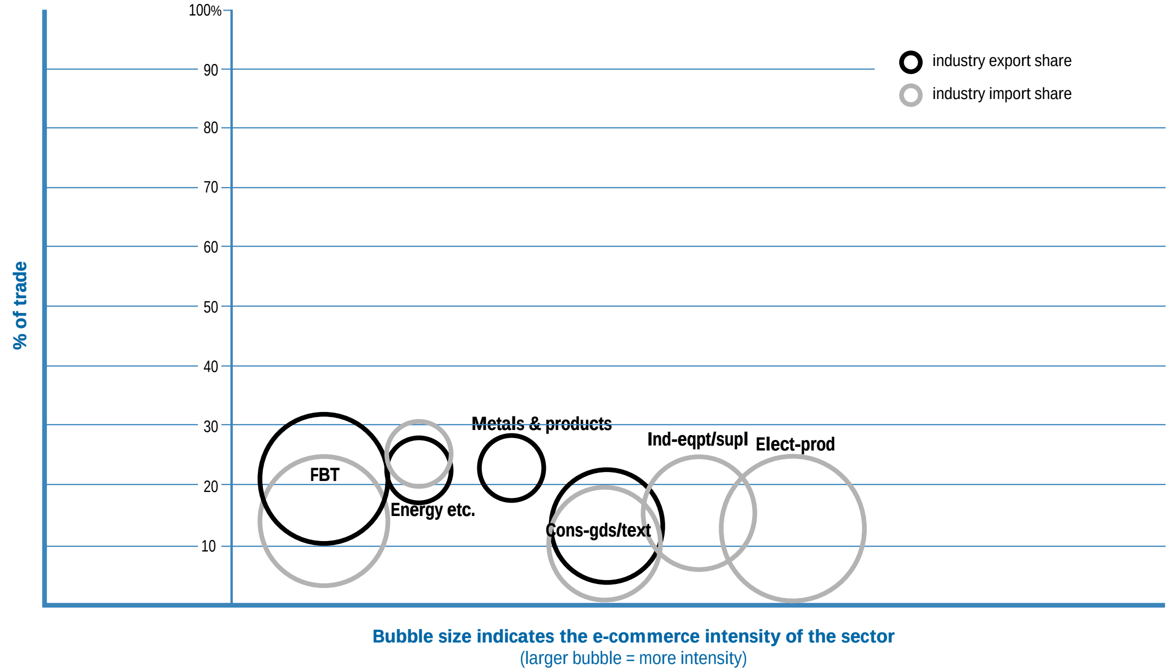
There are several ways to show the relationships among Networked Readiness, trade patterns, and industry e-commerce intensity. The first approach is to examine an economy by itself and consider how important e-commerce might be, given the industry trade patterns within an individual economy. A second approach is to examine each industry sector separately and consider how e-commerce might differentially affect the trade competitiveness of economies, comparing economies within an industry sector of trade. Third, weighted and aggregated patterns of trade and Networked Readiness allow a comparison of economies across all exports and imports.

Trade patterns and exposure to e-commerce

Data on the industry-sector trade patterns of a country can be mapped onto the Indicator of E-commerce Intensity to show how exposed an economy might be to the opportunities and pressures of e-commerce coming through the trade channel. Two economies are used as examples: Figure 1 shows trade data for Taiwan and Figure 2 shows data for Peru. Arranged along the horizontal axis are industry sectors for which there are both trade data (Standard International Trade Classification [SITC] classification) and the Indicator of E-commerce Intensity (Table 1): foods are at the left and automobiles are at the right.[8] Each industry for which the economy's export or import share exceeds 10 percent is shown by a bubble (the 10 percent cutoff is to avoid clutter). The center point of the bubble measures the share of that industry in exports (imports), which is measured on the vertical axis. The diameter of the bubble is the benchmark e-commerce intensity of the industry sector (from Table 1). Thus, larger bubbles indicate industry sectors that are using e-commerce more intensively and that are being more significantly transformed by e-commerce.

How should we interpret the figures? Consider Figure 1. About 40 percent of the exports in Taiwan's economy are concentrated in an industry sector (electronics production) that is actively using and being significantly transformed by e-commerce. (The e-commerce intensity indicator is a five out of five in Table 1.) An additional 25 percent of exports are in consumer goods and textiles, and 15 percent more of exports are in industrial supplies and materials, both of which are moderate users of e-commerce (ranked three in Table 1). Thus 80 percent of Taiwan's exports are in sectors that are in intensive and moderately intensive users of e-commerce. In addition, about 30 percent of imports are in electronics products, the sector that uses e-commerce most intensively, and about 15 percent of imports are in the sector that uses e-commerce moderately intensively—industrial supplies. Therefore, about 45 percent of Taiwan's imports are in sectors that are most intensive or moderately intensive users of e-commerce. All told, Taiwan's trade is very exposed to e-commerce.

Figure 2: **Peru—Low Exposure to E-commerce**



Source: SITC trade data, Table 1, author's calculations.

Now consider Figure 2. About 22 percent of Peru's trade is in the food, beverage, tobacco (FBT) sector, which is ranked four out of five in e-commerce intensity. About 12 percent of its exports are consumer goods and textiles, which rank three of five in e-commerce intensity. Another 44 percent of trade is in the low e-commerce intensity sectors of energy, natural resources, and chemicals (22 percent), and metals and metal products (22 percent). Therefore, a higher proportion of Peru's exports are in sectors that are low in e-commerce intensity. Approximate imports are 15 percent in electronic products, 15 percent in industrial equipment and suppliers, and 10 percent in consumer goods/textiles imports. The latter two are moderate users of e-commerce. About 40 percent of Peru's imports are in sectors that are high or moderately highly intensive users of e-commerce. All told, Peru's trade is much less exposed to e-commerce.

Comparing Taiwan and Peru, Taiwan is an economy that is much more exposed to the opportunities and pressures of e-commerce coming through the trade channel; Taiwan's electronics sector is particularly exposed, both on the import and export side. Therefore, it is particularly important for this economy to be Networked Ready. The benefits to be obtained by cost efficiencies coming through imports (as in the Vietnam example earlier) depend on Networked Readiness. Networked Readiness is also crucial for exporters to keep their presence in international markets (as in the Sri Lanka example). In contrast, Peru's economy is more insulated from e-commerce coming through the trade channel. Whereas such a country would be better off in a macro sense from having high Networked Readiness and good policy conditions (consider the macro evidence presented earlier), the trade channel is less likely to be the factor forcing domestic policy change to meet the demands of the Internet marketplace.

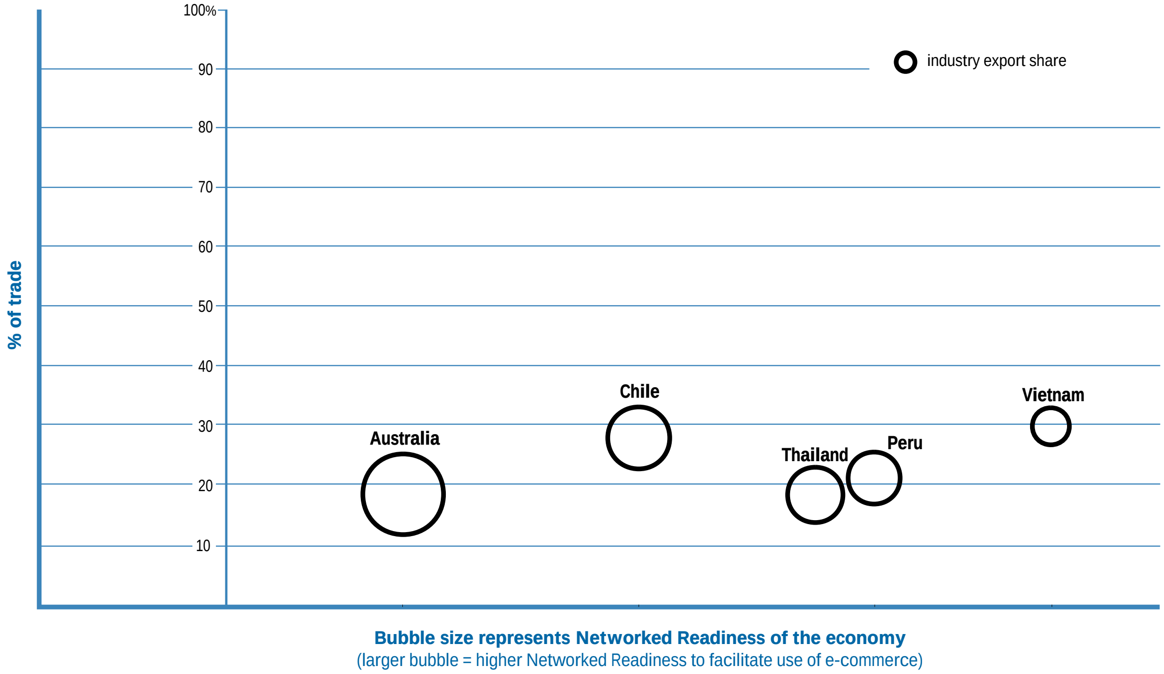
Policymakers from any country can undertake a similar analysis of their trade data to gauge how important e-commerce might be for them.

E-commerce intensity and trade competitiveness

While it is important for policymakers to know how exposed their economy is to e-commerce, it is also valuable for them to consider where their Networked Readiness puts them in a competitive sense vis-à-vis other economies within a specific industry sector. Maintaining the position of firms in an international value chain (or upgrading the position in the value chain) increasingly depends on e-commerce, which depends on Networked Readiness. Figure 3 and Figure 4 consider this question for a set of developing economies in the industry sectors of foods and electronic products.

As before, the vertical axis measures the share of the sector in exports of the economies. Selected exporters of foods (Figure 3) and electronics products (Figure 4) are ordered by real GDP per capita (World Bank 1999) along the horizontal axis. Each economy is represented by a bubble. The center point of a bubble measures the share of the sector in the economy's exports. The diameter of the bubble indicates Networked Readiness; the larger the bubble, the more facilitating is the environment for firms to take up, and be transformed by, e-commerce.

Figure 3: **Exports of Food Products**



Source: SITC trade data, Networked Readiness Indicator, author's calculations

For food products, hemispheric geography can be very important, so too can distance from the destination market. However, e-commerce intensive agricultural products increasingly go by airfreight, reducing the importance of distance. In comparing Australia and Chile with Thailand and Vietnam, Australian and Chilean exporters appear to have an edge because their domestic environment is more conducive to assisting firms in their uptake of e-commerce. This yields higher value-added exports for these producers.

Considering the electronics trade, e-commerce is part and parcel of participating in the global value chain of production. Exporters of electronic products will increasingly need to have high Networked Readiness scores to maintain trade competitiveness and to move into higher value-added positions on the value chain. A high share of electronic products in exports enhances the importance of Networked Readiness. Considering the economies shown in Figure 4, some are more Networked Ready than others (e.g., Taiwan versus Mexico); for those who trade heavily in this product category, the score on Networked Readiness should be improved (i.e., Philippines, Malaysia).

E-commerce exposure and Networked Readiness

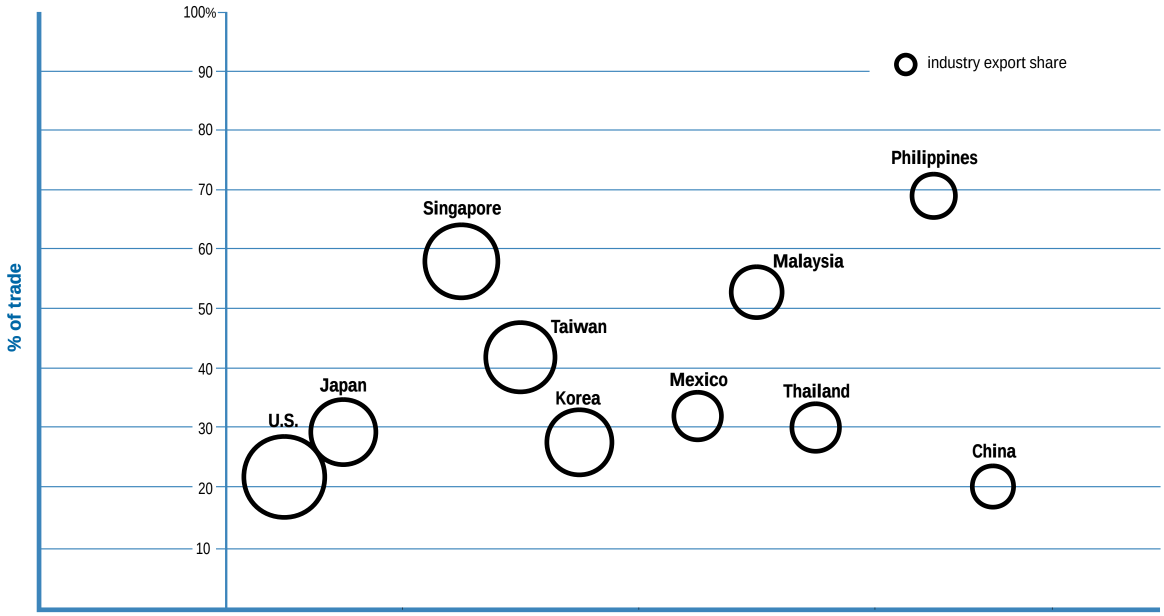
Figures 1 to 4 show policymakers how exposed their economies and certain sectors are to e-commerce, and how Networked Ready they *need* to be. But how Networked Ready *are* these economies? Figure 5 combines the information on trade exposure with the Networked Readiness measure to give an overall picture of how exposed a country is to e-commerce and how ready a country is to take advantage of it.

The three full-height cylinder and pointed cones to the left show the benchmark case: 100 percent of exports and 100 percent of imports are in sectors that are most intensive users of e-commerce, and the economy gets a perfect score for Networked Readiness. Reality is different. Figure 5 shows a set of countries just to give policymakers an idea of how to use the analytical tool when they are applying it to their own trade data and using the readiness indicator presented and discussed throughout this report.

How can we interpret the data in the figure? The taller the Networked Readiness cylinder, the more Networked Ready is an economy, and therefore the more facilitating is the environment to effective use of e-commerce. The taller the trade cones (import or export), the higher the share of an economy's trade in sectors that are using e-commerce intensively, and therefore the higher the exposure of the economy to the forces and demands of e-commerce coming through the trade channel. Economies vary in exposure and Networked Readiness, but four types emerge:

- Exposed and Ready. Consider an economy where the trade cones are tall and the readiness cylinder is tall (e.g., Singapore). Such an economy is exposed to e-commerce through trade, and its ability to use e-commerce (because the environment is facilitating) also is

Figure 4: **Exports of Electrical Products**



Bubble size represents Networked Readiness of the economy
(larger bubble = higher Networked Readiness to facilitate use of e-commerce)

Source: SITC trade data, Networked Readiness Indicator, author's calculations

great. Such an economy is likely already enjoying productivity gains and faster growth from e-commmerce.

- Less exposed, but Ready. Consider an economy where the trade cones are relatively short, but the readiness cylinder is tall (e.g., Australia). Here is an economy that is using e-commerce in the domestic market to enhance resource usage and gains in productivity and welfare. The tallish import cone indicates that imports are in e-commerce intensive sectors, which, when combined with a tall readiness cylinder, implies that domestic businesses will be able to obtain cost efficiencies from those imports. On the export side, the cone is not so tall now, but because the country's Networked Readiness is high, the domestic environment is good and exporters will be able to find new opportunities in new trade sectors.
- Exposed and less Ready. Consider an economy where the trade cones are tall and the readiness cylinder is short (e.g., Philippines). Such an economy is exposed to e-commerce through trade, but firms will find it hard to take advantage of the opportunities because the Networked Readiness of the economy is lagging. Firms in this economy might lose international market share, particularly in sectors that use e-commerce intensively, because their exporters cannot use e-commerce effectively. Moreover, gains from the efficient use of e-commerce by importers and domestic firms will be reduced.
- Less exposed and less Ready. Consider an economy where the trade cones are short and the readiness cylinder is short as well (e.g., Russia). This economy is unlikely to receive much of a boost from e-commerce technologies because the domestic policy environment is not particularly facilitating. Moreover, the trade channel is unlikely to be the factor forcing policy reforms.

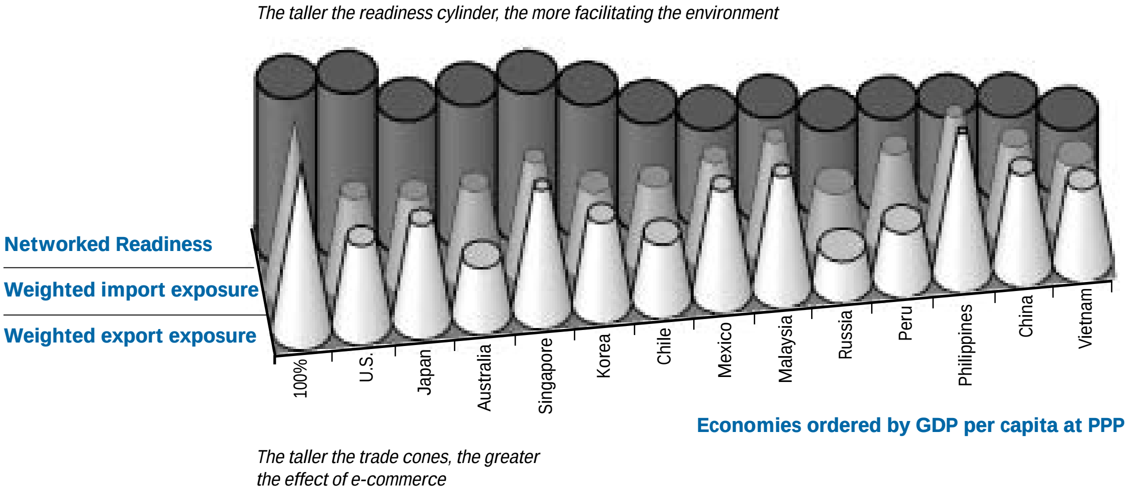
Polices to Create a Facilitating Environment

Are there different policy implications for the different economies described above? There is a general set of policies that needs to be in place to create Networked Readiness, but depending on the characteristics of the economy, differences in emphasis might emerge.

Services infrastructures are key for Network Readiness, e-commerce, and trade

Policies directed toward service sector infrastructures, including communications services, financial services, and distribution and delivery services, are essential. Each of these infrastructures play a key role in creating an environment conducive to the transformations of activity associated with greater use of the Internet and e-commerce (APEC 2001; Mann et al. 2000). Economies where trade exposure is high and Networked Readiness is low because of a poor access and policy environment must urgently pursue reforms, otherwise they could lose their ability to compete in international trade. Economies that are less Ready and are less exposed through trade still need to pursue these overall reforms, both to gain macroeconomic benefits and to start on the path of supporting new business activities.

Figure 5: **Networked Readiness and Trade Exposure**


The taller the readiness cylinder, the more facilitating the environment

The taller the trade cones, the greater the effect of e-commerce

Why are services infrastructures so critical? Communications policies directly affect Internet costs and uptake by businesses and citizens. Competition among communications providers improves access and significantly lowers the price of a local telephone call, which encourages Internet “surfing” (and thus the exploration of new information, products, and business opportunities available online). On the other hand, metered phone charges have the undeniable effect of reducing the time spent investigating and exploiting information and business opportunities on the Internet. The previously cited example from Vietnam shows the importance of the communications sector for effective use of e-commerce.

The performance of financial intermediaries affects the benefits of, and the global linkages offered by, e-commerce. A financial sector that can swiftly and securely process transactions electronically will significantly enhance the global reach of local firms. Policies that have the effect of slowing the development or use of online payments methods will reduce the competitiveness of domestic firms, not just in the Internet marketplace but in the global marketplace more generally. The previous example from Morocco shows the importance of this sector for the effective use of e-commerce.

Transport and distribution logistics as well as customs efficiency influence the speed and ease with which buyers and sellers can both meet and transact business over the Internet, and fulfill their contracts. For example, a multimodal and competitive transport sector combined with efficient cross-border customs means that global production facilities can be spread to rural areas. The example from Sri Lanka shows the importance of this sector for the effective use of e-commerce.

Moreover, e-commerce creates important synergies between the service sectors. Effective implementation of e-commerce to achieve the greatest benefit requires progressive upgrading all these infrastructures, otherwise the achievements in one area (e.g., reduced telecommunications costs) will turn into rents in another area (e.g., higher airfreight costs). Moreover, it goes without saying that electronic commerce (indeed, all forms of commerce) must be underpinned by a clear and predictable legal framework—one that is not e-commerce specific, but that embraces all aspects of commerce, consumer protection, and dispute settlement.

Beyond Infrastructure: Creating supportive business environment and society

Well-functioning services infrastructures are important, but may not be enough to engender new e-commerce intensive activities. What might be needed beyond services infrastructures is a function of the type of economy. For economies that are less exposed through international trade but are Ready based on their overall Networked Readiness measure, the issue may be broadly related to entrepreneurship—that is, how to get domestic firms to build on the Readiness foundation and start new e-commerce-intensive business activities. For economies that are not exposed through international trade and are not Ready the issue is basic social improvements—information and communications technologies opportunities, Networked Learning, and social capital.

What are some policy options beyond reform of services infrastructure? Entrepreneurship, venture capital, business incubators, and community access can play important roles, with the relative importance among these (and the role for government) a function of the existing Readiness of the economy.

For economies that are Networked Ready but that have not fully exploited opportunities in international trade, a focus on market-niche investigation and targeting, business development, and venture markets (which incorporate both risk finance and management expertise) could be the key. Most governments help develop profiles of which markets might be useful to pursue and can help with basic information (online, of course, to reduce information costs) on rules and regulations regarding international trade to these markets. Private firms, however, should play the dominant role here, given the dynamic nature of new markets. Expertise in business development is often undertaken in academic settings and through business-to-business interaction. Creating a supportive environment in which the value of having a venture capital market is understood could require changes in government regulations regarding listing and holding of stock in unproven companies.

For economies that are less Networked Ready, the issues are more basic, and focus on developing the Networked Society. It is clear that even as access increases for a country as a whole, Internet usage does not increase proportionately for all groups. Many citizens and business owners (particularly small business owners) do not know why e-commerce might be valuable for their firm. Nurturing leaders and entrepreneurs from these groups who come to use the Internet and start businesses that meet their own interests and needs will at the same time meet the needs and interests of other citizens and businesses like theirs.

Business incubators and community centers reduce the cost of access, build awareness, and create knowledge networks. The most successful centers build on the existing bond among people who frequent them: business or farming associations, learning or school groups, community or health centers, even coffee or social clubs. At these places, the awareness of how to use e-commerce is built from existing business and social interactions, rather than by trying to replace those relationships.

Government's role

The e-commerce marketplace is dynamic. Therefore, the guiding principle for policymakers is that their interventions must preserve the private sector's incentives to innovate. The government should be wary of undertaking business activities that have already appeared as private sector activities in some other sector or country. Moreover, the government should also be cognizant of the potential fiscal costs of their efforts and judge carefully whether they are building a foundation for a sustainable future, or one that will require ongoing financial support.

For example, Internet centers, business incubators, or technology parks are common approaches to supporting e-commerce awareness and business development. These appear as private sector operations in many economies. But they will not be financially sustainable unless the overall environment is facilitating—hence the focus on basic infrastructure as key to uptake of e-commerce. This suggests that limited and light-handed funding on the margin (Enterprise Ireland might be an example), rather than block grants (such as Malaysia's super-corridor project), makes more sense.[9]

The evidence is strong that the greatest gains from e-commerce come when it diffuses throughout the economy, not when it remains closeted in a park or zone. Thus, the approach of Sri Lanka or Thailand, where business incubator operations are combined with multifaceted education and training programs, has greater potential for domestic diffusion than a model in which only firms are located together. The issue of services infrastructure and the manner of government support are linked—when basic infrastructure remains poor or costly, governments tend to subsidize these activities in a park, which implies that domestic diffusion throughout the economy will be stymied.

Summary and Agenda for Future Research

Countries gain the benefits of networks built on global technologies, hardware, and standards. Once these are in place, and even as they continue to evolve, the most important new business opportunities come from meeting the needs and interests of a heterogeneous marketplace—both domestic and international.

This article discusses what e-commerce is and how it is changing the marketplace. Policymakers wonder how much their economy will be affected by these changes and how urgent are the policy reforms necessary to become Networked Ready. An analytical tool is presented to help policymakers in this assessment.

Economies are affected by e-commerce to different degrees because e-commerce is being used more intensively by some industry sectors than others. Therefore, because the sectoral pattern of international trade differs by country, some countries will be more exposed to the challenges and opportunities of e-commerce through the trade channel. Considering the measure of Networked Readiness developed in this report, economies end up in four categories: highly exposed to the challenges and opportunities of e-commerce through international trade and Networked Ready to take advantage of those opportunities; less exposed but Ready; highly exposed, but less Ready; and less exposed and less Ready.

How should policymakers use this tool? An assessment of exposure to trade and a ranking on Networked Readiness gives a policymaker the overall picture. It then makes sense to examine in more detail the sectoral composition of exposure and to assess the components of the Networked Readiness measure to determine which areas are in greatest need of policy attention.

Finally, there is work for the research community to do as well. A more systematic assessment of how industries are being transformed by e-commerce is vital for sectoral analysis of this type. Systematic assessment of numerous countries would be a step along the way to show how the domestic environment affects industry response. Clearly this would be a key input to the policy debate on what policies matter the most.

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Endnotes

* The author would like to thank Maria Unterrainer for her assistance in research.

1 Electronic Data Interchange is a precursor to e-commerce. However, this system uses proprietary systems, inflexible coding for specific data, and is about ten times more expensive than e-commerce. It thus restricts the type of both data and the firm able to use it.

2 The textile sector is somewhat different, with the U.S. sector using the Internet more intensively than its European counterpart. Since the textile and apparel sector has had extensive protection via the Multifibre Arrangement, this could account for the difference in uptake. Indeed, see the discussion in *European Information Technology Observatory 2000*, Millennium Edition Part Two, The Impact of E-Commerce on Five Vertical Sectors (prepared by GartnerConsulting in close collaboration with EITO Task Force and Enterprise DG of the European Commission).

3 GTAP was developed at Purdue University in conjunction with a number of international organizations including UNCTAD. See UNCTAD (2000:28–30) for more discussion on the model results.

4 In one of the simulations performed, UNCTAD examined a 1 percent improvement in resource utilization by industrial countries and a 0.3 percent in improvement by developing countries in conjunction with increased service sector efficiency. They note, "These percentages do not intend to reflect the actual differences in access to the Network…but simply represent a working assumption." Adjusting this parameterization to the same magnitude as the evidence found by Brookes and Wahhaj (2000), the UNCTAD "shocks" should be 3.5 times as large.

5 These figures use the same adjustment to the size of the shocks as noted earlier.

6 The vignettes are based on the author's research.

7 It would be useful to have both production and trade data, but only trade data are available for most economies.

8 Data for industry sectors calculated are major Standard International Trade Classification (SITC) categories, compiled to match the categories for which research underpins the Internet intensity indexes. "Foods" is the sum of SITC 0 and 1; energy, natural resources, and chemicals is the sum of SITC 2, 3, 4, 5; Metals and metal manufacturing is the sum of SITC 67, 68, 69; consumer goods and textiles is the sum of SITC 65 and 8; industrial equipment and supplies is the sum of SITC 71, 72,73, 74; electrical products is the sum of SITC 75, 76, 77; and automobiles is SITC 78. All data on trade come from the United Nations and are for 1998. For all the economies except Russia, the coverage of trade flows is at least 90 percent.

9 For more discussion, see chapter nine of Mann et al. (2000).

Appendix Table 1: **Research on Industry Use of Internet and E-commerce**

Industry	Goldman Sachs	Litan/ Rivlin	Forrester			NAM/E&Y				EITO (Europe)		
	Cost Savings	Cost Savings	Product Fit	Industry Readiness	Total	Zero	E-information	E-interaction	E-commerce	Internal	External	Total
Industry	%	%	score	score	average	% of firms in category				score	score	w. total
		or $B over 5 yrs										
Food Ingredients	3–5		4.8	3.4	4.1							
Consumer Goods			3.5	2.9	3.2	1	21	42	36			
Textiles										1.4	2.5	3.9
Energy, Chemicals, Natural Resources						7	32	29	28			
Coal	2											
Chemicals	10											
Pharmaceuticals			3.9	3.1	3.5					2.0	2.4	4.4
Forest Products	15–25											
Paper	10		3.8	3	3.4							
Steel	11											
Machinings (Metals)	22					9	29	40	21			
Heavy Industries			2	1.5	1.75							
Industrial Equipment and Supplies			2	4	3	6	22	47	25			
Technology and Electronics						0	25	40	35			
Computing and Electronics		5% (Cisco)	4	4.8	4.4							
Electronic Components	29–39											
Computing	11–20											
Aerospace Machinings	11		1.5	1.5	1.5					2.6	2.2	4.8
Autos	..	13%	3.3	1.5	2.4	3	24	47	26	2.7	3.2	5.9
Shipbuilding										2.0	1.6	3.6
Shipping/ Warehousing			4.4	4	4.2							
Freight Transport	15–20	3–79 $B										
Utilities			4.4	4	4.2							
Communications/ Bandwidth	5–15											
Health Care	5	41 $B										
Life Science	12–19											
Construction			2.2	4.5	3.35							
Media and Advertising	10–15											
Retail		not clear										
Finance		19 $B										
All Firms						4	26	42	27			
Added to U.S. Productivity Growth		0.25–0.5										

See text for full description of column headings.
Sources: Brookes and Wahhaj, Goldman Sachs (2000), The Shocking Economic Effect of B2B.
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CHAPTER 10

Trade in ICT Products: The Global Framework and Empirical Evidence

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That information and communications technologies (ICTs) serve as key drivers of economic productivity and growth highlights the need for emerging-market economies[1] to have access to, and use of, these technologies. Innovation, or the creation of new technologies, represents one mechanism for emerging-market economies to gain access to ICTs. But as in other fields of technological advance, innovations in ICT have remained largely concentrated in a limited number of highly industrialized countries. In a self-perpetuating process whereby each new technological innovation triggers yet further technological advances, core innovators (e.g., the United States, Canada, Western Europe, Japan, Israel, Korea, Singapore, and Taiwan), representing barely 15 percent of the world's population, account today for fully 99 percent of the patents issued for new inventions[2] (McArthur and Sachs 2001).

This chapter focuses on international trade, which, coupled with foreign direct investment, is the other mechanism enabling emerging-market economies to gain access to ICTs. International trade is vital to Networked Readiness because it allows domestic producers and consumers to have access to a greater variety of ICT products and services at prices lower than would otherwise be the case. Equally important is the role of international trade in facilitating technological diffusion, which is the process of adopting (and adapting) technologies developed abroad.[3] Indeed, the absorption of advanced technologies and capital from core economies has allowed certain noncore economies to achieve the highest economic growth rates in the world,[4] enabling economies such as Taiwan, Ireland, Hong Kong, Singapore, and Korea—which were noncore economies in the 1980s—to become core innovators by the year 2000.

Recognizing the relevance of technology in the development of noncore economies, Michael Porter (2001) (discussed in his essay published in *The Global Competitiveness Report 2001–2002*) developed a measure of how quickly noncore economies are absorbing and implementing internationally competitive production technologies from the core economies. McArthur and Sachs (2001) have created a variable that measures the extent of manufacturing technology in the export structure of noncore economies.[5] According to McArthur's and Sachs's findings, regression analysis confirms strongly that, all other things being equal, primary commodity-based economies indeed grew less rapidly in the last decade (and since 1970) than did more technology-based export economies.[6]

The present chapter employs a refined approach of analyzing the empirical evidence on the participation of countries in the global trade of ICT products. Specifically, the chapter uses a framework developed by the International Trade Centre (a joint subsidiary organ of the United Nations Conference on Trade and Development [UNCTAD] and the World Trade Organization [WTO]). This framework, referred to as the *Trade Performance Index* (TPI) is an examination of the trade performance of a country based on its current position in the world market as well as the changes in its position over the period from 1995 to 1999, focusing on four key product areas: electronic equipment and components, telecommunications equipment, electrical machinery and equipment, and office equipment and components.[7] For each of these groups, the TPI-based country rankings provide a systematic assessment of the multifaceted dimensions of export performance, incorporating aspects of competitiveness, diversification within a particular sector, and changes in international market share, among other variables.

Employing highly disaggregated data from the world's largest trade database, COMTRADE, our analysis is confined to trade in ICT products. The analysis excludes ICT services, which spans software development, application reengineering or conversion, consulting, and training, among others. That trade in ICT services suffers from a lack of official trade data is a serious gap, especially given that global software and related services have expanded rapidly in recent years to an estimated amount of US$450 billion. Trade in telecommunications services is also outside the scope of the report, as well as ICT-related innovations pertaining to callback services, cellular telephony, and the like. Exceptions aside, the coverage of the study remains substantial, as trade in information technology products amounted to more than US$800 billion in 1999, a figure exceeding the combined value of world merchandise trade in agriculture and automobiles.

Given the relevance of international trade in improving Network Access and facilitating technological diffusion, the first part of the chapter will provide an examination of the empirical evidence of the global trade in ICT products using the framework of the trade performance index. In the second part of the report, there will be an analysis of the trade performance assessment findings in the context of the international trading system and the digital divide. Policy conclusions are drawn, stressing the importance of updating the current multilateral framework for trade in ICT. Emphasis is also placed on the need for trade liberalization, as part of a comprehensive national strategy to improve Networked Readiness.

Development of Trade in ICT Products

To a considerable extent, the development of trade in ICT products reflects a phenomenon that began to be apparent around three decades ago. In the early 1970s, competitive pressures compelled many enterprises in industrialized countries to adopt global sourcing as a strategy. The main objective was to transfer costly production processes to countries with lower labor costs in order to overcome the pressures of increasing competition. Various production arrangements have evolved, ranging from joint ventures to manufacturing and licensing arrangements; the latter often includes buy-back clauses. As a result of these arrangements, thousands of new and technically advanced plants have been established in emerging-market economies, creating new job opportunities, upgrading labor skills, and generating income.

Consequently, the share of emerging-market economies in the total global output of ICT products increased significantly in terms of volume and technical sophistication. COMTRADE data reveal that emerging-market economies account for 25 percent of total ICT exports and 35 percent of total ICT imports. These market shares are particularly remarkable in the context of rapid expansion of the sector, posting an average annual growth rate of 15 percent in the second half of the 1990s.

Table 1 depicts imports of ICT products in 1999 for the seventy-five countries included in this report's Networked Readiness rankings as well as *The Global Competitiveness Report 2001–2002*'s competitiveness rankings.[8] The table portrays ICT imports in the four major product categories, which amounted to a total of US$868 billion in 1999.

Emerging-market economies represent a sizeable share of ICT imports, accounting for around 48 percent of total ICT products imported by the seventy-five countries covered in this report. However, ICT imports are not evenly distributed among the group of emerging-market countries. Rather, they are highly concentrated in a limited number of economies. Apart from Mexico, they are primarily situated in Asia and include China, Hong Kong, Korea, Malaysia, the Philippines, Singapore, and Taiwan. ICT imports represent a substantial share of total imports in many of these countries. In the Philippines and Malaysia, for instance, imports of electronic equipment and components account for around 30 percent of the countries' total imports.

Import data alone, however, can be misleading, because these figures tell us little about the use of these ICT products; in many cases, a substantial proportion of imports serves as inputs for exports. Import data alone also do not fully depict the degree of technological diffusion. In this regard, it is important to examine export data. (See Table 2.)

COMTRADE export data show that in 1999, emerging-market countries had a 38 percent market share in electronic equipment and components, and a 35 percent market share in office equipment and components. Similarly, emerging-market countries accounted for 30 percent of exports of electrical equipment and machinery as well as 21 percent of telecommunications equipment exports.

Table 1: Imports of ICT Products, 1999 (in US$000)

Country/ Trading Group	Electrical Machinery and Equipment	Electronic Equipment and Components	Office Machinery and Supplies	Telecommmunications Equipment
Argentina	985,572			
Australia	1,856,128	730,409	4,478,728	2,361,275
Austria	2,611,550	741,072	2,545,081	1,472,353
Bangladesh				
Belgium (incl. Luxembourg)	3,365,445	1,395,846	4,923,639	2,134,957
Bolivia				
Brazil	2,783,093	1,567,828	1,489,972	
Bulgaria	102,396	9,926	96,655	
Canada	7,787,467	6,833,537	10,405,779	3,776,706
Chile	435,706			
China	11,172,150	10,401,958	7,356,655	4,625,918
Colombia	310,550			
Costa Rica	204,666	414,428	151,643	65,182
Czech Republic	2,135,172	307,791	942,878	480,579
Denmark	1,717,366	398,778	2,442,795	1,144,370
Dominican Republic	387,148	10,271	73,540	132,089
Ecuador	116,215			
Egypt				
El Salvador	59,213			
Estonia	309,708	102,777	111,741	
Finland	1,906,231	1,167,081	1,708,520	621,034
France (incl. Monaco)	8,927,976	6,157,510	14,807,044	4,055,030
Germany	15,933,856	10,158,331	26,078,946	5,899,475
Greece	463,706	102,114	714,802	739,572
Guatemala	201,852			
Honduras	89,737			
Hong Kong SAR	11,622,421	13,220,005	13,709,606	5,654,056
Hungary	2,239,940	522,753	1,871,347	399,167
Iceland				
India	778,639	294,134	746,595	217,555
Indonesia	1,531,158	64,451	246,468	926,477
Ireland	2,200,943	2,403,055	9,014,899	1,658,200
Israel	1,244,227	724,322	1,423,725	890,441
Italy	5,850,382	2,787,781	7,999,505	4,485,051
Jamaica	33,879	40,383		
Japan	9,035,806	13,183,361	20,155,339	3,872,760
Jordan	78,704	35,742		37,722
Korea	5,696,185	15,748,265	4,336,380	1,462,850
Latvia	93,732	4,090	93,811	74,195
Lithuania	135,479	8,938	101,018	69,741
Malaysia	5,700,544	18,188,274	3,728,773	447,406
Mauritius				
Mexico	15,527,876	6,886,944	4,412,546	2,830,269
Netherlands	4,074,362	4,479,085	24,267,059	4,501,197
New Zealand	363,267	60,497	706,022	420,950
Nicaragua	100,307			34,294
Nigeria				
Norway	997,073	168,022	1,733,800	800,249
Panama				
Peru	224,760			
Philippines	2,176,575	10,050,566	2,015,499	489,560
Poland	1,663,132	363,869	1,613,690	1,209,137
Portugal	1,278,586	610,163	1,116,627	743,557
Romania	371,835		265,148	246,787
Russian Federation	586,562	38,593	297,514	599,312
South African Customs Union	768,815	209,720	1,245,747	1,275,579
Singapore	8,850,713	21,488,885	14,294,347	1,912,773
Slovak Republic	559,065	95,999	307,586	140,960
Spain	3,930,776	824,617	4,626,894	3,746,432
Sri Lanka	137,909		4,346	74,068
Sweden	3,184,373	1,617,958	3,378,481	1,815,576
Switzerland (inc. Liechtenstein)	2,783,350	719,272	4,544,687	1,321,297
Taiwan	5,408,491	12,010,301	6,517,235	1,772,968
Thailand	4,084,716	4,982,609	2,549,654	634,894
Trinidad and Tobago	71,204			
Turkey	1,414,861			
Ukraine	201,467	9,859	135,005	124,877
United Kingdom	10,842,140	7,462,271	26,962,591	9,456,848
Uruguay	106,362			
U.S. (incl. Puerto Rico, U.S. Virgin Islands)	37,792,762	37,963,002	85,038,804	21,743,982
Venezuela	575,326			
Vietnam	439,245		146,413	101,173
Zimbabwe	48,341			
TOTALS	218,669,192	216,025,059	328,184,613	105,194,251

Table 2: **Exports of ICT Products, 1999 (in US$000)**

	Electrical Machinery and Equipment		Electronic Equipment and Comp.		Office Machinery and Supplies		Telecommunications Equipment	
	Value (in US$000)	Market share (%)	Value (in US$000)	Market share (%)	Value (in US$000)	Market share (%)	Value (in US$000)	Market share (%)
Argentina	147,355	0.07						
Australia	531,971	0.25	95,966	0.05	442,944	0.14	220,930	0.20
Austria	2,992,930	1.42	788,631	0.39	885,350	0.29	488,532	0.44
Bangladesh								
Belgium (incl. Luxembourg)	3,293,916	1.56	1,204,617	0.59	3,380,780	1.09	1,519,154	1.36
Bolivia								
Brazil	653,141	0.31			387,142	0.13	379,386	0.34
Bulgaria	61,361	0.03	3,780	0.00	7,232	0.00		
Canada	4,028,850	1.91	2,730,393	1.35	4,776,623	1.54	5,608,649	5.03
Chile	27,674	0.01						
China	10,941,381	5.18	3,190,139	1.57	13,089,651	4.23	3,209,855	2.88
Colombia	66,081	0.03						
Costa Rica	171,107	0.08	74,761	0.04	2,490,595	0.80	10,236	0.01
Czech Republic	2,136,143	1.01	109,199	0.05	352,298	0.11	52,678	0.05
Denmark	1,932,106	0.92	146,983	0.07	1,083,208	0.35	1,219,722	1.09
Dominican Republic	374,744	0.18	3,047	0.00	5,029	0.00	16,154	0.01
Ecuador	6,962	0.00						
Egypt								
El Salvador	7,067	0.00						
Estonia	58,053	0.03			19,794	0.01	176,671	0.16
Finland	2,024,375	0.96	266,768	0.13	877,642	0.28	5,951,860	5.34
France (incl. Monaco)	10,518,762	4.98	6,932,409	3.42	10,333,733	3.34	7,468,626	6.70
Germany	23,853,702	11.30	8,325,866	4.10	14,322,737	4.62	10,064,971	9.03
Greece	181,492	0.09	7,745	0.00	74,363	0.02	117,042	0.10
Guatemala	14,174	0.01						
Honduras	4,252	0.00						
Hong Kong SAR	999,020	0.47	2,056,292	1.01	765,984	0.25	164,625	0.15
Hungary	1,309,633	0.62	84,700	0.04	3,346,653	1.08	53,108	0.05
Iceland								
India	240,610	0.11	58,955	0.03	222,304	0.07	16,582	0.01
Indonesia	886,147	0.42	308,306	0.15	1,251,550	0.40	158,224	0.14
Ireland	2,263,950	1.07	2,794,942	1.38	16,133,333	5.21	3,208,156	2.88
Israel	823,890	0.39	413,546	0.20	1,439,466	0.46	2,716,793	2.44
Italy	6,400,524	3.03	1,648,729	0.81	3,609,728	1.17	2,507,819	2.25
Jamaica	1,500	0.00			258	0.00		
Japan	31,330,880	14.84	29,097,002	14.35	28,268,395	9.13	8,098,165	7.26
Jordan	4,564	0.00			4,653	0.00	4,076	0.00
Korea	3,436,111	1.63	18,749,416	9.24	10,653,908	3.44	4,624,559	4.15
Latvia	22,939	0.01	2,971	0.00	6,183	0.00	4,382	0.00
Lithuania	18,842	0.01	3,993	0.00	10,988	0.00	5,832	0.01
Malaysia	4,480,322	2.12	16,214,511	7.99	17,223,107	5.56	2,204,645	1.98
Mauritius								
Mexico	3,120,684	6.21	1,973,134	0.97	9,726,083	3.14	3,423,940	3.07
Netherlands	3,874,662	1.84	5,761,616	2.84	20,889,690	6.75	2,946,120	2.64
New Zealand	207,922	0.10	13,625	0.01	75,674	0.02	79,515	0.07
Nicaragua	192	0.00			.161	0.00		
Nigeria								
Norway	552,912	0.26	20,173	0.01	511,988	0.17	429,453	0.39
Panama								
Peru	9,110	0.00						
Philippines	1,732,287	0.82	11,415,822	5.63	8,603,878	2.78	577,981	0.52
Poland	881,497	0.42	19,580	0.01	115,273	0.04	66,370	0.06
Portugal	913,546	0.43	384,413	0.19	108,246	0.03	89,805	0.08
Romania	172,605	0.08			104,978	0.03	28,748	0.03
Russian Federation	626,838	0.30	159,104	0.08	81,050	0.03	47,980	0.04
South African Customs Union	211,870	0.10	15,199	0.01	197,090	0.06	121,513	0.11
Singapore	7,161,718	3.39	21,948,293	10.82	30,217,700	9.76	2,303,982	2.07
Slovakia	334,646	0.16	23,832	0.01	139,425	0.05	38,039	0.03
Spain	2,586,155	1.22	482,416	0.24	1,895,340	0.61	1,273,929	1.14
Sri Lanka	52,577	0.02	2,624	0.00	88,342	0.03		
Sweden	3,287,947	1.56	519,727	0.26	847,615	0.27	9,456,986	8.48
Switzerland (incl. Liechtenstein)	4,642,576	2.20	527,528	0.26	1,522,185	0.49	592,657	0.53
Taiwan	9,591,258	4.54	15,369,295	7.58	28,766,265	9.29	2,840,410	2.55
Thailand	3,649,992	1.73	3,709,672	1.83	8,062,786	2.60	788,673	0.71
Trinidad and Tobago	7,012	0.00						
Turkey	559,818	0.27						
Ukraine	115,463	0.05	6,624	0.00	9,292	0.00	10,095	0.01
United Kingdom	10,520,497	4.98	6,394,793	3.15	21,260,489	6.87	10,530,498	9.44
Uruguay	5,536	0.00						
U.S. (incl. Puerto Rico, U.S. Virgin Islands)	28,036,379	13.28	37,074,634	18.28	40,619,674	13.12	15,361,861	13.78
Venezuela	33,520	0.02						
Vietnam	279,664	0.13			21,841	0.01	33,996	0.03
Zimbabwe	1,047	0.00						
TOTALS	209,416,461	99.2	201,135,771	99.2	309,330,696	99.9	111,313,983	99.8

In the electronic equipment and components product group, emerging-market countries are among the top seven exporters. Korea, Malaysia, Taiwan, and the Philippines occupy the fourth to seventh top ranks, with a combined export market share of 41 percent. For these countries, electronics exports comprise a significant proportion of total domestic exports: in the Philippines, it accounts for 35 percent of total exports; in Malaysia, 20 percent; in Korea, 14 percent; and in Taiwan, 12 percent. Although not included in the Networked Readiness and growth competitiveness rankings, Malta is particularly notable, with electronics exports comprising 57 percent of total exports, and per capita electronics exports of US$2,722—greater than Malaysia's per capita electronics exports of US$789 or the US$140 of the U.S. It should be noted, however, that for the leading emerging-market country exporters, the contribution to local value-added is significantly smaller than the gross export data suggests. In many countries, the contribution amounts to less than a quarter of gross exports.

In the telecommunications equipment subsector, most of the top fifteen exporters are high-income countries, except for five emerging-market economies: Korea, Mexico, China, Taiwan, and Israel. These five leading emerging-market exporters have a combined market share of 15 percent of total exports of telecommunications equipment in the world. Telecommunications equipment, however, does not comprise a large proportion of national exports. The emerging-market countries with the highest proportion of telecommunications equipment exports are Israel, where the subsector accounts for 11 percent of total exports, and Estonia, where it comprises 6 percent of total exports. Chile and Mexico are also worth mentioning because like Israel, their individual market shares have exceeded those of many industrialized countries, including Austria, Belgium, Denmark, Italy, and Switzerland. Notably, many emerging-market countries are net importers of telecommunications equipment, with net imports by China, one of the largest exporters in this area, amounting to US$1.4 billion.

In terms of trade in office equipment, which consists primarily of fully assembled computers, the leading exporters from emerging-market economies are Taiwan, Malaysia, and China, with a combined market share of 19 percent of total world exports. Other significant exporters of office equipment are Costa Rica and Hungary, with net exports of US$2.3 billion and US$1.5 billion, respectively. In terms of per capita exports, Costa Rica and Hungary also rank high with US$724 and US$328, per capita, respectively. As a percentage of country exports, office equipment comprises 40 percent of Costa Rican, 25 percent of Philippine, 22 percent of Taiwanese, and 21 percent of Malaysian exports. Notably, Mexican exports in this category were more than twice as much as Canadian exports, while exports from Switzerland were less than half of the value of exports from Hungary.

Many emerging-market countries are also exporters of electrical machinery and equipment. Mexico, China, Taiwan, Malaysia, and Thailand are the top exporters in this product group, with a combined market share of 27 percent of total world exports. However, emerging-market countries are generally net importers of electrical machinery, which tends to be more human-capital intensive than the production of electronic components and computers. Of the aforementioned countries, Taiwan is the only net exporter, while the other countries are notable net importers. Mexico's electrical equipment exports, for instance, comprise 10 percent of their exports and 11 percent of their imports. In value terms, other notable exporters include the Czech Republic and Hungary, although electrical equipment represents a relatively smaller share of their total exports.

The Trade Performance Index

While trade data provide useful information about the extent to which individual countries have successfully penetrated foreign markets, a comprehensive assessment of a country's trade performance and competitiveness needs to be based on a broader set of indicators. For this purpose, we employ the Trade Performance Index (TPI), which has been designed to mirror a country's trade performance both at a given point in time and the changes it makes over time.

Reflecting a country's trade performance in a given year, the so-called Current TPI is a function of five variables, namely: (1) net exports, (2) per capita exports; (3) world market share; (4) degree of product diversification; and (5) level of market diversification. The rationale of this approach is summarized briefly in Box 1.

Analysis of the TPI likewise confirms that while trade in ICT products has been very dynamic, it is still highly concentrated on a limited number of countries, mostly high-income countries. As far as trade in electronic equipment and components is concerned, Singapore, Japan, and France represent the three top performers. Emerging-market economies in Asia, especially Taiwan, the Philippines, and Korea, again outperform most other countries. With few exceptions, Central and Eastern Europe, Latin America, and Africa (in particular), appear much less integrated (Table 3).

A similar picture emerges regarding office machinery and supplies. Ireland enjoys the highest rank, followed by Singapore and Japan. Among the emerging-market economies, East Asia has achieved a far higher degree of integration than other regions, with Taiwan, Malaysia, Korea, and China being ranked fourth, fifth, sixth, and ninth, respectively. Some transition economies, notably Hungary (fourteenth), Slovenia (twenty-sixth), the Czech Republic (twenty-seventh), and Estonia (thirtieth), have also performed well. By contrast,

Box 1: The Current TPI

An important advantage of using net exports (i.e., exports minus imports), rather than the absolute value of exports, is that the former take into account reexports, and hence show that a considerable part of imported intermediate products found in exports usually belong to the same sector (e.g., electronic parts and assembled computers). Thus, net exports seem better suited to reflect the globalization of production processes and the induced vertical specialization of countries at various stages of production.

In the Current TPI, net exports are supplemented by per capita exports as an indicator of a country's general level of outward orientation. Moreover, the Current TPI includes the share of countries in the world market for a given product, reflecting the success of its exporters vis-à-vis their foreign competitors. This indicator is measured by the ratio of a country's total exports of a particular product to total world exports, which is equivalent to the country's share in national markets for each partner country, weighted by the importance of each of these partners in world trade.

The extent to which a country's product base is diversified mirrors not only its industry's development level, but also indicates the degree of vulnerability with regard to industry-specific external shocks. The TPI uses two measures of product diversification: the spread index (S), and the so-called equivalent number (EN). The former measures the dispersion between the highest and lowest value in a statistical series calculating for each country the distribution of export products on the basis of weighted standard error and comparing it to the average export value. The greater the distribution of exports from a country compared to the average, the higher the value of the index. By contrast, the EN represents the number of markets of identical size that would lead to the degree of export concentration exactly equal to the observed one. Calculated as the inverse of the Herfindahl-Hirschman Index (a commonly accepted measure of market concentration),[9] the EN distinguishes for each country the equivalent number of exported goods of equal importance leading to the same concentration of exports. The increase in rank is a function of the increase in the level of diversification—the greater the index value, the greater the diversification of exports.

Finally, the TPI is a function of market diversification and takes into account that diversifying trading partners reduces a country's dependence on a small number of export markets, and hence the vulnerability to shocks in the destination countries. Again, spread indices and equivalent numbers are calculated to estimate the degree of diversification.

South America appears to be less integrated in trade in this sector, with the exceptions of Mexico and Costa Rica. Finally, sub-Saharan Africa seems to have been least able to penetrate foreign markets for this product group.

The European economies clearly lead in terms of their performance of trade in electrical machinery. In fact, with the exception of Taiwan, the top ten countries are all from Europe; except for Switzerland, they all belong to the European Union (EU), and with the further exception of the United Kingdom, they all participate in the European Monetary Union (EMU). In this context however, it has to be duly noted that much of this trade is intra-EMU trade, which from a monetary standpoint now represents domestic trade—similar to that of the U.S., which enjoys rankings ranging from ten to seventeen for the product groups considered here. Interestingly, some transition economies in Central and Eastern Europe also perform well, especially the Czech Republic and Slovenia, both candidates for EU enlargement.

European exporters also lead in the trade of telecommunications equipment. France, the U.K., and Finland represent the three top performers, followed by Sweden and Germany. While Japan and Canada also belong to the group of top performers, noteworthy emerging-market countries in this area—apart from Taiwan and Malaysia—include Israel and Mexico.

While the Current TPI provides a useful snapshot of a country's performance in a particular export sector, this measure contains little information about the dynamics of foreign trade. Therefore, we have also calculated a Change TPI, which covers the period 1995 to 1999 and whose construction is briefly explained in Box 2.

The Change TPI draws a complementary picture, with only two developed countries, New Zealand and Ireland, belonging to the group of the ten best performers regarding trade in office machinery and supplies (Table 4). Instead, the emerging-market economies in Asia (Malaysia, the Philippines, and Korea) and the transition economies in Central and Eastern Europe (Hungary, Slovenia, and Russia) appear to have been particularly successful in becoming more integrated. By contrast, progress in South America and the Caribbean has been relatively slow, with the notable exception of Costa Rica, which was ranked fifteenth compared with twenty-ninth in the Current TPI. Similarly, Africa's efforts to improve its trade performance in ICT products have had limited success, with the South African Customs Union (SACU), the most advanced in the region, being ranked forty-second, both in terms of its position and Change TPIs.

However, SACU has proved considerably more successful in terms of the change in its trade performance in the area of electronic equipment and components, being ranked among the top ten exporting economies covered in this paper. The most rapid improvement in this product group is concentrated in the emerging-market economies of Asia, notably Thailand, Indonesia, and the Philippines. Russia and the Ukraine have also shown an impressive performance. As far as Europe is concerned, Ireland has clearly outperformed its competitors, from an already high level as indicated by the Current TPI. South America and the Caribbean, on the other hand, have been showing relatively little progress, with the notable exception of Costa Rica.

Table 3: **Trade Performance Index: Position Ranking (1999)**

	Office Machinery and Equipment	Electronic Equipment and Components	Electronic Machinery and Equipment	Telecommunications Equipment
1	Ireland	Singapore	Germany	France
2	Singapore	Japan	Japan	United Kingdom
3	Japan	France	France	Finland
4	Taiwan	Taiwan	Sweden	Sweden
5	Malaysia	Philippines	Switzerland	Germany
6	Korea	Korea	Italy	Japan
7	Netherlands	Switzerland	Austria	Ireland
8	Germany	Malaysia	Finland	Taiwan
9	China	Ireland	Taiwan	Canada
10	Belgium	United States	Ireland	Malaysia
11	United Kingdom	Austria	United Kingdom	United States
12	France	Belgium	Belgium	Singapore
13	United States	Germany	Netherlands	Israel
14	Hungary	Thailand	Denmark	Belgium
15	Sweden	United Kingdom	Czech Republic	Norway
16	Philippines	Netherlands	Singapore	Mexico
17	Thailand	Sweden	Slovenia	Italy
18	Austria	Hong Kong SAR	United States	Spain
19	Mexico	China	Spain	Denmark
20	Switzerland	Russia	Norway	Korea
21	Finland	Czech Republic	Russia	Switzerland
22	Denmark	Denmark	Korea	Austria
23	Norway	South African Customs Union	China	Netherlands
24	Israel	Spain	Portugal	Thailand
25	Italy	Italy	South African Customs Union	Philippines
26	Slovenia	Indonesia	Thailand	Australia
27	Czech Republic	Finland	Mexico	Portugal
28	Spain	Hungary	Australia	Czech Republic
29	Costa Rica	Poland	Hungary	Greece
30	Estonia	Israel	Canada	China
31	Australia	Australia	Bulgaria	New Zealand
32	Indonesia	Slovak Republic	Malaysia	Estonia
33	Russia	Norway	Israel	India
34	Canada	Mexico	Turkey	South African Customs Union
35	Poland	India	Poland	Slovenia
36	Portugal	Slovenia	Greece	Slovak Republic
37	Hong Kong SAR	Canada	Brazil	Indonesia
38	Bulgaria	New Zealand	Slovak Republic	Russia
39	Greece	Portugal	New Zealand	Poland
40	India	Costa Rica	Hong Kong SAR	Brazil
41	Lithuania	Bulgaria	Indonesia	Lithuania
42	South African Customs Union	Greece	Philippines	Hungary
43	Ukraine	Ukraine	Romania	Romania
44	Vietnam	Latvia	Dominican Republic	Ukraine
45	Slovak Republic	Lithuania	India	Hong Kong SAR
46	New Zealand	Sri Lanka	Costa Rica	Vietnam
47	Brazil	Dominican Republic	Estonia	Jordan
48	Sri Lanka		Ukraine	Costa Rica
49	Romania		Argentina	Dominican Republic
50			Colombia	
51			Sri Lanka	
52			Vietnam	
53			Venezuela	

Latin America's exporters seem to be enjoying greater success in the area of electronic machinery and equipment, where the Change TPI ranks Mexico and Argentina sixth and eighth, respectively. Again, East Asia also proves successful in this product group, with four emerging-market economies among the top ten performers. Sri Lanka's performance is particularly impressive. Although its current export base is still very low, it has enjoyed the relatively greatest improvement in 1995 to 1999, according to the Change TPI. Clearly, Sri Lanka's top ranking reflects to a large extent a base effect, but it does appear that encouraging progress has been made not just in terms of increasing exports but also with regard to diversifying the country's export products as well as markets. Other noteworthy cases include Israel (second) and Norway (fifth).

Israel (eighth) is also performing very well in terms of penetrating export markets for telecommunications equipment. Interestingly, a number of advanced countries have continued to show a high degree of dynamism, outperforming most other countries. In particular, this group includes Finland (second), Ireland (fourth), and the U.K. (seventh). Rapid improvements are recorded in a number of countries in East Asia (e.g., Malaysia and China) and Latin America (e.g., Mexico and Costa Rica). However, the most rapid change in trade performance in the 1995 to 1999 period has taken place in Romania, albeit from a relatively low level.

In sum, notwithstanding some important limitations (Box 3), the TPI confirms that while international trade in ICT products has expanded rapidly, exports have been concentrated to a relatively small number of countries. With few exceptions, ICT products continue to have their origin in the triad and a few emerging-market countries in Asia. On the import side, emerging-market economies have become significantly more integrated in the area of telecommunications equipment. However, in other areas, notably electronic data processing equipment (by far the largest product group), their share in terms of global imports has remained disappointingly small.

Trade Policy and Implications

As the above analysis has shown, many emerging-market economies have yet to become integrated in the global ICT trade, and this presents important challenges to international and domestic policymakers. On a national level, trade policy must form part of a comprehensive strategy to foster an economic environment conducive to promoting the growth of the information technology sector. Trade liberalization is essential, both as a tool for becoming a competitive ICT producer and integrating in the global production network, and as an instrument for improving Networked Readiness by enhancing access to, and use of, ICTs in the country. Indeed, trade policy forms an integral part of Network Policy, which is one of the five components of Networked Readiness.

Box 2: The Change TPI

The Change TPI reflects five factors, namely (1) the change in a country's world market share; (2) the trend of the coverage of imports by exports; (3) an index reflecting a country's ability to adapt to the dynamics of world demand; (4) the change in the diversification of products; and (5) the change in market diversification.

In estimating the variation in a country's world market share, the Change Index decomposes the overall change in world market share into four complementary, additive effects that are quantified separately. These are the competitiveness effect, the impact of initial geographic specialization, the impact of initial product specialization, and the adaptation to changes in the patterns of world demand. All these indicators enter into the Change Index. The *competitiveness effect* captures gains in market share due to increased competitiveness. It is calculated as the change in the exporting country's share in imports of target market, multiplied by the initial share of the partner countries' imports in world trade. The *initial geographic specialization* captures the benefits associated with the initial specialization of domestic exports on dynamic markets. It is calculated as the initial market share of the exporting country in partner countries, multiplied by the change in the share of partner countries in world trade. The *initial product specialization* captures the benefits associated with the initial sector specialization of the exporting country on products facing a dynamic demand. Finally, the *adaptation effect* captures the ability to adjust the supply of exports to changes in world demand. The ranking for the change in market share is calculated as the simple average of the rankings for these four items.

The trend in the coverage of imports by exports is used to indicate the evolution of the trade balance for a group of products. It is calculated as an index of the average annual growth rate of the cover ratio between 1995 and 1999 (based on Ordinary Least Squares [OLS]).

Adapting to changes in world demand is critical for a country's ability to benefit from foreign trade. In calculating this third subindex, we employ Spearman's rank correlation between the ranking share of the exporting countries' export products in its total exports and the rank of growth trends in worldwide exports of those products. Ranging from –1 to 1, the index indicates the extent to which the importance of a country's exported goods is in accordance with the ranking of world export growth rates for the same products.

The calculations of the changes in the diversification of products and market diversification, finally, are based on the same approach as the Current TPI. (See Box 1.) Specifically, the change in the product diversification of a given country represents the average annual variation over the period 1995 to 1999 in the number of equivalent export products. The change in the product spread is calculated as the average annual variation in the concentration of export products over the same period. Likewise, the change in the diversification of markets is represented by the average annual variation in the number of equivalent export markets over the 1995 to 1999 period, whereas the change in the product spread is given by the average annual variation in the concentration of export markets.

Table 4: **Trade Performance Index: Change Ranking (1995–1999)**

	Office Machinery and Equipment	Electronic Equipment and Components	Electronic Machinery and Equipment	Telecommunications Equipment
1	Hungary	Thailand	Sri Lanka	Romania
2	Malaysia	Indonesia	Israel	Finland
3	Philippines	Philippines	China	Malaysia
4	New Zealand	Russia	Philippines	Ireland
5	Russia	Ireland	Norway	China
6	Slovenia	Ukraine	Mexico	Greece
7	Romania	Taiwan	Indonesia	United Kingdom
8	Ireland	China	Argentina	Israel
9	Korea	South African Customs Union	Czech Republic	Mexico
10	Ukraine	Slovak Republic	Poland	Brazil
11	Finland	Malaysia	Portugal	Belgium
12	Slovak Republic	Australia	Canada	Sweden
13	Greece	Costa Rica	Hungary	Philippines
14	Norway	Singapore	Slovak Republic	Costa Rica
15	Costa Rica	Sri Lanka	Korea	Estonia
16	Belgium	Spain	Ireland	Vietnam
17	Austria	France	South African Customs Union	Denmark
18	Netherlands	Dominican Republic	Dominican Republic	Dominican Republic
19	Poland	Switzerland	Greece	Hungary
20	Mexico	United States	Thailand	Indonesia
21	France	Denmark	Costa Rica	Italy
22	Spain	Canada	Austria	Spain
23	Estonia	Greece	Finland	Czech Republic
24	Israel	Finland	Venezuela	Portugal
25	Vietnam	Belgium	Turkey	Poland
26	Sri Lanka	Sweden	New Zealand	New Zealand
27	Lithuania	New Zealand	Slovenia	Slovak Republic
28	Thailand	India	Malaysia	Thailand
29	Bulgaria	Japan	Romania	India
30	Canada	Bulgaria	Belgium	Canada
31	Singapore	Germany	Netherlands	France
32	Taiwan	United Kingdom	Spain	Netherlands
33	Denmark	Czech Republic	Bulgaria	Ukraine
34	Portugal	Korea	Colombia	Austria
35	Sweden	Italy	United Kingdom	Slovenia
36	China	Poland	Denmark	Jordan
37	Australia	Latvia	Estonia	Korea
38	United States	Norway	Vietnam	Russia
39	Japan	Netherlands	Sweden	Norway
40	Czech Republic	Mexico	Russia	Germany
41	Germany	Hungary	Singapore	South African Customs Union
42	South African Customs Union	Hong Kong SAR	Switzerland	Lithuania
43	Switzerland	Austria	Germany	Latvia
44	United Kingdom	Slovenia	Taiwan	Singapore
45	Indonesia	Israel	United States	Switzerland
46	Brazil	Portugal	Italy	United States
47	Hong Kong SAR	Lithuania	France	Australia
48	Italy		Australia	Japan
49	India		Japan	Taiwan
50			Ukraine	Hong Kong SAR
51			Brazil	
52			Hong Kong	
53				

Box 3: Limitations of the Methodology

Drawing the implications of the TPI rankings into the context the international trading system and the digital divide requires two distinctly different analytical perspectives. Analyzing in the context of the international trading system assesses the country as a producer of information technology products, while analyzing in the context of Networked Readiness assesses the country as a user of information technology products.

Though most useful in the context of evaluating the integration of emerging-market economies in the trade of ICT products, the TPI assessment of the country as a trade producer may not be comprehensive in every case. For a few countries where the domestic market is fairly significant and even greater than their export market, looking at trade data alone can be misleading. China's trade performance in telecommunications equipment, for example, does not reveal the extent of the country's production, most of which goes to its massive domestic market.

The TPI also only indirectly provides an indication of the performance of emerging-market economies in improving Networked Readiness. A country's trade performance may be more a reflection of its ability to participate in the global production system (integration in the international trading system), as opposed to its ability to use information technology in its economy (Networked Readiness). The Philippines is a case in point; the country has one of the highest Current TPI rankings in electronic equipment and components, and yet it persists in having a very low ratio of penetration of information and communications technologies, particularly computers.

Limitations notwithstanding, the TPI is a remarkably accurate tool for monitoring trade performance across product groups. As the analysis above shows, the TPI provides a concise assessment of a country's participation in the global trade in information technology products.

Equally important, if not more critical, is the need to create a multilateral trading framework to facilitate the integration of emerging-market economies in the global trade in ICT. As economies become more integrated in the global economy, trade—particularly trade in ICT—needs to be based in an open trading framework. If trade is crucial to enabling emerging market economies to have access to ICTs, then barriers to trade must be minimized.

Although clearly a major step in the right direction, the Information Technology Agreement (ITA) forged in 1997 (Box 4) needs to be expanded and updated. While the potential benefits of the ITA appear to be high, with estimates of total economic gains ranging up to US$100 billion per year (International Trade Centre 1999), many emerging-market economies perceive that the potential gains of creating a global information infrastructure are unequally distributed because of the huge investment needs associated with the development of ICT products, and their rapid depreciation rates. Thus, an ITA II proposal has been formulated to:

1. Enlarge the coverage of ITA products to include computer software applications and services, and other similar products
2. Harmonize certification requirements, specifications, and customer protection and environment protection instruments that could otherwise serve as nontariff barriers to trade
3. Eliminate restrictions on the movement of certified software professionals
4. Provide technical assistance to emerging-market economies for the purchase of technology
5. Provide financial packages for ITA infrastructure development from international organizations.

To date, however, no agreement has been reached and there have been no products added to the original coverage.

Tariff barriers, however, are not the only major constraints facing the participation of emerging-market economies in the global trade in ICT. Nontariff barriers are often as significant, and accordingly, participants in the ITA have begun to turn their attention to addressing this matter.

That different technical regulations and standards may represent important barriers to trade is not a particularly new insight; as a matter of fact, a WTO Agreement on Technical Barriers to Trade (TBT) was signed in 1995. The aim of this agreement is to ensure that regulations, standards, testing, and certification procedures do not create unnecessary obstacles for foreign trade. While the TBT recognizes the rights of countries to adopt the standards they consider appropriate and to take measures to ensure that these standards are met, it requires countries to use international standards where these are appropriate.[10] Deviations from these international standards, for climatic, geographical, or technical reasons, require WTO Members to publish a notice sufficiently in advance to allow interested countries to comment on the proposed mandatory regulation.

Regulations imposing mandatory standards often require that certificates of conformity be obtained from designated agencies (third-party certification). While these agencies are usually highly competent, independent, and impartial bodies, obstacles arising from conformity assessments continue to exist because of the continued lack of a uniform global accreditation system. However, important measures are underway to achieve a one-step assessment, namely: (a) the conclusion of bilateral, mutual recognition agreements between certification bodies in different countries; (b) the conclusion of multilateral recognition agreements; and (c) steps towards the establishment of an international recognition system.

Obstacles to foreign trade may also arise from different quality systems (i.e., mechanisms for organizing, managing,

Box 4: Information Technology Agreement

The Information Technology Agreement (ITA) has its roots in an initiative taken by the Information Technology Industry Council (ITI) of the United States, the European Association of Manufacturers of Business Machines and Data Processing Equipment (EUROBIT), and the Japan Electronic Industry Development Association (JEIDA). As a prerequisite for establishing a global information infrastructure, the initiative identified the free flow of information and telecommunications technologies and products, and recommended the: (1) elimination of tariffs on IT products according to a specific time frame; (2) establishment of a multilateral mechanism for overseeing the IT sector; (3) integration of IT markets into a uniform global market; and (4) adoption of open systems. Following intensive discussions beginning in late 1994, the Quad group (Canada, the U.S., the EU, and Japan) took up the initiative and formulated a proposal for the IT sector that was presented two years later to the Singapore Ministerial Declaration on Trade in Information Technology Products.

Providing for the step-wise elimination of all customs duties and other charges on these products by the beginning of 2000, the Declaration, or IT Agreement, went into effect in March 1997 when forty WTO members and states accounting for more than 90 percent of the trade in this sector, agreed to participate. Six broad product categories are specified in Attachments A and B of the ITA, namely:

1. Computers (including complete computer systems and laptops as well as components such as central processing units [CPUs], keyboards, printers, display units [monitors], scanners, hard-disk drives, power supplies, etc.)
2. Telecommunications equipment (including telephone sets, videophones, fax machines, switching apparatus, modems, and parts thereof; telephone handsets, answering machines, radio broadcasting and television transmission and reception apparatus, and pagers)
3. Semiconductors (including chips and wafers)
4. Semiconductor manufacturing equipment (including a wide variety of equipment and testing apparatus used to produce semiconductors, such as vapor deposition apparatus, spin dryers, etching and stripping apparatus, laser cutters, sawing and dicing machines, spinners, encapsulation machines, furnaces and heaters, ion implanters, microscopes, handling and transport apparatus, measuring and checking instruments, and parts and accessories)
5. Software (contained on diskettes, magnetic tapes, CD-ROMS, etc.)
6. Scientific instruments (including measuring and checking devices, chromatographs, spectrometers, optical radiation devices, and electrophoresis equipment).

Other main products covered by the ITA include word processors, calculators, cash registers, ATMs, certain static converters, indicator panels, capacitors, resistors, printed circuits, certain electronic switches, certain connection devices, certain electric conductors, optical fiber cables, certain photocopiers, computer network equipment (LAN and WAN), flat panel displays, plotters, and multimedia upgrade kits. In contrast, the ITA does not cover consumer electronic goods.

sustaining, and improving specified quality objectives on a continuous basis). These systems involve marketing and market research, product design and development, purchasing, production or provision of service, verification, packaging and storage, sales and distribution, installation and commissioning, technical assistance and servicing, after-sales, and disposal or recycling at the end of useful life. Universally accepted, standard quality assurance systems that serve as a benchmark for the assessment of a supplier's quality system reduce the need for purchasers to carry out individual evaluations, while saving exporters from the task of multiple assessments. Such a benchmark is provided, for example, by the ISO 9000 series of standards for quality assurance systems. This series includes five core standards, which are supplemented by a number of more detailed standards.

According to surveys recently conducted by the International Trade Centre (1999), it appears that importers in industrialized countries typically insist on dealing with suppliers that have obtained ISO 9000 certification, usually a complicated and lengthy process. Exporters in emerging-market economies frequently viewed this requirement as an important obstacle to penetrating new markets. Similarly, they felt that product-specific conformity requirements in industrialized markets often went against them, by, for example, delaying the launch of a specific product (a potentially serious issue given the degree of competition and the short life span of many ICT products). Moreover, many respondents from emerging-market economies were of the view that the infrastructure problems in their economies made conforming to the quality and product requirements of industrialized countries difficult. These problems existed despite measures at the company level, such as importing certified components and parts. While respondents in emerging-market economies generally stressed the importance of introducing appropriate policy measures to address these infrastructure problems, they emphasized the need for mutual recognition of standards and product certification to ensure the development of ICT trade in all regions.[11]

Indeed, one reason for the limited integration of ICT product markets is different technical regulations and standards, which may present important barriers to trade. Removing redundant testing and certification requirements should therefore be viewed as an important objective on the trade policy agenda.

At the same time, there remains an important need for agreeing on product coverage under the ITA. A more open trading framework is clearly a prerequisite to enable emerging-market economies to capture the gains from applications of information and communications technologies.

Conclusion

Our preliminary analysis leads us to four crucial observations. First, emerging-market economies, as a group, have made significant progress in enhancing their ability to produce and trade in information technology products. Our analysis using the TPI reveals that a steadily growing number of emerging-market economies have begun to play a role as exporters of ICT products; foreign direct investment has no doubt represented an important factor. The ability of the many emerging-market economies to penetrate the international export markets and participate in the global production system, demonstrates the possibilities for other countries yet to be integrated.

Second, the progress in trade in information technology products has been unevenly spread among emerging-market economies. This is explained by a complex set of factors, including differences in the stage of development, levels of education, regulatory frameworks, macro policies, and trade policies. While it is beyond the scope of this paper to quantify the various explanatory variables, the TPI rankings provide a comprehensive empirical picture both from a static and dynamic perspective. According to the rankings, selected countries in East Asia and Central and Eastern Europe as well as Mexico, Israel, and Costa Rica have demonstrated remarkable successes in integrating in the global ICT trade, but there are over a hundred countries that do not participate in the trade in electronics equipment and components, telecommunications equipment, and office equipment.

Third, for emerging-market economies, part of the difficulty in penetrating the ICT product markets can be assumed to lie in the technical regulations and standards, which often present important barriers to trade. Removing redundant testing and certification requirements should therefore be viewed as an important objective on the trade policy agenda. At the same time, there remains an important need for agreeing on the product coverage under the ITA. Equally important, is the necessity to get a better idea of the quantitative impact of nontariff barriers on trade in ICT. A more open multilateral framework for trade in ICT products is imperative for enabling emerging-market economies to have access to trade. Of course, this step should be part of a comprehensive strategy if a national capacity to reexport ICT products is to be developed.

Finally, international trade can form an integral part of a broader national strategy to improve Networked Readiness, particularly for countries that have limited resources to allocate for technological innovation and diffusion. Just as it is imperative to have a more open multilateral framework for trade in ICT products, so it is crucial to effect trade liberalization at the national level. Given how vital a mechanism is international trade for facilitating technology diffusion and enhancing access to ICTs, there can be little doubt that trade policy will have to play a more critical role if the digital divide is to be turned into the digital opportunity.

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Endnotes

1 The paper focuses on the trade performance of emerging-market economies, which refers to countries with per capita gross national income in the year 2000 of less than US$20,000 per annum. Twenty countries exceed this threshold, mostly the higher-income countries from Western Europe and North America, plus Japan, Singapore, Australia, and Brunei. Although Hong Kong, as a territory, has a per capita gross national income above US$20,000, it was included in the analysis given its integration into China, which has a per capita gross national income within the parameter. Note that the COMTRADE database includes a significant number of nonreporting countries; for them, external trade statistics are reconstituted on the basis of partner country statistics (mirror statistics). This approach does not capture trade among nonreporting countries.

2 Utility Patents granted by the U.S. Patent Office.

3 Depending on the stage of development, new technologies are not just imported from abroad, but also developed domestically. As a result, in many countries different diffusion processes are in motion.

4 McArthur and Sachs (2001) note that catch-up growth has its inherent limits. A noncore economy's ability to narrow the income gap with the technological leaders further diminishes with the size of the remaining divide. In order to close the income gap fully, the noncore country must become a technological innovator—in other words, it must become part of the group of core countries.

5 Of course, this approach should be considered as an approximation rather than an exact diffusion measure. In principle, it is possible that imports and reexports of ICT products take place in a largely isolated sector, without much diffusion to the rest of the economy.

6 These findings are in the context of Porter's stages of economic development (Porter 1990). In the first, or factor-driven stage, basic factor conditions such as low-cost labor and access to natural resources represent the dominant sources of competitive advantage; the second, investment-driven stage, where competitiveness is increasingly achieved by harnessing global technologies to local production; and the final, or innovation-driven stage, where global competitiveness depends on innovation, high rates of social learning, and rapid adaptability to new technologies.

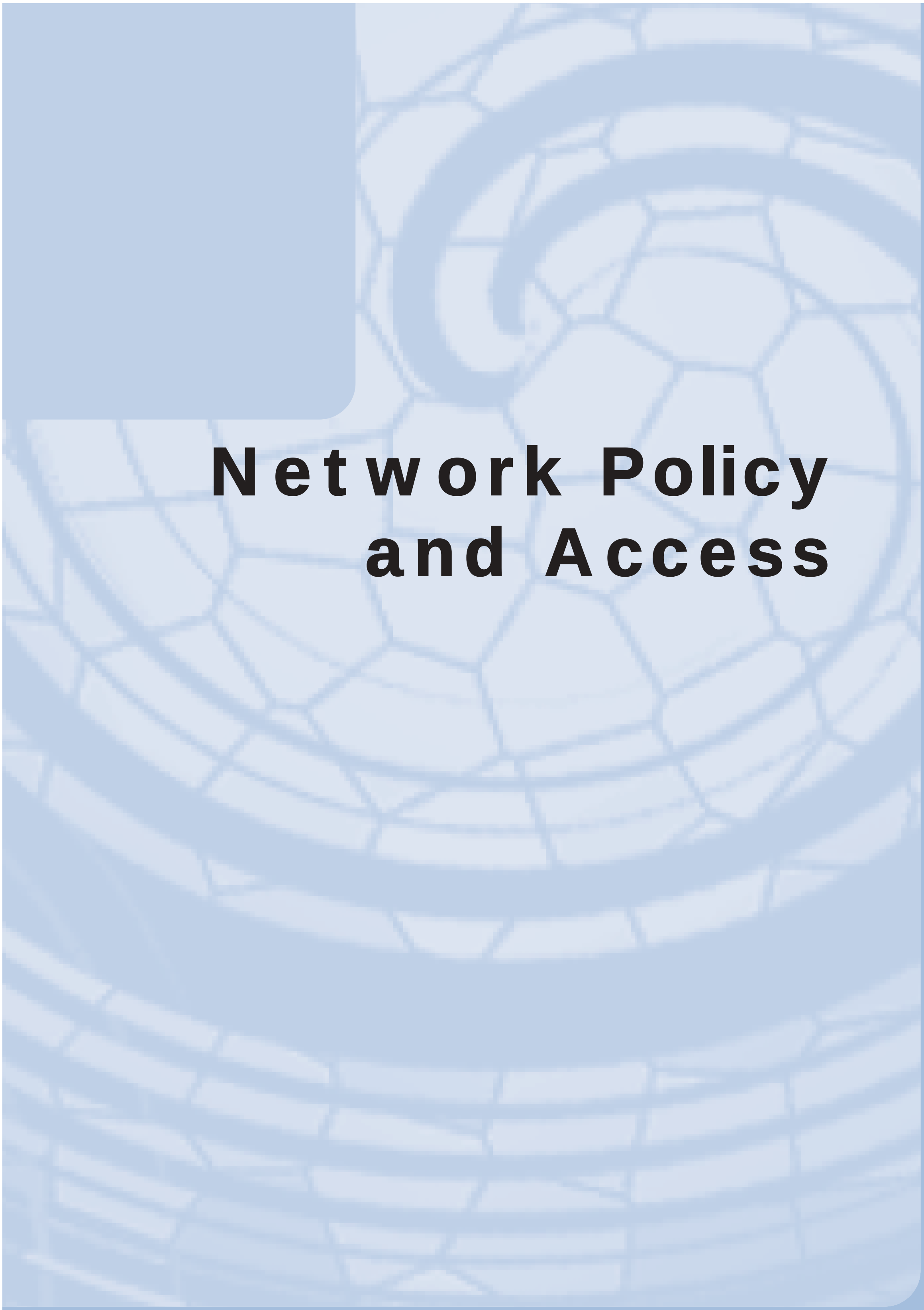
7 According to the Standard International Trade Classification (SITC).

8 The seventy-five countries included in the rankings account for almost the entire global trade in ICT products. Note that according to the COMTADE database, one hundred twenty-nine countries do not participate in the trade of electronic equipment and components; likewise, one hundred twenty-four countries are not involved in the trade of telecommunications equipment; one hundred ten countries are not part of the trade in office equipment; and eighty-four countries do not engage in the trade of electrical machinery.

9 The Herfindahl-Hirschman Index is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

10 As far as ICT products are concerned, three bodies set international standards: the International Electrotechnical Commission (IIEC), the International Organization for Standardization (ISO), and the International Telecommunications Union (ITU).

11 These concerns are not confined to producers in emerging-market economies, however. According to a different survey by the European Organization for Testing and Certification (EOTC), small and medium-sized enterprises in the EU identified the lack of harmonization and interpretation of regulations and standards as the chief obstacle of trade with third countries. A serious problem was also seen in the cost and time required for complying with conformity requirements.



Network Policy and Access

CHAPTER 11

Telecommunications Sector Reform—A Prerequisite for Networked Readiness

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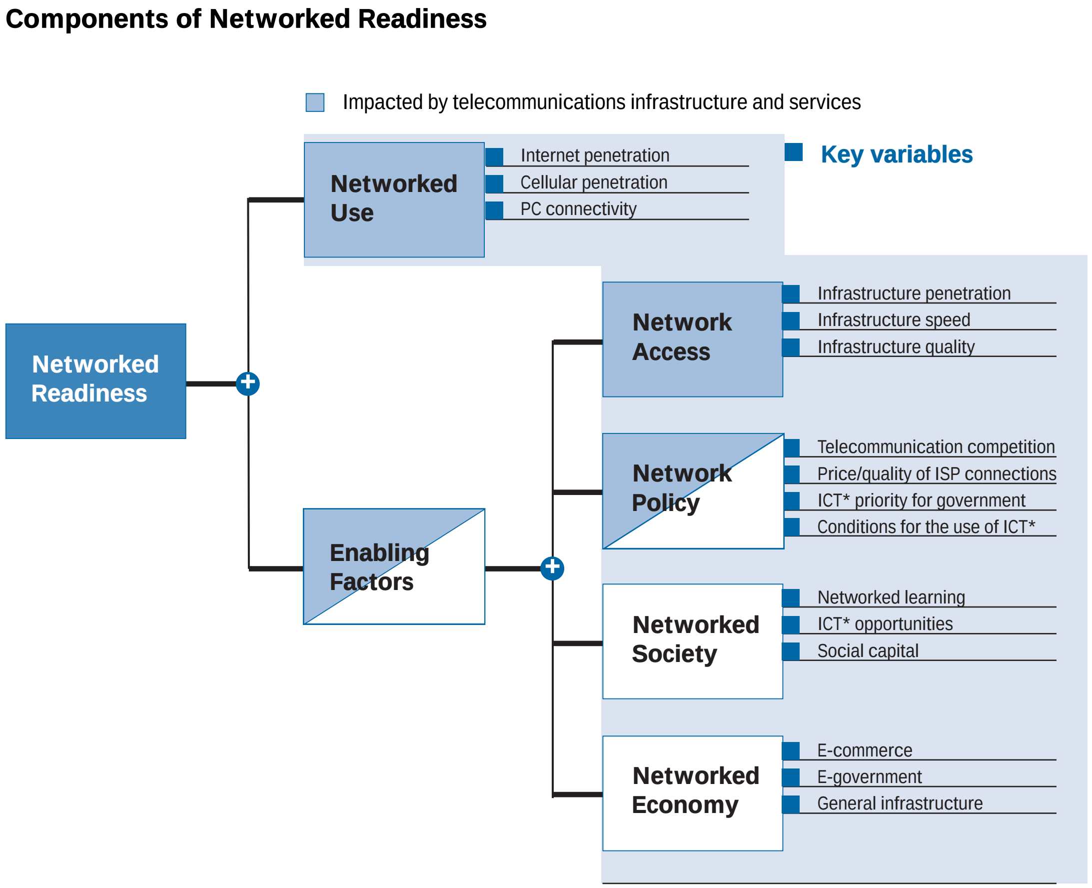
Executive Summary

Policymakers around the world have successfully used sector reform as a tool to improve the performance of telecommunications markets. Because of the direct link between Networked Readiness and the level and diversity of telecommunications services available to users, sector reform has played a key role not only in improving a country's readiness, but also in providing several important additional benefits.

- Regardless of the level of GDP, countries that have reformed their telecommunications sector have achieved a significantly higher Internet penetration than their economic peers.[1]
- Telecommunications sector reform has unlocked significant value for governments and shareholders in the period following privatization. Total market value of incumbents that was captured at the time of initial public offering (IPO)[2] was US$534 billion. This value increased to US$984 billion as of August 31, 2001.
- Reform has encouraged increases in teledensity and user intensity. Countries that reformed generally have had more rapid increases in teledensity and user intensity, regardless of their income level. Nevertheless, despite significant increases in Internet penetration around the world, there is tremendous potential for improvement—about 5.7 billion people are still not participating directly in the networked economy.[3]
- Differences in Internet penetration for equal GDP levels, as well as variance in user intensity for a given teledensity level (and vice versa) are partially explained by the details of sector reform. Customer behavior and other external factors such as PC penetration play a role as well.

In addition to direct benefits, experiences suggest that focus matters. Generally, countries that prioritized one or two medium-term objectives (e.g., benefits to customers, increasing incumbent valuations, or enhancing universal service) have, in general, made better progress towards their goals.

Figure 1: **Networked Readiness and the Impact of Telecommunications**



ICT* = Information and Communication Technologies

Source: World Economic Forum; Center for International Development at Harvard University; McKinsey

Networked Readiness and Sector Reform

Networked Readiness is directly impacted by telecommunications

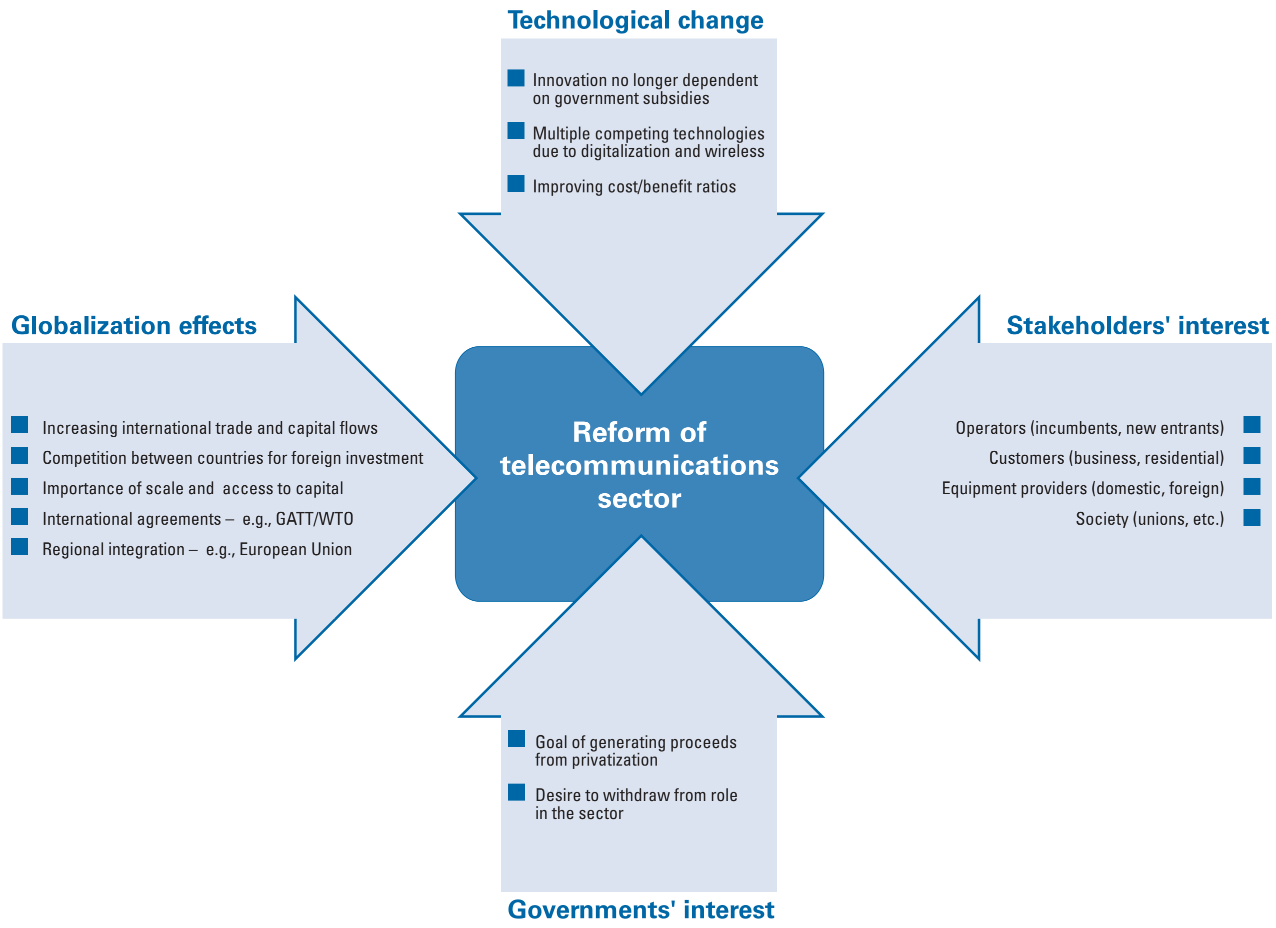
Networked Readiness, defined as “the degree to which a community is prepared to participate in the Networked World,” is seen as critical for communities because it provides the following benefits (Sachs):

- Creation of opportunities. Networked Readiness increases consumer convenience and choice, extends market reach for businesses, and allows the emergence of new business models to support economic growth.
- Elimination of barriers. The open provision of information across the network allows individuals to overcome physical and virtual isolation and to better inform themselves of the policies and processes of government.
- Promotion of efficiency. A networked business world can streamline product and service delivery, increase transparency of operations, and reduce transaction costs.

When looking at the components of Networked Readiness as defined by Harvard University (and presented earlier in this book), one can observe that telecommunications directly impacts Networked Readiness. Telecommunications essentially defines Networked Use and one of its key enabling factors, Network Access; it also influences Network Policy, another key enabling factor. (See Figure 1.) Telecommunications sector reform is critical in that it is part of the Network Policy component; the success of reform largely determines the state of the Network Access component and, finally, Networked Use.

There are two levels of connection. The first is basic communication services (voice and fax communications) and the second is advanced services (access to data services and the Internet). It is, of course, critical for countries to take the first step of achieving sufficient penetration of basic communications services to permit communication, which often serves as a platform for the introduction of advanced services. However, going forward, stimulating advanced services will be critical for all countries, because prospects associated with the effective use of the Internet are much broader than those of voice communications only. This document takes the need for advanced

Figure 2: **Forces Driving Reform of the Telecommunications Sector**



Source: McKinsey

communication services into consideration by describing Networked Readiness using Internet penetration as indicator.

An increasing number of countries have chosen market-based sector reform to improve their telecommunications infrastructure

Increasingly, internal and external forces are pushing governments away from direct control of the telecommunications industry towards market-based mechanisms

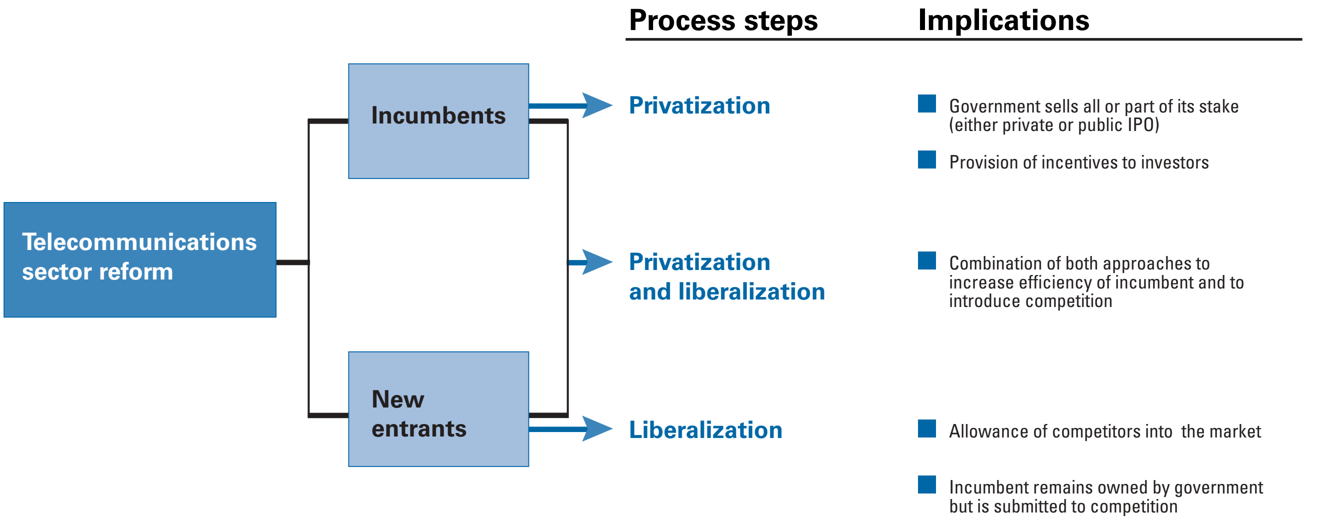
Historically, most countries had direct public control of the telecommunications sector. In this model, a state-owned monopoly provider had to meet targets, such as teledensity or affordability, which had been set by its government. This model worked well in developed countries in that it delivered significant penetration and network quality.

To distinguish countries, this document applies a typology based on economic wealth, thereby using the countries' real GDP per capita as of 2000. Categories used are (GDP per capita): developed countries (above US$10,000), emerging countries (US$3,001 to US$10,000), and developing countries (below US$3,000). Developed countries are separated into upper high income countries (above US$20,000) and lower high income countries (US$10,001 to US$20,000) to extract some more details when analyzing their Networked Readiness.

However, increasing pressure from both internal and external forces has altered the status quo. (See Figure 2.) The most important forces involved are:

- Ever accelerating technological change. State-owned companies often react too slowly to keep up. They also struggle to master the uncertainty created by change.
- Growing political consensus around the world on the benefits of open markets and reduced government control. This has been promoted mainly by international organizations such as the World Trade Organization (WTO) and the European Union (EU).
- Stakeholders pushing for change. These include retail consumers looking for better service, businesses that require data connections to compete both locally and globally, and domestic and foreign investors who want to participate in a growing market.

Figure 3: **Process Steps of Sector Reform**



Source: McKinsey

- Increasing fiscal pressure on government and budgets, which means that resources have to be reallocated. It often results in privatization and liberalization, including the sale of telecommunications to new operators, both to generate budget financing and to decrease state investment in the sector.

An added impetus for change in emerging and developing countries is the lack of capital. In these countries, sector reform is the only way to bring in the funding needed to expand their telecommunications infrastructure, and ensure the provision of communication services to their citizens. For this reason, many of those countries have been moving towards reform in recent years.

Despite these forces, state control of the telecommunications sector is still a viable option for some countries. Countries that follow this path are basically reproducing the route taken by developed countries prior to sector reform. China, for example, decided to assign priority to building out its telecommunications infrastructure, as the government undoubtedly recognized that this was key to making the country economically powerful. The country has been adding more fixed lines than the rest of the world in recent years, and creating incentives for equipment providers to manufacture in the country. State control has increasingly been coupled with sector reform and partial privatization. This option can work if a government has resources to divert towards infrastructure build-out and if it is willing to subsidize the provision of access with profits earned in other segments, such as long-distance. In addition, a government must be able to manage possible pressure to deliver open access and/or competitive entry.

A market-based reform generally allows market forces to set prices, quantities, and quality, as well as to determine the services to be provided. Governments can start reform in three ways: through privatization, liberalization,[4] or by a combination of both (full sector reform). A more detailed description of each option is included in Figure 3. Full sector reform is rarely done in one leap. Countries usually start with either privatization or liberalization before combining both approaches. This document breaks down the development process into three categories in order to explain variations among countries. These categories are: liberalization (combining full sector reform and liberalization alone), privatization, and no reform.[5]

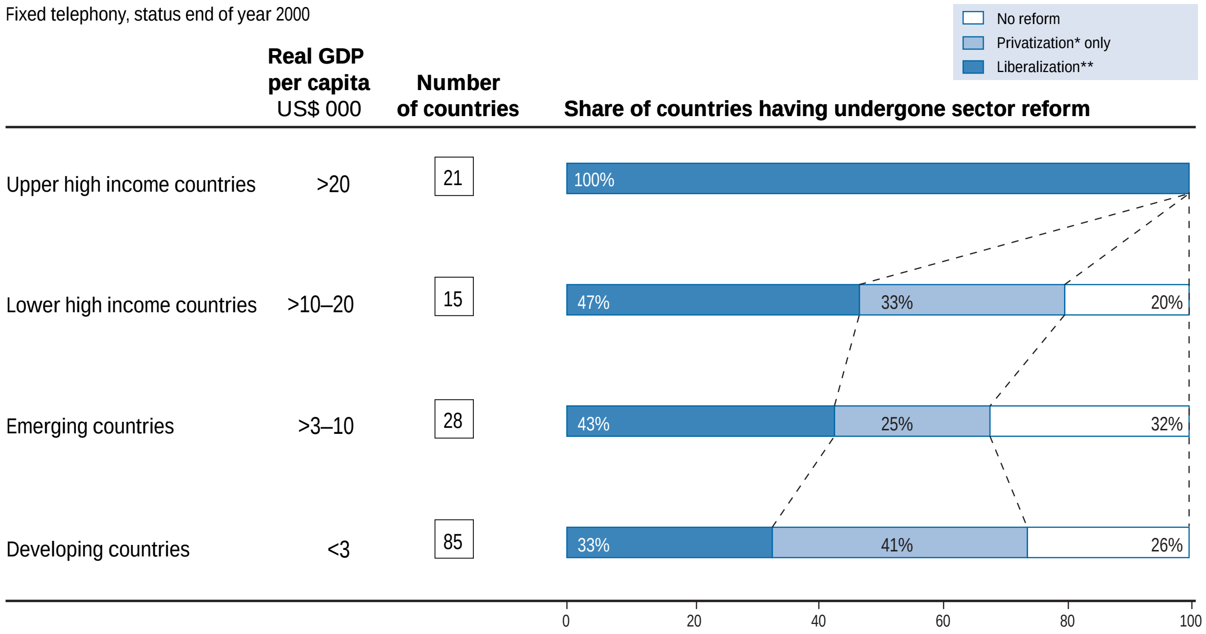
Networked Readiness is primarily led by the reform of fixed telecommunications

For several reasons, fixed telecommunications appear to be more important than mobile services in driving Networked Readiness. Mass-market Internet access has traditionally been facilitated by fixed networks, where service pricing seems to influence usage. Businesses and governments usually have high-speed access through fixed data networks.[6]

Despite more extensive competition among mobile networks than among fixed, two factors reduce the impact of mobile networks on Networked Readiness:

- Technological constraints. So far, technological constraints seem to have limited the ability of mobile networks to be a significant enabler of Internet access (with the exception of I-mode in Japan). This could change in the future with the advent of advanced wireless data networks. However, recent announcements from newly licensed 3G operators suggest that for the years to come, even 3G networks will operate at relatively low data transmission rates of only 64 kbps, discouraging the rapid adoption of mobile Internet services.
- Lack of immediate effect on penetration. Although most

Figure 4: **Status of Telecommunications Sector Reform**



*Includes partial privatization and privatization in progress
**Includes countries with liberalization only and full reform (privatization and liberalization)
Source: ITU; McKinsey

mobile markets have seen the introduction of multiple, alternative operators, it appears that this has not had an immediate effect on penetration per se. Even when competitive entry became common in the early 1990s, mobile services remained expensive and provided limited bandwidth and quality. It was only with the introduction of prepaid services (which was a product innovation) and price reductions due to technological progress, from about 1996, that mobile penetration rose significantly.[7]

In the future, developing countries may be able to exploit what is now a relatively cheap technology. Experiences in Egypt, Botswana, and Morocco (which all had significant increases in penetration following the licensing of a second operator between 1998 and 2000) suggest a high potential for mobile services in developing countries due to pent-up demand. Mobile networks can be deployed more rapidly and at relatively lower cost than fixed networks, which allows them to meet demand more efficiently, even if end user costs are higher. The introduction of prepaid services has permitted a segment of the population to pay for a service without the need for banking intermediaries, and has reduced bad debt. Both of these factors have encouraged operators to push penetration. As a result, mobile networks may be the primary form of communication and access to global information in developing countries, and it is in this sense that those networks have a positive impact on the first level of Networked Readiness.

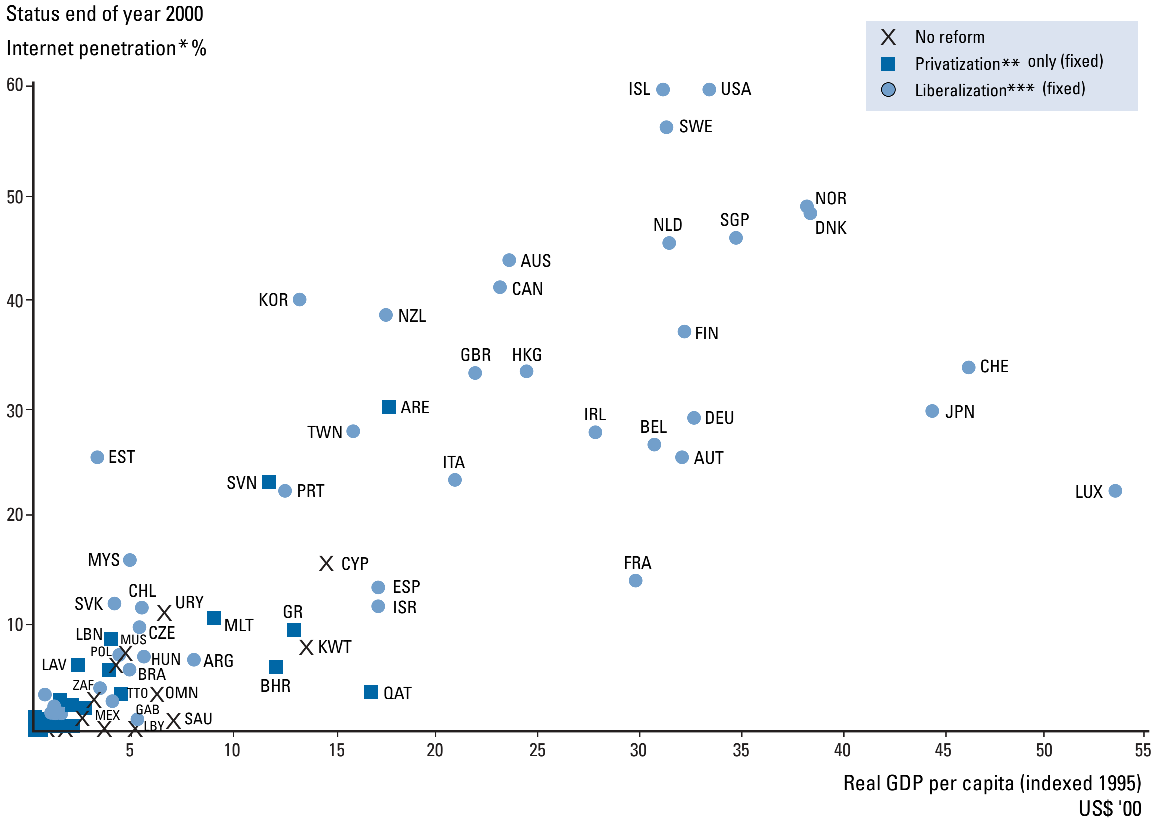
In addition, in many emerging and developing countries, liberalization of mobile services took place before reform of the fixed service. The direct competition existing between mobile and fixed service makes it increasingly difficult to build fixed networks, as margins from fixed services are under pressure from mobile competition.

Clear trend towards full sector reform, with developed countries leading

Following the lead of the U.S. and the U.K. in 1984, sector reform has now spread around the globe. As of the end of 2000, more than 55 percent of 236 countries and territories around the world had undergone some sort of reform.[8] Among these are all upper high income countries, most lower high income countries, and a large number of emerging and developing nations.

In terms of the extent of reform, there is a clear trend towards full sector reform, with upper high income countries leading in this respect. (See Figure 4.)[9] This preponderance of relatively wealthy countries means, however, that the primary focus of liberalization has been on increased economic efficiency (which, among other things, implies working towards the elimination of cross-subsidies and overstaffing at incumbents), promoting customer choice, and lowering prices. This efficiency drive coincided with a broader trend towards reduced state intervention in economic activity and also with governments' attempts (particularly in Eastern Europe and Latin America) to increase their budget resources through license fees and returns from privatization.

Figure 5: **Internet Penetration and Economic Wealth**



*Based on unique Internet users who access the Internet at least once a month
**Includes partial privatization and privatization in progress
***Includes countries with liberalization only and full sector reform (privatization and liberalization)
Source: ITU; EMC; NielsenNetRatings; WEFA; World Economic Forum; McKinsey

Sector reform has worked

Strong correlation between network access and GDP

This document uses Internet penetration, defined as the percentage of Internet users in a population, as the main indicator of the level of network access.[10] It is a more appropriate indicator than, for example, teledensity alone, because it reflects both the availability of infrastructure and the performance and intensity of competition in the telecommunications industry. This means that it offers a measurable target by which to gauge the success of efforts to improve Networked Readiness. Furthermore, it provides a measure of the quality of a country's network. High teledensity does not necessarily result in high Internet penetration, particularly if a large number of the phone lines cannot be used to establish reliable connections.

Figure 5 shows a high correlation between Internet penetration and a country's GDP.[11] Internet penetration increases in proportion to a country's economic wealth. Both developments are mutually reinforcing. As a country's national income increases, its inhabitants demand additional telecommunications services, buy more PCs, and work increasingly in information-intensive sectors (such as design and financial services). Growth in information-intensive sectors drives up GDP, and so on.

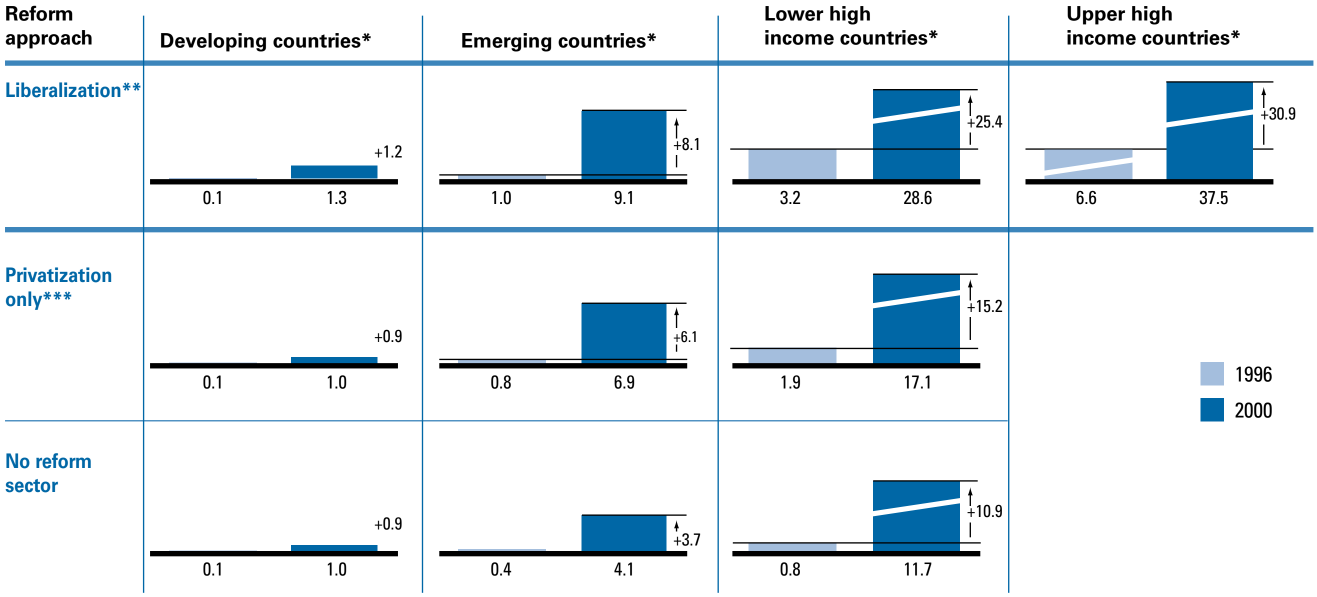
Countries with liberalization have reached higher Internet penetration even after adjusting for GDP

The snapshot of Internet penetration at the end of 2000 shows that countries that have undergone full sector reform have reached a higher level of Internet penetration than countries with privatization or no reform. (See Figure 5.) This observation holds across all economic bands, but is particularly true for emerging and developing countries. Here, the majority of countries that had started to reform their telecommunications sector were positioned above peer countries that had yet to initiate reform.

In addition, whatever the level of economic wealth, countries with liberalized telecommunications markets experienced much stronger Internet penetration growth between 1996 and 2000 than other countries. (See Figure 6.)[12] One can also observe the correlation between this penetration and economic wealth. Developing countries appear to have had the slowest advance-

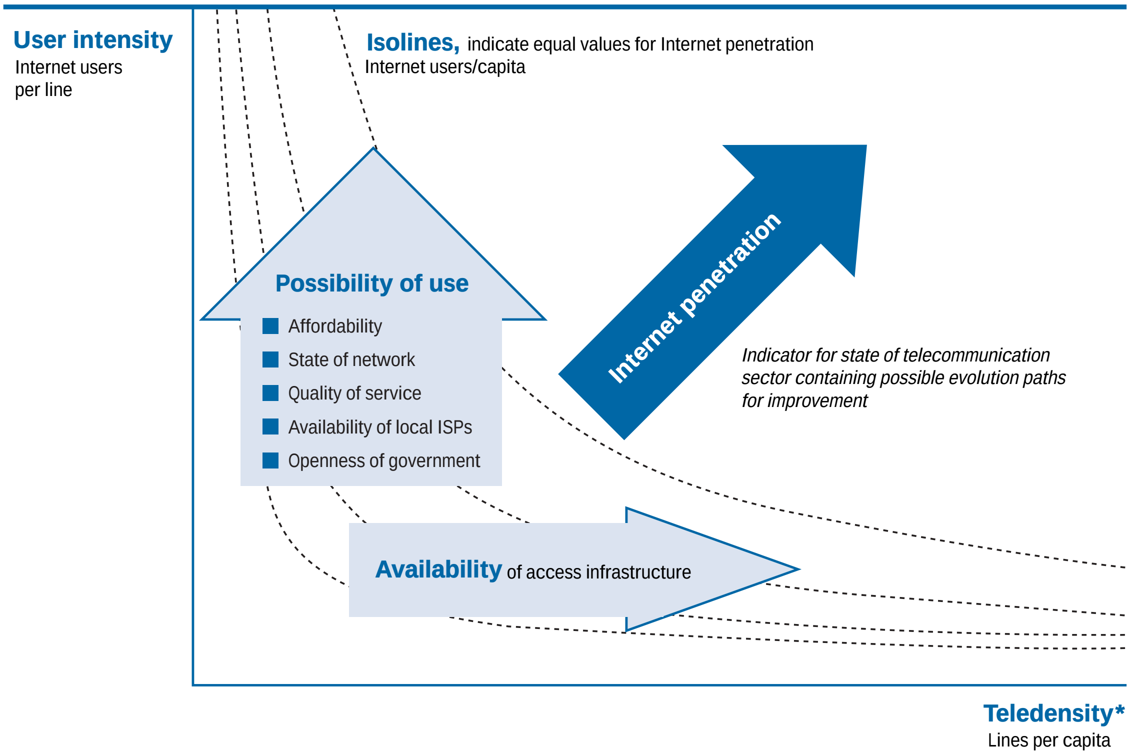
Figure 6: **Comparison of Internet Penetration 1996 vs. 2000**

Average Internet penetration at end of respective year, %



*Each sample contains all countries with data available
**Includes countries with liberalization only and full sector reform (privatization and liberalization)
***Includes partial privatization and privatization in progress
Source: ITU; EMC; NielsenNetRatings; WEFA; McKinsey

Figure 7: **Control Map of Internet Penetration**



* Combined fixed and mobile teledensity
Source: McKinsey

ment, and also did not show a significant variation in Internet penetration as a function of the reform approach they applied. As of 2000, liberalization clearly facilitated higher growth rates and higher Internet penetration in emerging and developed countries.

Details of reform matter: regulatory execution drives differences among countries

Teledensity and user intensity define network access. Sector reform affects both dimensions

To make clear differences in Internet penetration, this document breaks the indicator down into two dimensions, teledensity and user intensity. The resulting Control Map of Internet Penetration, combines these two dimensions, with Internet penetration, defined as the percentage of Internet users in a population, as their product shown on the isolines. (See Figure 7.) Choices of sector reform and the resulting regulatory policies have a direct impact on both dimensions.

Teledensity describes the availability and reach of the telecommunications infrastructure, and is defined as lines per 100 inhabitants.[13] Increasing teledensity is a political objective achieved through specific government targets. As such, it requires a more interventionist reform approach. Most developed countries have achieved high levels of teledensity, driven mainly by the political pressure to provide access to all citizens, and secured by investment over several decades. For emerging and developing countries that lack sufficient financial resources to catch up quickly, however, high teledensity will be much more difficult to achieve.[14] Those countries therefore need to develop innovative universal access schemes and funding mechanisms. For example, Chile has used universal service funds to finance community Telecenters which provide Internet access.

User intensity describes the extent to which the available infrastructure is used to access the Internet and is defined as Internet users per line; that is, voice-only usage of a line is excluded. User intensity reflects the possibility of use, and summarizes a number of potential factors that ultimately drive demand for Internet use, such as affordability, the state of network and quality of service, the availability of access devices, and the presence of service providers.[15] In addition, it is influenced by the general openness of a country's political regime. If political policy hinders access to the Internet, no amount of suitable infrastructure will get users online.

Regulatory policy can influence user intensity in a number of ways. A government can improve affordability by introducing competition that leads to price decreases, or it can impose price caps on a monopoly provider. For example, the policy of free local calls in the U.S. has clearly stimulated dial-up Internet traffic. A government can also directly influence the affordability of Internet service provision through the interconnection regime defined, even if this is not always the intended outcome. For example, free Internet service providers (ISPs) in Europe were made possible by termination payments from the incumbent local operators to the ISPs. This, in turn, grew out of the failure of regulators to adapt the voice interconnection regime to Internet access. A regulator can specify network performance and service targets for service providers or, in the ideal case, open the market to competition, making such targets superfluous. Brazil constantly monitors improvements in metrics such as the number of peak-time calls completed, or the speed with which operators respond to customer complaints. The operators are subject to fines if they do not meet certain targets. In general, the factors that determine the possibility of use can be influenced by liberalization and privatization approaches.

Higher penetration levels can be reached by influencing either dimension

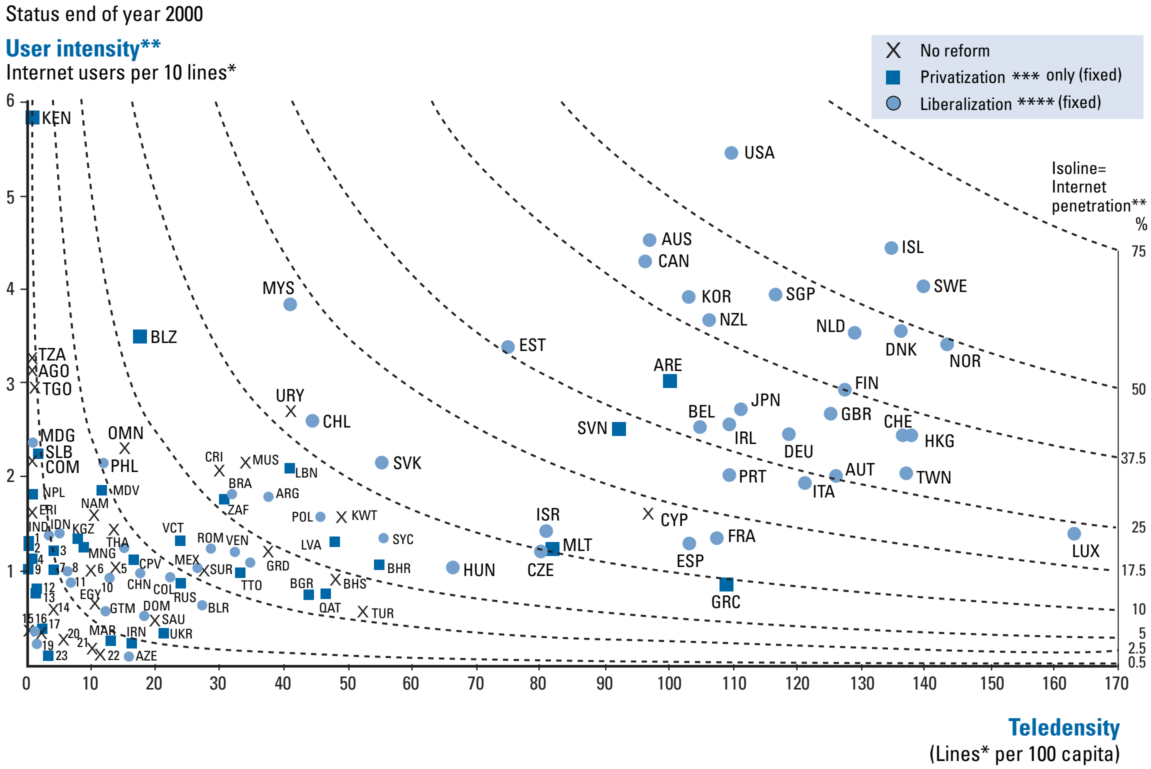
As was shown earlier, there are some differences in penetration rates even among countries at similar stages of economic development or with the same extent of sector reform. Mapping all the countries studied onto the control map sheds more light on these differences, and on the challenges for emerging and developing countries associated with improving Networked Readiness. Figure 8 shows that higher teledensity correlates with higher user intensity and thus the number of Internet users per capita.

A number of other observations emerge from analyzing the control map:

- Countries with highest Internet penetration also have high GDPs. With the exception of Estonia, countries with more than 17.5 percent Internet penetration have a GDP per capita of more than US$10,000.[16]
- Apart from a few islands or small states (such as Cyprus, Macao, and Uruguay), all countries with more than 10 percent Internet penetration have undergone one type of sector reform.
- Countries that have chosen not to undergo sector reform have shown no improvement in either teledensity or user intensity.
- There are significant differences in how developed countries achieve Internet penetration. Some countries have moved along the teledensity dimension, but have relatively low user intensity (e.g., Germany), and some have reached a similar penetration level through more intense use of a limited number of lines (e.g., New Zealand).

When developing countries are compared to developed countries and emerging countries, significant differences emerge.

Figure 8: **Control Map of Internet Penetration**



*Fixed and mobile subscriptions
**Based on unique users who access the Internet at least once a month
***Includes partial privatization and privatization in progress
****Includes countries with liberalization only and full sector reform (privatization and liberalization)
Source: ITU; EMC; NielsenNetRatings; World Economic Forum; McKinsey

The user intensity of developing nations tends to be higher, which can be explained by a certain degree of latent demand, that is, people want and can afford Internet access, but do not own an access line. This higher user intensity, however, does not result in high Internet penetration.[17] Countries may, therefore, need to reach a minimum level of teledensity in order to unleash this latent demand. If this is so, increasing teledensity ought to be a priority for developing countries.

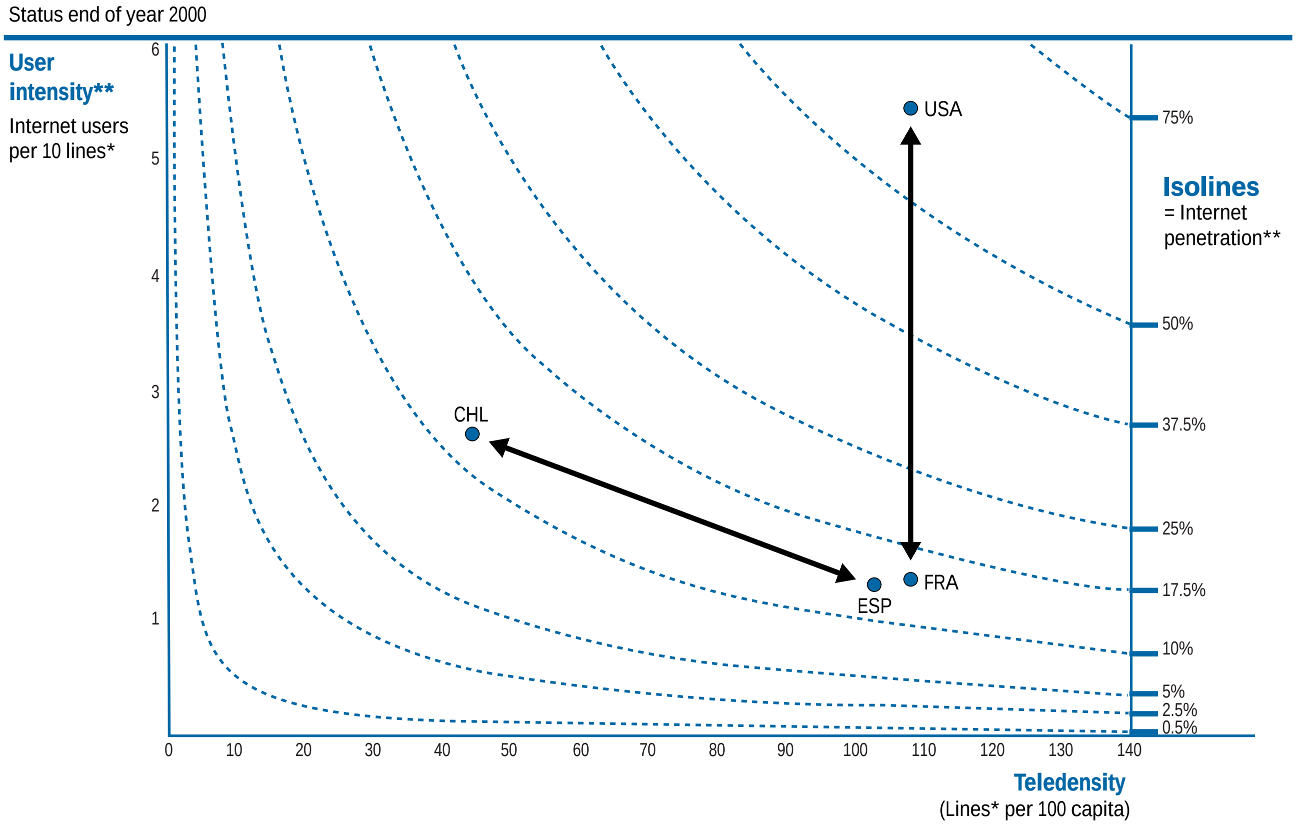
Policy variations can explain some of the differences between discrete country pairs

A closer look at certain pairs of countries highlights and explains differences along both dimensions. (See Figure 9.)[18]

Differences between countries with the same combined teledensity, but different user intensity, are colored by regulatory decisions. If France and the U.S. are compared, for example, it can be seen that their respective local access charges are polar opposites. Local calls are not metered in the U.S., but they are metered by the minute in France. Moreover, the prices of leased lines used by businesses are far lower in the U.S., in this instance due both to more aggressive rate regulation and to more competition in the leased line market. Other differences are the higher mobile penetration in France (it should be noted that mobile devices do not yet offer a sufficiently positive user experience to make them a large-scale means of Internet access), and the greater competition between ISPs in the U.S.[19] U.S. regulators spurred competition by putting in strong structural and nonstructural safeguards to prevent local incumbent operators from suffocating ISPs (Oxman 1999). In addition, prior to the advent of Internet services, France Telecom had rolled out an alternative online information service, Minitel, which met with early success and may have limited the uptake of Internet services similar to that of the competitive U.S. market. A country with lower intensity needs to determine to what extent increasing affordability, network quality, or changing behavior will stimulate more user intensity.[20]

The most interesting cases are those where countries have the same Internet penetration despite differences in both user intensity and penetration, such as, Chile and Spain. Language differences do not explain the differences in penetration; Spain has a higher GDP per capita than Chile (US$17,000 versus US$5,400), which may explain its higher teledensity. Sector reform may have helped Chile to overcome its wealth disadvantage. Chile started reform in 1989, and adopted a particu-

Figure 9: **Snapshot Analysis of Control Map**



*Fixed and mobile subscriptions

**Based on unique users who access the Internet at least once a month

Source: ITU; EMC; NielsenNetRatings; World Economic Forum; McKinsey

larly aggressive approach towards liberalization after 1994, together with a strong emphasis on modernizing its network. Whereas Chilean main lines have been 100 percent digitalized since 1997, the Spanish network was only 87 percent digitalized in 1999. Sector reform in Spain started later, and while its liberalization process has followed EU guidelines, it has not been as aggressive as the Chilean model.

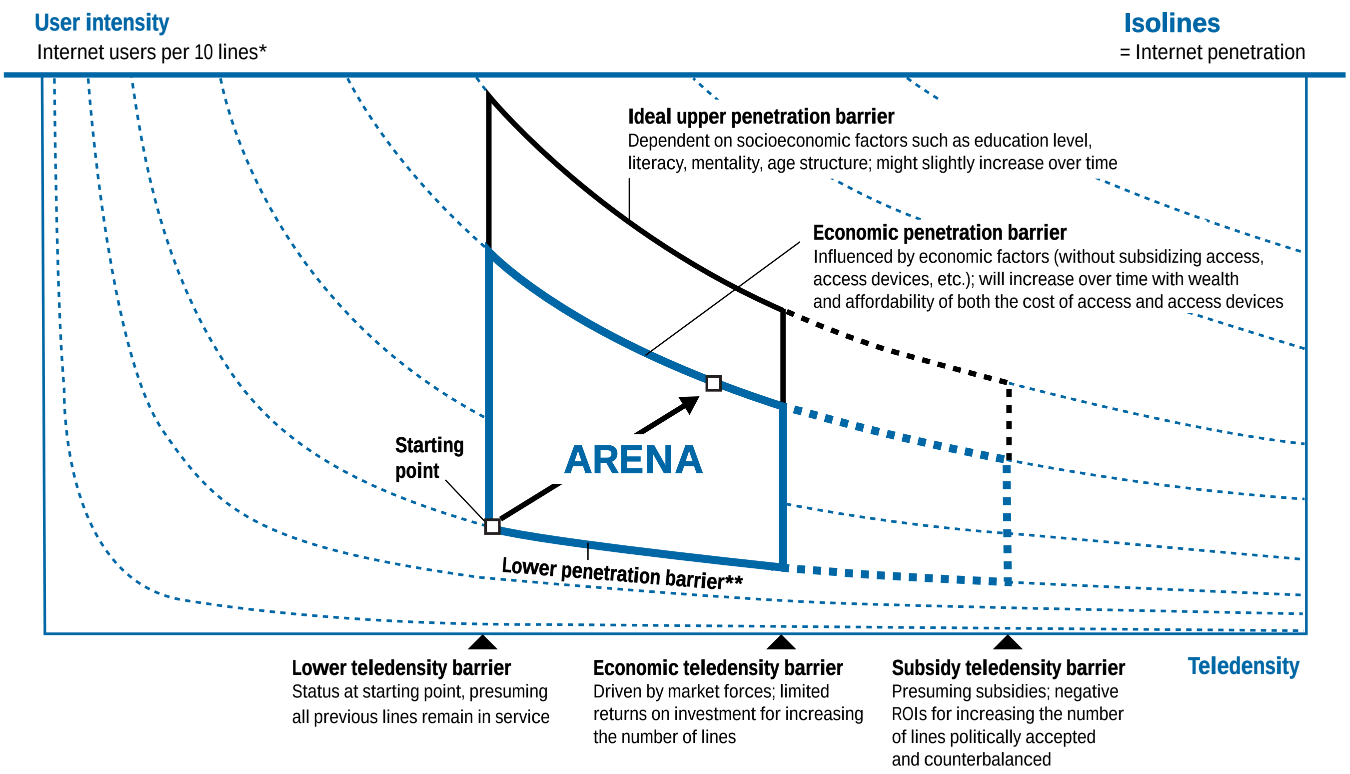
Aspirations for advanced Networked Readiness: the need to consider economic and behavioral constraints

Countries should use the control map to identify whether they need to put more emphasis on teledensity (and determine which network to be used—fixed or mobile) or on user intensity (determine how to enable the network to provide connectedness). As illustrated in Figure 10, countries may face limitations when trying to move in either direction. Increasing teledensity is constrained by two barriers: an economic barrier, where operators' investments in additional lines no longer pay off, and a subsidy barrier, where there are no sufficient funding mechanisms to finance further expansion of the network. When increasing user intensity, there are also two barriers: an economic penetration barrier, where limits may be imposed by affordability, and prices cannot be reduced enough to facilitate widespread use, and an ideal penetration barrier, which is mostly affected by habits and other socioeconomic factors that could potentially limit more people from using the access lines.

Within these limits, governments need to decide whether to move along both dimensions, or to focus on one in preference of the other. This decision depends on an understanding of where the limits are for their own country. This understanding also helps to avoid unrealistic expectations. Clearly, both economic barriers and subsidy or upper penetration barriers are reached earlier by developing countries. Therefore, they should not expect large increases in Internet penetration, but rather a gradual movement within the arena.

However, countries need to recognize that achieving advanced Networked Readiness must be accomplished within the context of overall sector reform, that is, within an understanding and consideration of the possible impacts of regulatory policies on the telecommunications sector as a whole. For developing and emerging countries in particular, improving teledensity is a prerequisite for achieving readiness. This needs to be reflected in the objectives of telecommunications reform.

Figure 10: **Control Map and Arena of Improving Readiness**



*Fixed and mobile subscriptions

**Assumes that no Internet users would be lost

Source: World Economic Forum; McKinsey

Value from Telecommunications Sector Reform

Significant impact and benefits through sector reform

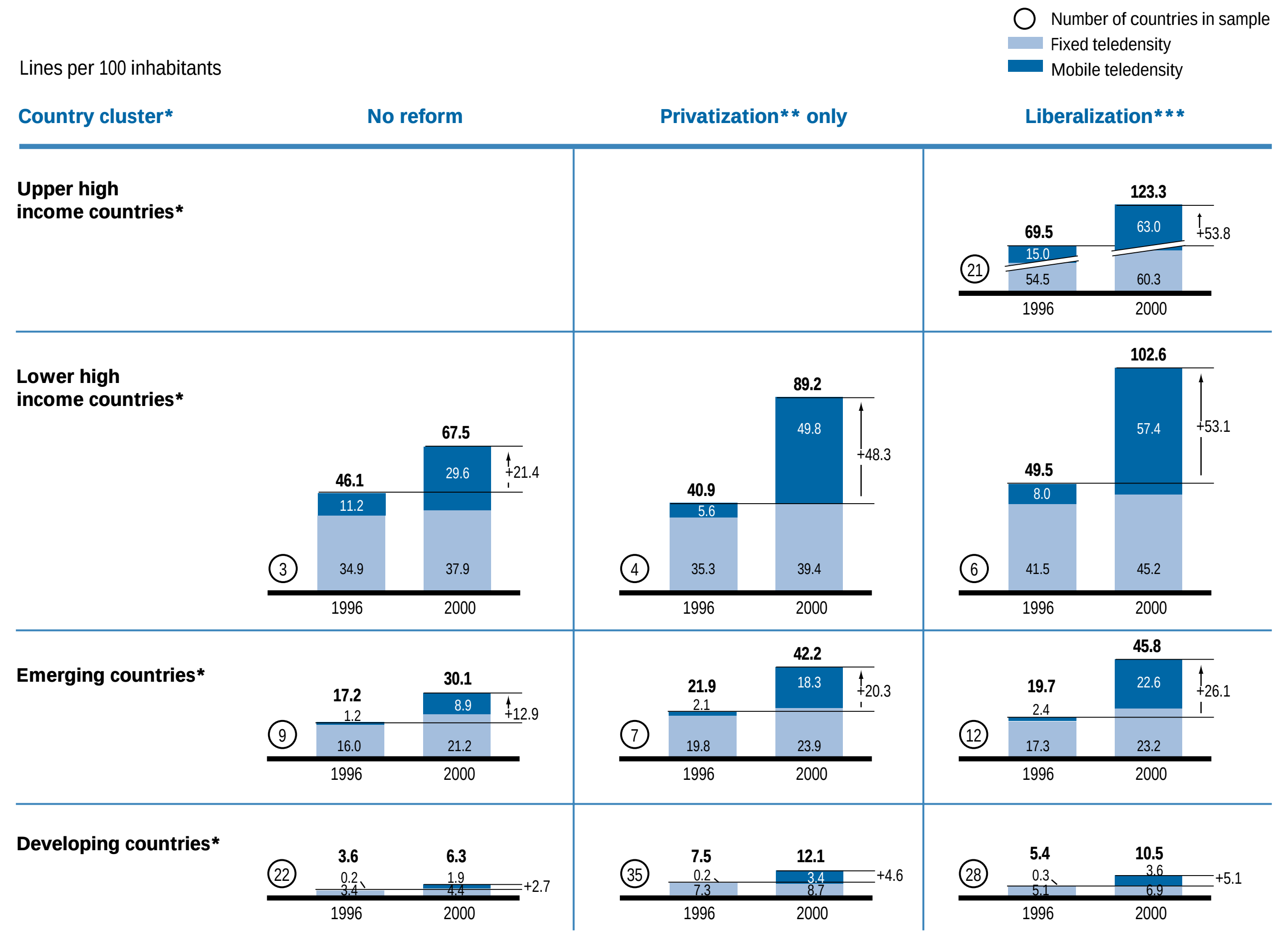
While Networked Readiness has been positively influenced by telecommunications sector reform, most countries have so far not made it a primary objective of their reform process. This is because sector reform has historically been important for the huge value potential; this potential has been felt in many ways, providing benefits for society, governments, and customers. Whether or not Networked Readiness is an explicit objective of reform, it is important that governments and regulators understand the value and impact of reform if they are to draw up an appropriate scheme for it.[21]

For example, teledensity in countries that have reformed their telecommunications sector grew at a much higher rate between 1996 and 2000 than in countries where reform had not taken place. (See Figure 11.) As was seen with the Internet penetration figures, this holds for all levels of economic wealth, with emerging and developed countries being more effective at growing their teledensity than developing countries. The method of reform appears to have less impact on effectiveness in the developing countries.

Privatization made the value of the incumbent operators transparent and attracted huge amounts of capital to the industry. As illustrated in Figure 12, total value generated through public IPOs was US$534 billion worldwide, a value that grew by 16 percent annually to US$829 billion over three years. Even with recent capital market developments, the market value of incumbents in developed countries is generally still higher today than at the time of initial flotation. Operators in developing countries have seen their values decline following IPO. Market value in emerging countries did increase initially, but today is also lower than at flotation. Apparently, operators in these countries did not deliver on their promises.

Given this scenario, governments need to include a capital market perspective in their decisions. Venture capitalists, institutional and private investors have become very selective about where to allocate their investments. Capital markets now are very reluctant to fund new entrants. Recent developments in the telecommunications industry, such as the high cost of 3G mobile licenses, have created difficulties for a number of large internationally active incumbents from developed countries; this means that they are now less likely to act as strategic investors. As a consequence, governments of emerging and developing markets need to carefully assess how

Figure 11: **Average Increase in Teledensity, 1996–2000**



*Each cross sample contains all countries with data available
**Includes partial privatization and privatization in progress
***Includes countries with liberalization only and full sector reform (privatization and liberalization)
Source: ITU; EMC; WEFA; McKinsey

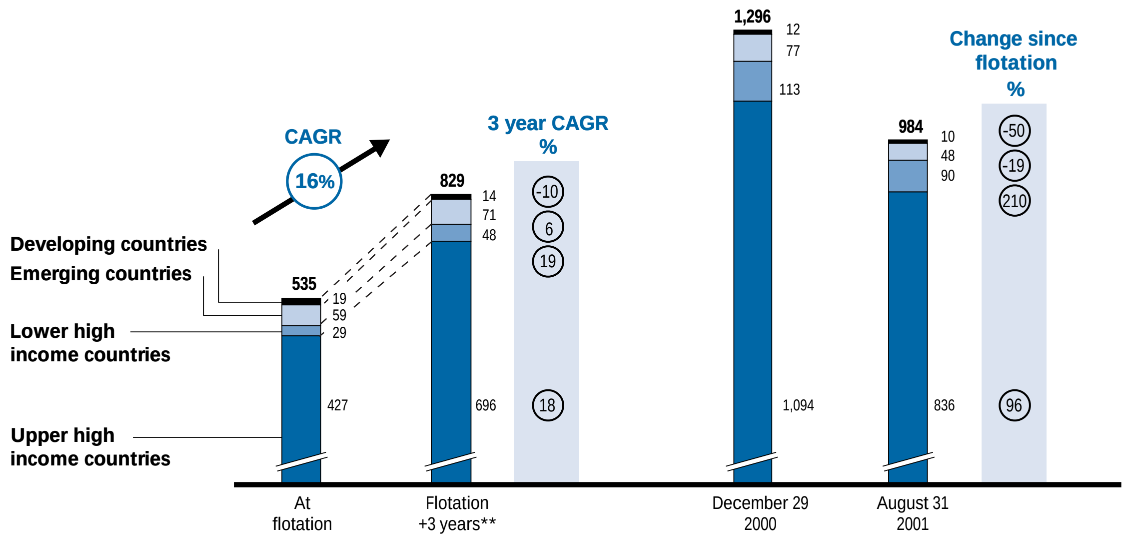
to design sector reform and to strike the best deal with the few, strong international players remaining (these are mainly incumbents) so that they can still access their operating skills and financial resources.

A detailed cross-country analysis of how telecommunications revenues evolved between 1996 and 1999 suggests that the additional value for emerging and developing countries created through sector reform was US$29 billion, or 10 percent more than if these countries had not undergone reform. (See Figure 13.)

Especially in developing countries, privatization appears to have had a more positive impact on performance than liberalization. In developing markets, the growth rate of sector revenues in countries that privatized was twice as high as that of countries that liberalized. The main reason for this is the low penetration of telecommunications infrastructure in developing countries, resulting in a high level of unsatisfied demand. It would seem that adding more lines can absorb this demand without the necessity of price cuts to attract more users. Developing countries should, therefore, take a stepwise approach towards sector reform, consequently not introducing competition until they have reached a basic infrastructure penetration that allows for the take-up of additional demand. If they do not, the margin squeeze caused by competition could prevent operators, and the incumbent in particular, from making the investments necessary to enhance penetration.

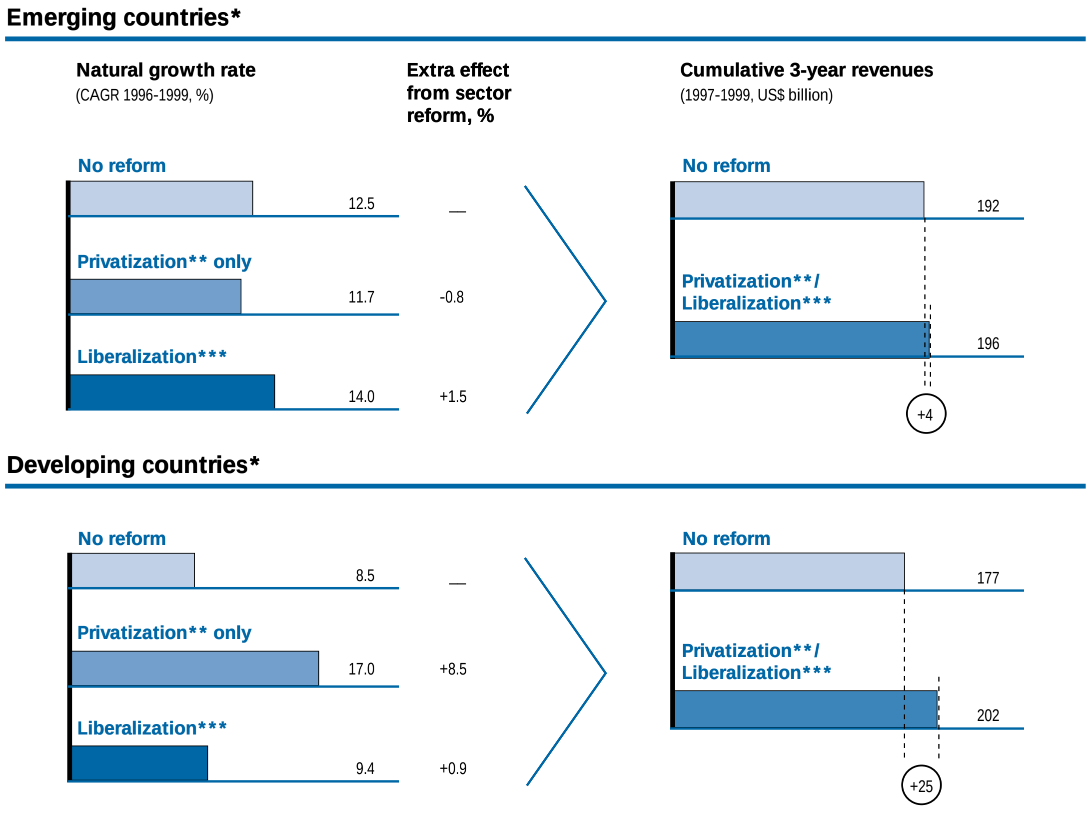
Emerging countries apparently had a basic teledensity level at which decreasing prices did benefit a portion of the population with higher price elasticity. This resulted in an overall revenue increase that was slightly stronger than that of countries with only privatization efforts. However, most of these countries did

Figure 12: **Market Capitalization of Incumbent Operators***



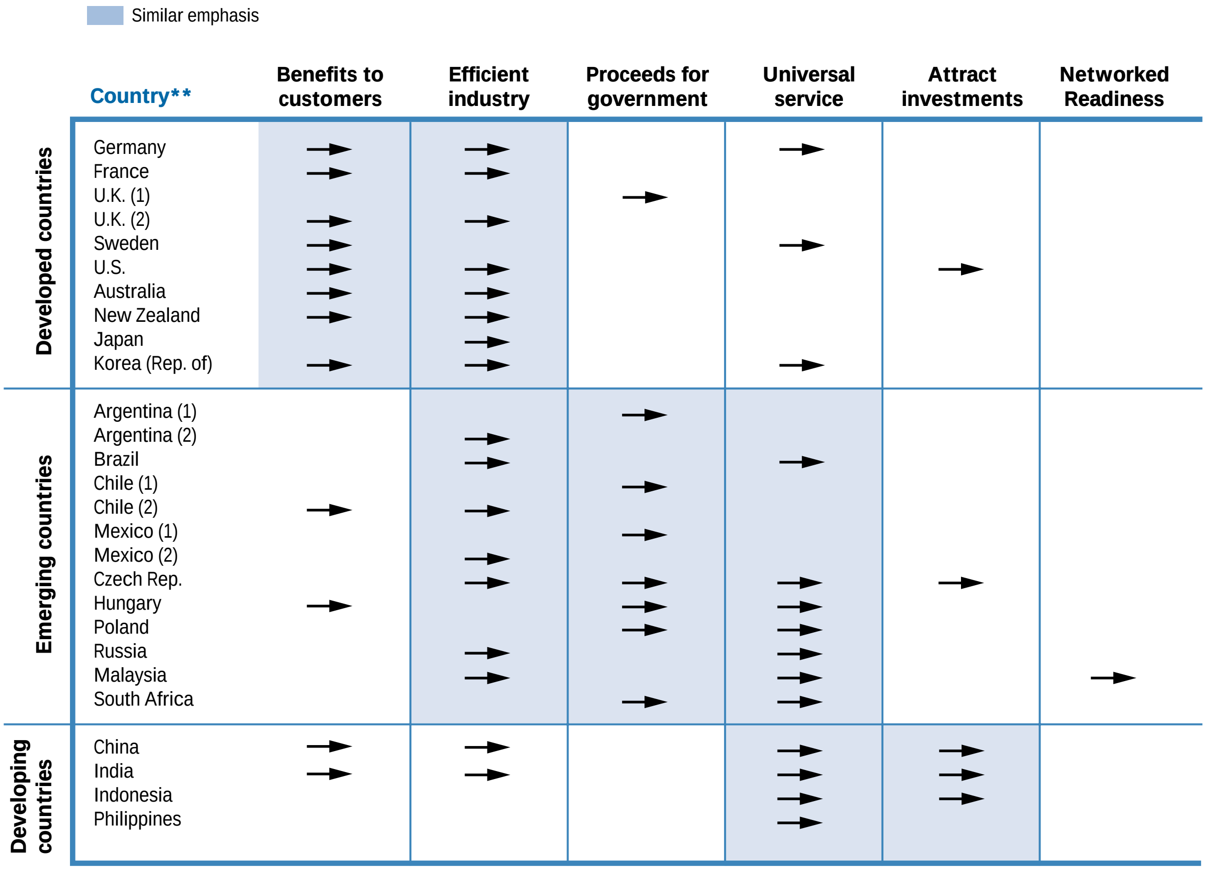
*Based on 42 countries where information on market capitalization was available
**In cases where flotation dates less than 3 years, market capitalization of August 31, 2001 was used
Source: Bloomberg; Datastream; McKinsey

Figure 13: **Telecommunications Revenues and Influence of Sector Reform**



*Based on a sample of 56 countries, extrapolated to total sample of 113 countries
**Includes partial privatization and privatization in progress
***Includes countries with liberalization and with full sector reform (privatization and liberalization)
Source: ITU; McKinsey

Figure 14: **Prioritization of Sector Reform Objectives***



	Country**	Benefits to customers	Efficient industry	Proceeds for government	Universal service	Attract investments	Networked Readiness
Developed countries	Germany	→	→		→		
	France	→	→				
	U.K. (1)			→			
	U.K. (2)	→	→				
	Sweden	→			→		
	U.S.	→	→			→	
	Australia	→	→				
	New Zealand	→	→				
	Japan		→				
	Korea (Rep. of)	→	→		→		
Emerging countries	Argentina (1)			→			
	Argentina (2)		→				
	Brazil		→		→		
	Chile (1)			→			
	Chile (2)	→	→				
	Mexico (1)			→			
	Mexico (2)		→				
	Czech Rep.		→	→	→	→	
	Hungary	→		→	→		
	Poland			→	→		
	Russia		→		→		
	Malaysia		→		→		→
	South Africa			→	→		
Developing countries	China	→	→		→	→	
	India	→	→		→	→	
	Indonesia				→	→	
	Philippines				→		

*Relative prioritization of objectives implied from execution and regulatory details

**Due to significant change of objectives over time, some countries' reform process was split into two phases

Source: Espicom; ITU; national policy statements and legislation; press clippings; World Economic Forum; McKinsey

use a paced process, in which incumbents were granted an initial period of "monopoly grace" to become more efficient and prepare for competition.

Prioritization of objectives has led to better results

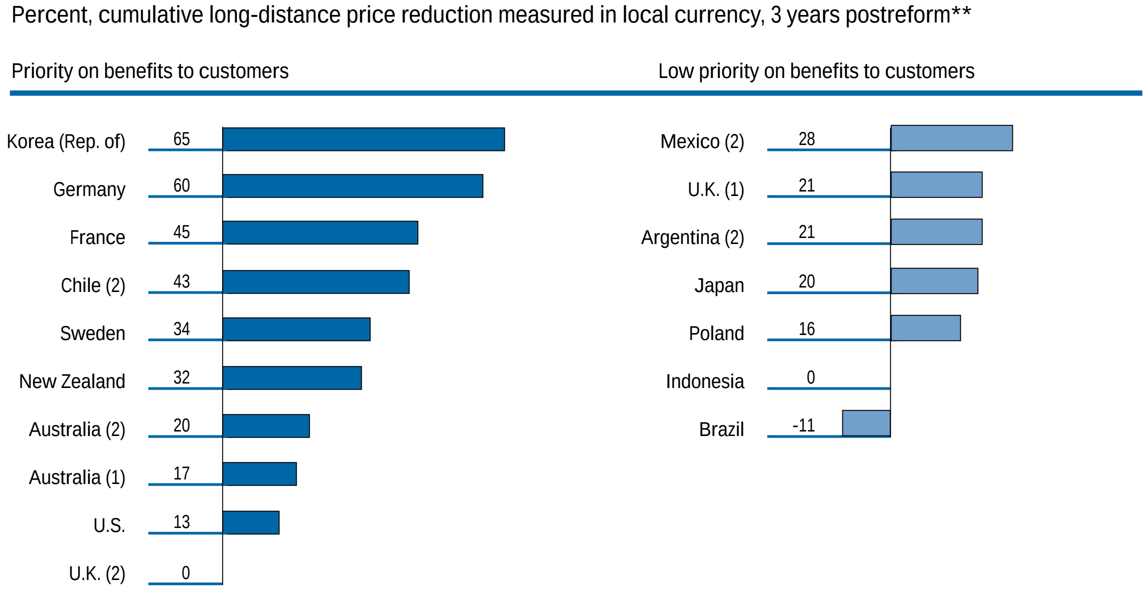
Multiple objectives with varying prioritization

Telecommunications sector reform can and should be directed toward a number of objectives. Government objectives have primarily included increasing benefits to customers, increasing industry efficiency, maximizing proceeds for government, enhancing universal service, and attracting investments.[22] Stimulating Networked Readiness has not been a specific objective historically, although going forward, it may play a more prominent role.

Starting conditions often determine the priority that individual countries place on specific objectives. (See Figure 14.) Developed countries have typically focused more on increasing benefits to customers and on improving the efficiency of their telecommunications sector. On the other hand, emerging countries generally have had three main priorities: generating proceeds for government, increasing industry efficiency, and enhancing universal service. Developing countries have focused on universal service and attracting investments.[23]

To give an example of the differing priorities, a major, initial reform driver for both Argentina and the U.K. was raising proceeds for the government or eventual shareholders of the incumbent operators, and as such, to make privatization a success. This translated into policies that, at first, supported the incumbent's efforts to improve efficiency and generate large profits. This, however, came initially at the cost of

Figure 15: **Benefits to Consumers: Price Reductions***



*Based on tariffs of incumbent operators
**With the year before effectiveness of reform being used as the base year
Source: ITU; World Economic Forum; McKinsey

potential entrants and customers. Other countries emphasized competition and benefits to customers from the beginning (e.g., Chile in its second phase of reform and Germany).

Emerging and developing countries, in particular, are under significant pressure to increase teledensity and/or continue the provision of subsidized access (via various universal service requirement mechanisms). In addition, they are pressured to increase the quality and range of telecommunications services. Forcing operators to fulfill both of these demands for unprofitable customer segments can have huge costs, and may damage the reform process by discouraging potential entry into the sector, thus lowering the privatization price and the potential future performance of the incumbent.

Prioritization generally results in better progress toward objectives

To assess the progress that countries have made toward their objectives, this document looks at one characteristic indicator for each of the five main objectives.

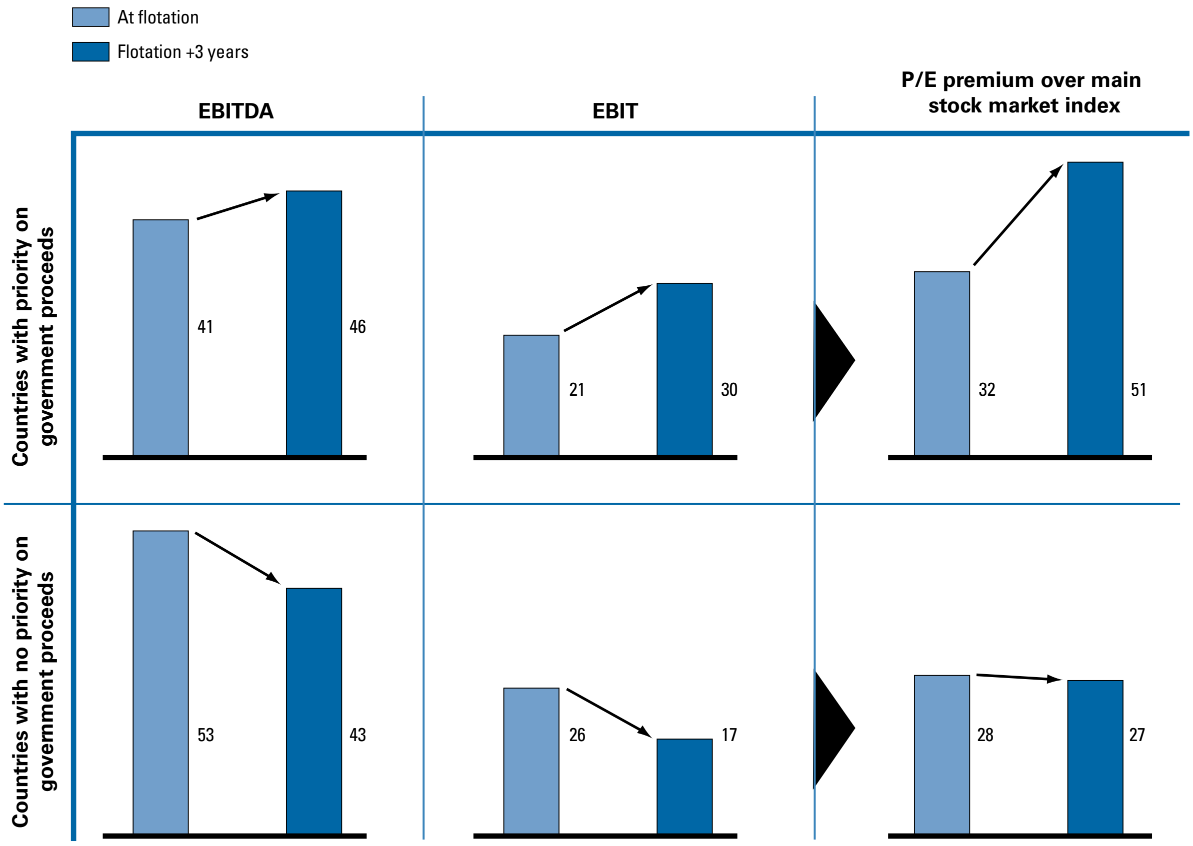
As shown in Figure 15, countries that prioritize increasing benefits to customers have experienced significantly higher reductions in long-distance call prices. These countries tended to allow in competition rapidly, and implemented interconnection and access policies that favored new entrants. This approach has transferred value from the operators to the customers.

An analysis of price declines also highlights the importance of carefully assessing the impact of applying regulatory policies. Germany introduced an interconnection regime favorable to new entrants. In addition, no contributions to universal service funds or minimum infrastructure requirements were imposed. As a result, resellers entered the market and were able to quickly engage in very aggressive pricing. Almost all of the 60 percent decrease shown in Figure 15 was realized in the first year of competition. The regulator had not expected such a rapid decline.

Improving efficiency has been another objective in many countries. Interestingly, the majority of countries have been able to increase productivity of their incumbents by between thirty and fifty lines per FTE over a three-year period, with different effects on the percentage, depending on the base used. Productivity gains were made regardless of whether this objective was given priority. There is, however, a wide spread in the relative gain: developing countries usually realize a productivity increase of between 70 and 150 percent over three years, versus between 40 and 100 percent in emerging countries. This is not surprising, as the need for efficiency is a direct consequence of the pressure on margins resulting from a focus on increasing benefits to customers.

Figure 16 shows that in countries that placed priority on proceeds for the government, and therefore a more protective regime for the incumbent or delayed entry of competition,

Figure 16: **Priority on Proceeds for Government and Key Indexes***



*Analysis referring to flotation dates of incumbents from 19 countries
Source: ITU; Datastream; Bloomberg; McKinsey

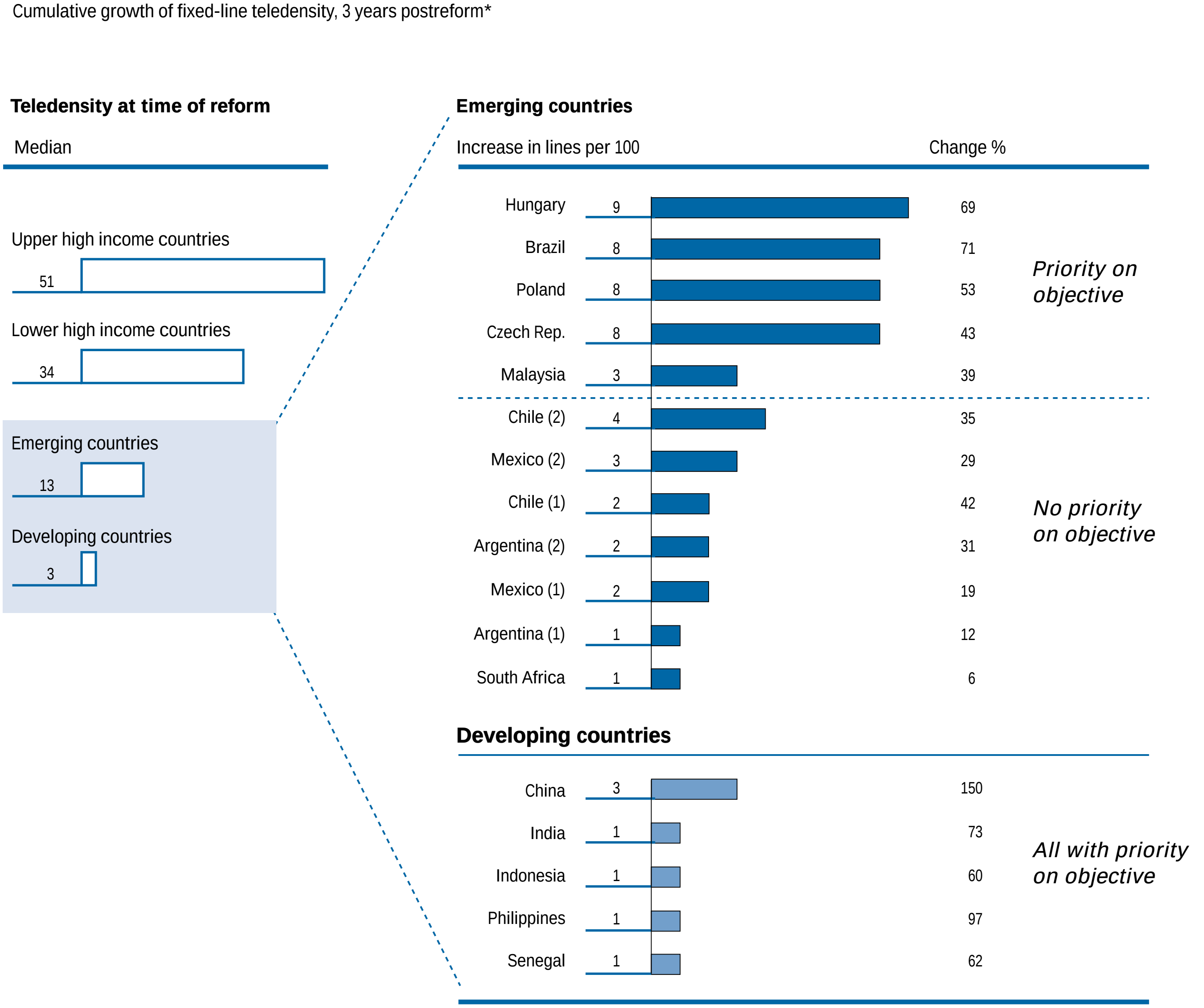
incumbent operators had a significantly higher median P/E-ratio than the main stock market index of that country three years after the start of reform. Initial premiums were relatively similar, possibly reflecting a widespread uncertainty about future outcomes and a lack of trust in government promises. In addition, operating results, reflected by EBITDA[24] margins, and overall results, reflected by EBIT[25] margins, were higher for operators under regimes putting emphasis on government proceeds. This also translated into a higher increase in share prices. During the three years after the first flotation, the median share price increase of incumbents in a protective regime was 70 percent, compared to 57 percent for operators where proceeds where not a priority.

Underlying policy choices in the countries influenced these results. Countries that were not focused on proceeds allowed for more and faster competition. As a result, the median price decrease three years after privatization for national long-distance calls was 11 percent and for international calls, 27 percent. In countries with a focus on proceeds, national long-distance prices went up by 1 percent, and international call prices decreased only by 2 percent. In addition, the incumbents' performance was influenced through the prevailing rebalancing regimes.[26] Countries that had a priority on proceeds rebalanced more aggressively, leading to a median increase for local call prices of 97 percent after three years, compared to unchanged prices in countries where proceeds were not a priority.

Thus, governments retaining a large stake in their incumbent operator, and aiming at two or more tranche flotations, should be concerned about managing the reform process carefully if they are to be successful in maximizing proceeds as a key objective.

Whereas the impact on proceeds for government, benefits to customers, and industry efficiency is, to a large extent, independent of differences in the starting conditions, the impact on universal service objectives and investments is determined by these very conditions. This document will show the impact on these objectives in only emerging and developing countries.

Figure 17: **Impact of Telecom Sector Reform* on Teledensity Growth**



*Privatization and liberalization efforts
Source: ITU; Espicom; McKinsey

Prioritization of universal service results in a higher absolute and, in most cases, relative increase in lines per hundred inhabitants versus countries with no particular universal service priority (See Figure 17.), with a strong difference in the absolute increase. However, it would appear that because of their low level of wealth, developing countries find significant improvements difficult to achieve. Such countries should therefore pursue a focused approach to reform that addresses latent demand bottlenecks by, for example, first enhancing business communications. Not surprisingly, increasing the telecommunications share of a country's total investment is closely related to universal service targets. Those countries that had the highest increases in telecommunications investments (relative to total gross fixed capital formation) also emphasized universal service. Countries ahead of the field, such as Chile, Brazil, Hungary, and South Africa, have achieved an increase in this metric of between 3 and 4 percentage points within three years.

Prioritization of objectives is, therefore, critical for reform success. However, countries should be careful about focusing on a single, politically sensitive objective to the exclusion of all others. While potentially attractive in the short term, long-term goals may be compromised. Furthermore, it is often difficult to switch tactics after courses of action lead to unintended outcomes. The focus on monetary gain from the auctions of

UMTS (Universal mobile telecommunications system) spectrum by German and U.K. governments is a possible case in point. Overall, a government's choice of reform objectives needs to be based on a thorough understanding of that country's starting conditions, factoring in the interests of stakeholders so that broad-based support can be assured.

Conclusion

The analysis clearly demonstrates that sector reform has contributed significantly to the promotion of Networked Readiness. Countries that have pursued sector reform clearly improved their Networked Readiness (as measured through the network access indicator teledensity and the Networked Use indicator user intensity) significantly more than countries that have not pursued reform. In addition, sector reform is the single most important lever determining the value of a country's telecommunications industry.

Although Networked Readiness has come a long way over the past decade, there is still a huge distance to travel. There are more an estimated 500 million Internet users in the world—that still leaves approximately 5.7 billion people without Internet access.[3] Many countries still lack basic infrastructure, and many developed countries still have low Internet penetration. Creating conditions that attract the substantial infrastructure investment required to develop network access via strategic investors or capital markets investment can only be achieved through a regulatory process that has clear objectives, is thoroughly adapted to a country's specific conditions, and makes infrastructure investment economically viable. Given the large amount of investment required to both improve basic Networked Readiness and take Networked Readiness into the broadband age, regulators and policymakers alike still face substantial challenges in even the most developed markets, and cannot take digital readiness for granted. Lessons learned in the successful design of this process are described in Chapter 12 of this book, entitled "The Elements of Successful Telecommunications Sector Reform."

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Endnotes

1 This document uses Internet penetration as an approximate indicator to describe Networked Readiness.

2 That is, the first listing of a corporation at a stock exchange.

3 As of August 2001, the total number of Internet users was approximately 500 million people worldwide (Source: NUA Internet online - www.nua.com). The total world population as of December 2001 is 6.2 billion (Source: U.S. Bureau of the Census)

4 Based on ITU (International Telecommunications Union) classification: countries with at least partial competition for either long distance, international calls, local loop, or xDSL services were considered being liberalized.

5 This is to reflect the importance of market forces in achieving sustainable positive change. Among countries with a liberalized market there are differences in the aggressiveness towards and the scope of liberalization.

6 In most of Western Europe and the Western Hemisphere, there was liberalization of data services prior to liberalization of fixed services.

7 Other factors are the introduction of longer-lived batteries for handsets, and digital services providing higher privacy. The existence of a second provider may have helped to increase adoption of new technologies and to quicken the uptake of prepaid services. But no immediate effect on penetration has been observed.

8 Source: ITU statistics as of August 2001 (http://www.itu.gov). The assessment uses the criteria presented in endnote 4, and includes dependent territories (American Samoa, Greenland), the Holy See, and a large number of islands (Channel Islands, South Sea islands).

9 The analysis shown in Figure 4 comprises 147 countries for which complete and reliable information on both the extent of sector reform and economic wealth is available.

10 This document counts Internet users, and not subscribers, since this metric allows the consideration of multiple usages, for example in schools, or in public Internet centers (prevalent in developing countries).

11 This document uses GDP to reflect the overall stage of development of a country, since it best summarizes all other indicators, such as transparency (corruption perception), literacy, school enrollment, and the participation of nonagricultural sectors in a country's GDP. All these metrics are also positively correlated with Internet penetration.

12 Analysis made using the average of countries falling into one of the categories.

13 This document uses the combined fixed (defined as installed main lines) and mobile teledensity (defined as number of subscribers) to reflect the rapid growth in mobile networks and the increasing availability of mobile access to the Internet, whether by using mobile phones as modems or for direct access.

14 Teledensity correlates with economic wealth. However, even in developed countries, not all access lines are economically viable (due to an unfavorable ratio of returns and investment required). For developing countries, given the lower purchasing power of their citizens, the limits of economically viable teledensity are reached earlier, thus requiring alternative funding mechanisms to support the expansion of their infrastructure.

15 Of the drivers mentioned above, the availability of access devices (e.g., PCs, handhelds) is the most important. However, it usually is not subject to measures directly related to the telecommunications sector. A government that wants to stimulate readiness needs, of course, to act on this driver as well.

16 The high penetration of Estonia is caused by two factors. The Estonian government has pursued a dedicated policy to increase Internet penetration, even making Internet access a constitutional right for its citizens. In addition, the country is small, which makes achieving high penetration rates relatively easy.

17 Given their low teledensity, improving user intensity (which is easier and results in more immediate effects than increasing teledensity) makes developing countries move vertically along the steep slope of the isoline, thus barely improving penetration.

18 Large differences in teledensity, but not user intensity, are mainly influenced by economic wealth. As such, there is no large regulatory influence to be explained.

19 In addition, behavioral differences, the availability of content in the local language, as well as a higher PC penetration in the U.S. play a role. These factors are not directly influenced by telecommunications sector reform.

20 Countries with strong use of English as a second language often have a higher Internet penetration (e.g., the Scandinavian countries). Therefore countries either should encourage the use of English and/or aggressively develop local content.

21 For example, a very customer-friendly regime that does not allow players to achieve a reasonable return on capital could damage the industry and prevent further investments, thus negatively affecting readiness goals. Similarly, allowing a large number of competitors into a country where the market potential is sufficient for at most two players also would lead to a period of shakeout during which readiness goals probably would not be pursued.

22 Assessment made by doing a qualitative analysis of the reform processes of a set of countries within each level of economic wealth with an ongoing reform process, based on stated and implied objectives.

23 Describing those objectives seen as being the priority of a country. This does not mean that other objectives have not been pursued.

24 Earnings before interest, taxes, depreciation, and amortization.

25 Earnings before interest and taxes.

26 Rebalancing is a regulatory policy lever that usually means lowering long-distance prices and raising local call prices (either the subscription or the per-minute fee) in order to reflect the real costs of these services. In most countries, profits from long-distance business were historically used to cross-subsidize local access provision to large parts of the population, largely following political and societal objectives.

CHAPTER 12

The Elements of Successful Telecommunications Sector Reform

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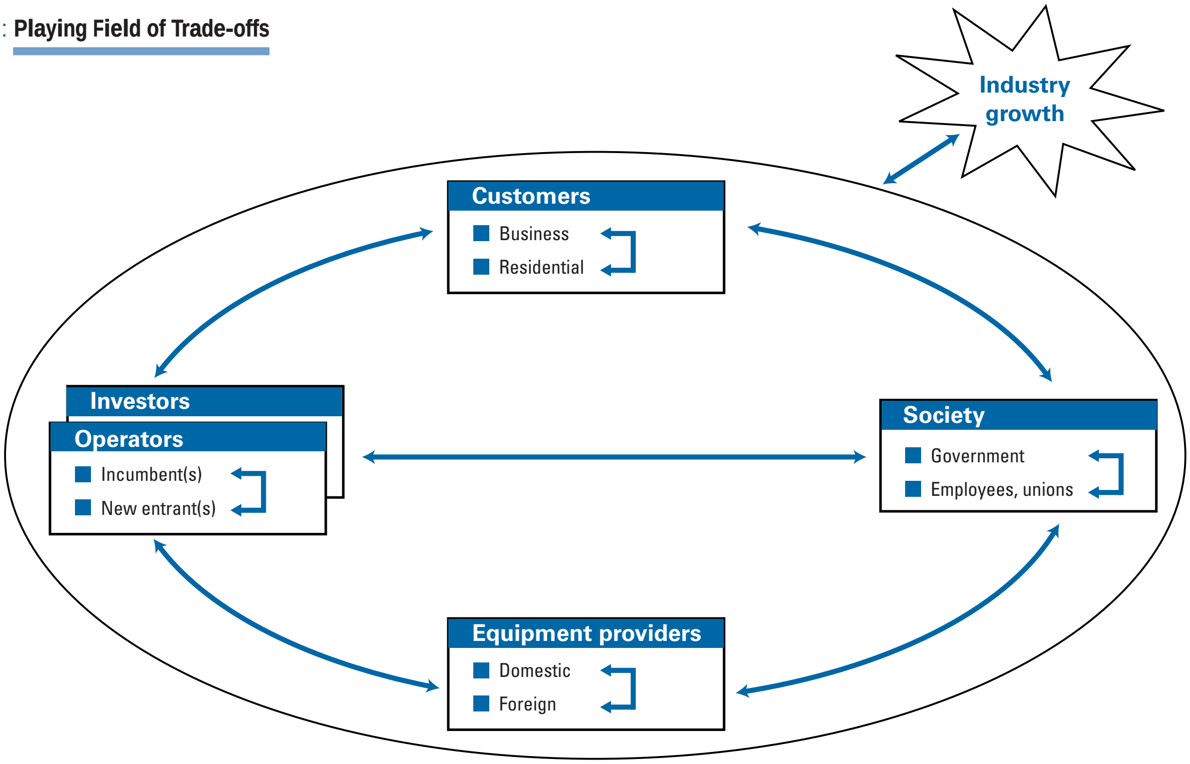
Executive Summary

This chapter outlines the complexities, challenges, and options facing policymakers trying to run a telecommunications sector reform program, and explains the key regulatory tools they have at their disposal. It builds on the findings from the article “Telecommunications Sector Reform—A Prerequisite for Networked Readiness” presented in Chapter 11 in this book. To make sector reform a success, policymakers and regulators must build a comprehensive process that addresses multiple dimensions and resolves several critical issues:

- The significant value at stake during sector reform and the nature of the political process often means that reform is an iterative, and often opaque and uncertain process in which governments must try to balance the interests of multiple key stakeholders: consumers, the incumbent, potential foreign investors, other operators and, possibly, equipment providers. As a result, the path followed, and the details of a country’s reform process are unique and will reflect the de facto compromises struck during the process.
- A few regulatory levers appear critical to ensure that reform is effective. These include industry structure, interconnection, and pricing; country differences may sometimes be added to this list.
- Subtle differences in policy can have major, practical repercussions on market structure and the evolution of market structure.
- As a result, several key priorities are important for various industry stakeholders.
  - Governments in countries that have not reformed to accommodate telecommunications should understand the economic implications and the political constraints for reform and explore how to unlock value in the sector.
  - Telecommunications operators must build the capabilities to manage the reform process in order to preserve or create value.
  - Equipment providers should develop innovative ways of stimulating reform, as it promotes investments in new telecommunications infrastructure.

Figure 1: **Playing Field of Trade-offs**



Source: McKinsey

Orchestrating sector reform

The value at stake from sector reform requires balancing the interests of key stakeholders

Multiple trade-offs between stakeholders

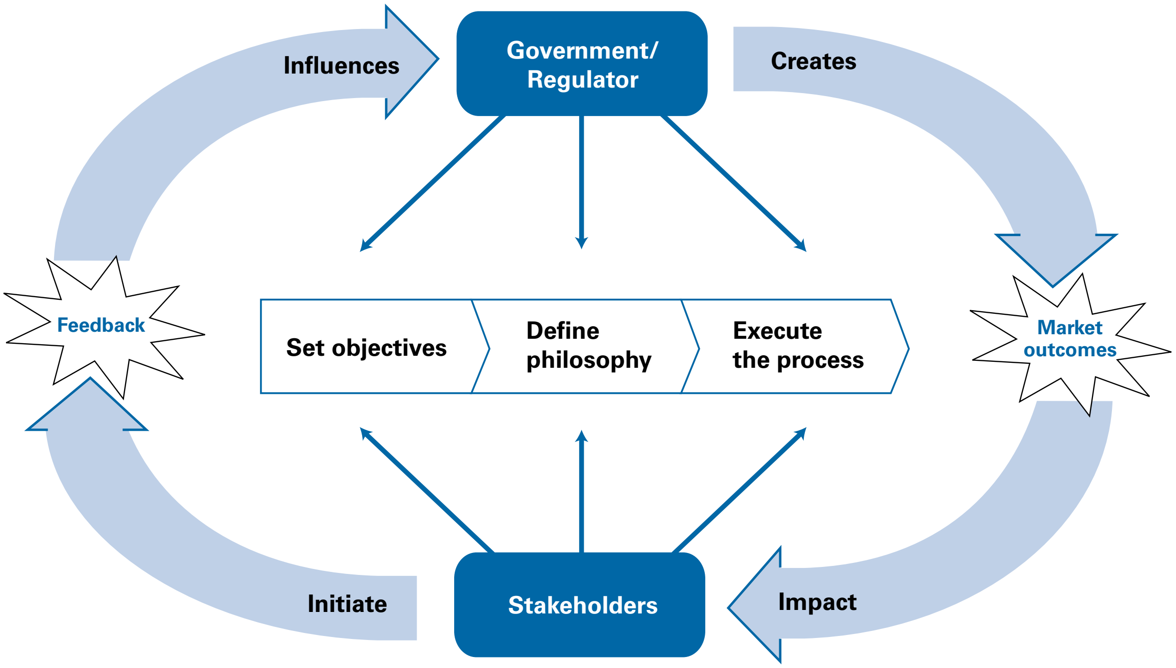
Sector reform typically entails significant changes in ownership, cost levels, and prices of multiple services. Because of that, understanding and managing what stakeholders are likely to win or lose in the process (such as the distribution of value among them) is of central importance. This understanding ensures, first, that reform takes place in a timely manner, and second, that it is successful and results in significant progress toward reform objectives.

Because various stakeholders compete for a share of the total value in the market, governments must allow for complex trade-offs among them. (See Figure 1.) The most common trade-offs are between the incumbent and customers and the incumbent and potential entrants. Policies that encourage customer benefits are likely to do this by increasing competition. This may lower service prices or the incumbent's market share, thereby reducing the incumbent's profitability and valuation and potentially putting additional pressure on the incumbent to reduce costs; this will have an accompanying impact on employment levels. In this simple case, the incumbent, the incumbent employee unions, potential incumbent investors, and the country's treasury are likely to push for slower and less aggressive competitive entry, whereas customer interests and potential entrants are likely to lobby for policies more favorable to new entrants.

This distribution of value should be broadly consistent with economic principles, and encourage market forces as much as possible by removing artificial subsidies and artificial barriers to entry. However, this is not always the case. In many countries, for example, full rebalancing is not pursued because of political pressures to keep local call rates down (Rebalancing is a pricing mechanism that removes cross-subsidies generally by increasing monthly access fees and local call rates and decreasing long-haul traffic prices.) As a result, local competition has frequently been discouraged. In the Telecommunications Act of 1996, the U. S. followed a philosophy of enabling the telephone network as a low-cost platform. As a result, Internet service providers (ISPs) did not have to pay the access charges that long-distance carriers had to pay. The flat-rate pricing regime for local calls represents a huge subsidy for Internet usage, with the subsidy being provided through revenues from long-distance and other services.

The determination of these key trade-offs and the give-and-take through the political process affects not only the distribution of overall industry value among key players, but also the pace of change and the regulatory and legal detail that shapes sector reform. The key challenge is to think through these trade-offs explicitly in advance of, and during, the reform process. Otherwise, unintended consequences that are difficult to reverse could arise.

Figure 2: **Sector Reform Feedback Loop**



Source: McKinsey

Evaluating the likely impact of policy decisions requires a good understanding of the economics of the industry. For example, the effect of a delay in competitive entry, or of potential penetration and service level targets on the incumbent, are not immediately obvious. Governments also need to understand if their country's market potential is large enough to support two or more players competing for market share. As shown earlier in this section, developing countries have to be particularly careful not to rush the introduction of competition. Despite the importance of such questions and the pressure to respond quickly when reform is on the political agenda, governments seldom have the knowledge or ability to provide answers. In addition, because this process occurs under political constraints where the underlying government agenda is often unclear, it is difficult to identify the most appropriate approach towards sector reform.

Sector reform is an ongoing, iterative process. Governments have multiple options of designing the process at their disposal

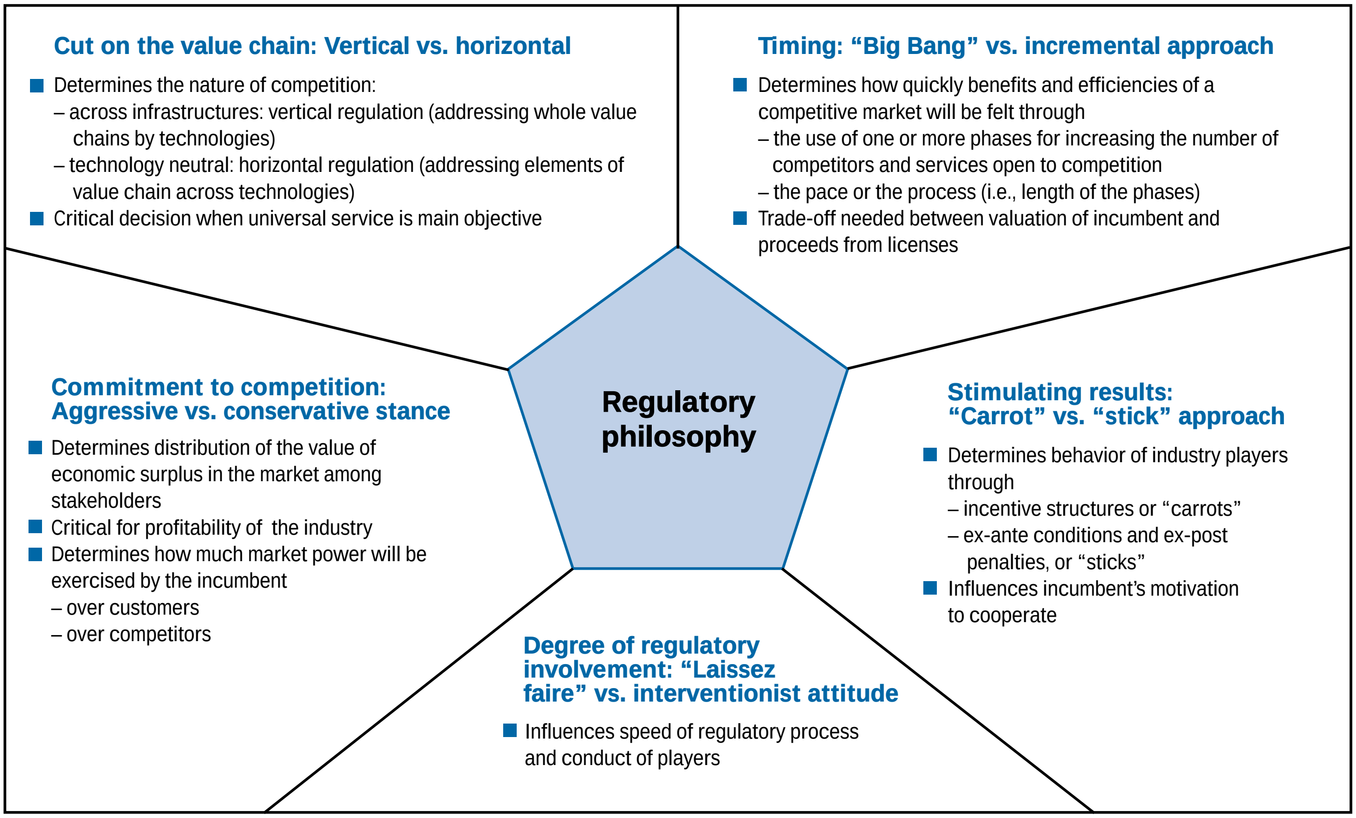
Sector reform is an ongoing process, with continuous progress being made towards achieving objectives. Political pressures can mold developments in unexpected ways. Governments need to understand that policy decisions may trigger market outcomes at odds with the interests of key stakeholders, who will try to influence or change the objectives that were set initially, or to alter some of the policies already implemented. Policymaking bodies, therefore, need to prepare for an iterative process in which regulation will impact the market and, consequently, the stakeholders. The market impact of reform needs to be constantly reviewed and, if necessary, elements of the regulatory process should be adapted to allow for breathing space. (See Figure 2.)

This process can create significant uncertainty, and the final outcomes can, potentially, be a significant departure from the government's early proposals. For example, the South African government back-tracked on a decision to license two new fixed operators, only a few weeks after it was announced in July 2001, following opposition from both the incumbent operator and its investors, and potential new entrants. Generally speaking, the outcome of weighing competing stakeholder interests against reform goals depends on the political strength of a government and the relative pressure that each stakeholder can bring to bear.

Defining the philosophy. Choose the right options

When determining an overall reform model or regulatory philosophy, governments can build a number of different designs based on five key elements. (See Figure 3.) These elements are: timing ("big bang" vs. an incremental approach), the degree of commitment to competition (aggressive vs. conservative stance), the degree of regulatory involvement ("laissez-faire" vs. interventionist attitude), the approach towards stimulating

Figure 3: **Elements of the Regulatory Philosophy**



Source: McKinsey

results ("stick" vs. "carrot" approach towards operators), and the cut on the value chain (vertical vs. horizontal regulation).

When it comes to timing, there is no "unique" approach or pattern. Countries have moved forward at very different speeds. For example, the time taken to reach full liberalization has varied from immediate, as was the case in Sweden, to twelve years, which was the option taken in Japan.[1] Furthermore, whether a private monopoly and limited competition constitute intermediate steps in reaching full liberalization also impacts on timing. (See Figure 4.) It can be seen that the earlier that privatization was started, the longer it took to attain full liberalization. However, the speed of technological change, globalization (following, for example, World Trade Organization [WTO] agreements) and the convergence of services (mobile vs. fixed) all increase the need for a quick process. In addition, the revenues of traditional fixed-line incumbents are threatened by mobile services, which are more easily and rapidly implemented, and by local access technologies that bypass their last mile connection. The local access issue means that governments have to decide whether or not to license fixed wireless access technologies. Thus, in contrast to countries that started their reform process ten to fifteen years ago (e.g., the U.K. and Argentina), countries still planning to undergo a sector reform have little choice but to take rapid steps toward sector reform. Each further year lost will make reform more difficult.

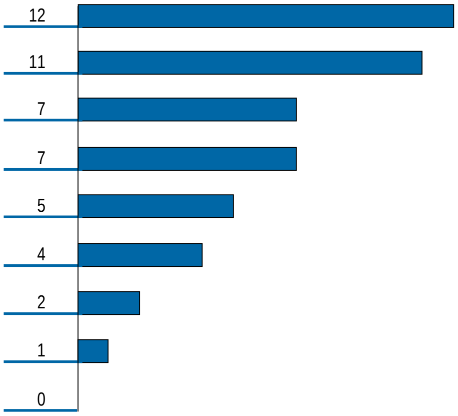
Stakeholders can influence the commitment to competition. For example, even though both France and Germany underwent "big bang" reform, their liberalization philosophy was different. Germany had more aggressive policies than France, which shielded its incumbent operator from some aspects of competition. Brazil, which has a strong emphasis on universal service, paced the introduction of competition to allow the incumbents to prepare their businesses for the market. This may be a possible solution for developing countries as well.

When it comes to the degree of regulatory involvement, a government needs to decide whether to take an interventionist or a laissez-faire attitude. New Zealand chose the latter, introducing telecommunications legislation that laid down the basic rules of business conduct in the industry, and then letting the operators fight out the details in court. No regulatory body administering and implementing policies was set up. Germany and U.K., on the other hand, introduced regulators that have a say in virtually every telecommunications-related issue.

The cut on the value chain is important as it determines if services or technologies are subject to regulation. Under a horizontal stance, the technology choice is left to operators. A vertical regime needs to make specific choices as to where to apply a specific technological platform. Developed countries

Figure 4: **Time Lines Of Sector Reform Processes**

Country	Start of reform*	Total time to full competition years	Duration of… private monopoly years	limited competition years
Japan	1985	12	2	10
Argentina	1990	11	9	2
Mexico	1997	7	7	–
U.K.	1984	7	–	7
Chile	1989	5	2	3
Brazil	1998	4	2	2
Germany	1996	2	2	–
France	1997	1	1	–
Sweden	1997	0	–	–



* Date of initial privatization or liberalization
Source: ITU; McKinsey

have historically focused on vertical regulation. Convergence, and the resulting possibility to provide similar services through multiple technological platforms, may require changing this focus towards regulating services, for example, voice communication, independently of the technology used (e.g., fixed lines, mobile telephones, or cable television).

In line with their prevailing teledensity objective, developing countries in particular need to decide on how best to achieve this objective. This could be done, for example, by segmenting customers and their needs. Examples of such segmentation include:

- Businesses/educational institutions. These require data services, and thus higher bandwidth, which is only efficiently delivered over fixed infrastructure.
- Residential customers. These require primarily voice services or dial-up Internet access, which does not demand high bandwidth. This means that they would be most efficiently served using mobile infrastructure.[2] Wireless infrastructure is cheaper to install, can be built out more quickly and focused on areas where there is demand, thereby making flexible use of resources.

Stimulating results. Countries need to decide whether to use a "stick" or "carrot" approach toward operators. Brazil has used both. It offers incentives to the three regional fixed-line incumbents to expand nationally, two years ahead of the original plan, if they also reach penetration and quality of service targets two years early. This has led to a high increase in penetration and service quality of fixed lines. That said, incentives must be strategically designed to encourage the incumbent operators to cooperate in the reform process. The lack of sufficient incentives to incumbent operators can have a negative impact on the deployment of new technology. This was the case in the U.S., where the unbundling regime introduced by the 1996 Telecommunications Act based the interconnection rate on long-run incremental cost. This inhibited incumbent investments in high-speed access technology, while new entrants could not afford to build an entirely new facility-based infrastructure.

Successful sector reform sets up legal prerequisites and regulates for the case on the ground

If policymakers are to support successful reform, they have to decide on a complex set of legal prerequisites and regulatory levers. The legal requirements are essentially rules and policies that operators must follow to participate in the market. Some of these are prerequisites to reform, some are the "rules of engagement" for the industry, and others are simply a reflection of social or political priorities. In the early stages of reform, the incumbent's position as a dominant operator means its competitors have to be provided with legal safeguards to ensure that competition can develop. As a result, governments step in to impose asymmetric regulation on incumbents to ensure that new entrants are not at a disadvantage relative to the incumbent.

To do this successfully requires detailed knowledge of regulatory levers and how these might be applied. Not all the levers need to be used at once, or at all, and there may be more than one way of reaching the same result. In addition, governments need to calibrate their capabilities to enable the regular update and revision of policies that are not working as intended. Governments are typically unable to manage all of these elements in the early stages of reform and, as a result, the process often covers the same ground more than once.

Putting prerequisites in place

Among institutional prerequisites are the rule of law and a functioning political system. If a country lacks the necessary institutions or a credible legal system, attempts at sector reform may end in disappointment. In addition, prior to reform, a predictable legislative environment needs to be created for investors. Critical elements in this include profit repatriation and ownership rules (foreign vs. domestic ownership).[3]

Frame legislation needs to be in place. Government ministries or national legislatures will normally introduce telecommunications sector reform and adopt the necessary legislation. The actual legal or administrative instruments used to implement these policies may vary. The options include an overarching telecommunications law or act, conditions placed on the license of the incumbent operators or new entrants, or tailored pieces of legislation.

Creation of a regulator

Once the framing legislation is in place, the executive branch of the government, or preferably a sector-specific independent regulator, must implement specific policies and enforce their application.

If regulators are appointed in the context of privatization of the incumbent operator but prior to any liberalization, their overall objective may simply be to ensure that public policy objectives for the sector are met. Following liberalization, these regulators are then empowered to implement policy. For example, the regulator's responsibilities might include authorizing or licensing new operators, removing barriers to market entry for new entrants, overseeing the interconnection between the incumbent and competitive networks, and resolving disputes.

The regulator needs to possess enforcement authority to both resolve disputes and impose effective sanctions on operators who do not comply with license conditions or who indulge in anticompetitive behavior. In this context, the regulator, rather than the telecommunications ministry, must be able to control key policy decisions (e.g., interconnection and pricing). In addition, countries need to ensure that no body, other than the courts, can overturn the decisions of the regulator.

Market confidence in the impartiality of regulatory decisions generally increases with the degree of independence from both government and operators. Market confidence is key to reform because it promotes increased domestic and foreign investment in the sector. The independence of the regulator can be ensured by separating it from the ministries responsible for the sector, and by freeing the regulator of the need to report to political authorities. Another important factor in stimulating investment is regulatory transparency. Information supplied to the regulator needs to be widely accessible, and regulatory decisions have to be publicized.

Regulatory levers

Sector reform is implemented through varying combinations of regulatory levers. Broadly, regulatory levers can be grouped into six main categories, each of which applies to both fixed and mobile services, with some difference in the degree of applicability from lever to lever. Those categories are: industry structure, pricing, interconnection, customer access, universal service, and performance levels. (See Figure 5.) Some of the categories are more related to liberal objectives (industry structure, interconnection, pricing); others more to societal objectives (universal service, performance levels). The customer access levers are related to both objectives. This section explains the categories and the associated levers.

The industry structure category consists of those levers that allow multiple carriers and service providers to enter the market and operate competitively. Levers within this category include the number of competitors/licenses issued, ownership and control rules, and decisions on the networks and services that are open to competition. In summary, they define any type of lever that determines how many competitors can operate in the industry and under what conditions (e.g., whether they are allowed to offer infrastructure-based services or resell, at what rates they can resell, when they can enter the industry, what spectrum is allocated to particular services, and how it is assigned to service providers).

Governments have varied in their approach to allocating types of service among players. For example, when the U.S. broke up the AT&T fixed line monopoly in 1984, AT&T itself continued to provide interregional, intraregional, and international long-distance service, while the regional companies spun off from AT&T dealt with local and intraregional long distance service. With the introduction of the Telecommunications Act of 1996, however, all operators could expand their service offerings into each other's fields. Brazil has essentially adopted the same model in its first phase of sector reform, begun in 1998. The government consolidated the former twenty-seven state operators into three regional incumbents that provided local and intraregional long distance service, and installed one provider for national and international long-distance services. With the introduction of full competition in 2002, companies will be allowed to enter into each other's markets. When South Korea started to open up its telecommunications market in 1990, the incumbent operator remained a full-service provider, with separate competitors being awarded licenses for international long

Figure 5: **Overview of Regulatory Levers**

Regulatory levers	Levers for fixed services	Levers for mobile services
Industry structure	Number of competitors Ownership and control rules, including restrictions on foreign investment Networks and services open to competition Licensing procedures and conditions	Number of network operators Ownership and control rules Licensing procedures and conditions
Pricing	Price caps Tariff rebalancing Access deficit compensation Pricing regime for local calls	Controls against abusive retail pricing Controls against abusive international roaming pricing Access deficit compensation applied to mobile operators
Inter-connection	Rights and obligations to interconnect Structure and level of charges Collocation and infrastructure sharing Conditions for unbundling network elements Interconnection for ISPs	Rights and obligations to interconnect Structure and level of charges Collocation and infrastructure sharing Requirements for national roaming Access for Mobile Virtual Network Operators (MVNOs)
Customer access	Numbering plan Number portability Length and ease of carrier prefixes Subscription mechanism for carrier preselection	Numbering plan Number portability Length and ease of carrier selection codes Subscription mechanisms for indirect access
Universal service	Universal access and service obligation definitions Universal service funding mechanism Penetration targets	Universal access and service obligation definitions Universal service funding mechanism Network rollout and coverage requirements
Performance levels	Service quality targets	Service quality targets

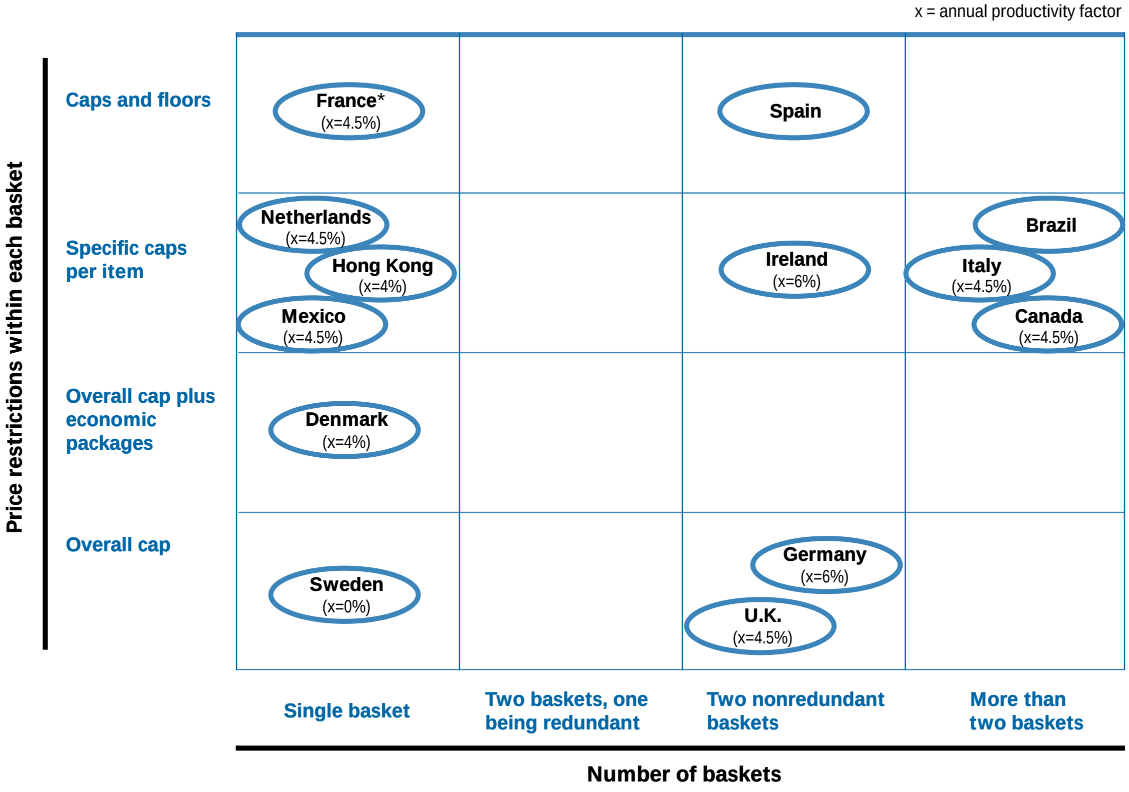
Source: McKinsey

distance (1990), national long distance (1995), and local services (1999). From 1999, multilicense competition was allowed.

Governments need to find the right balance in terms of the number of competitors allowed to enter a market. Licensing too many competitors can quite easily have a negative effect on industry performance, as was the case in the mobile markets of the Netherlands (five competitors) and Malaysia (eight competitors). The number of UMTS (Universal Mobile Telecommunications System) licenses in some countries (e.g., Germany auctioned six licenses) also raises concerns about economic viability. On the other hand, duopolies may have no or little effect on improving competition and efficiency. This is particularly true if they operate in each other's former market, as was the case in Argentina between 1999 and 2000. Here, the two regional incumbents were allowed to enter each other's turf for long-distance services.

The pricing category covers those levers that are used to eliminate or maintain the historic cross-subsidies that existed under the monopoly utility model, where the incumbent subsidized local service access and call tariffs by charging higher rates for long-distance and other services. At the point of sector reform, these levers are often one of the most important, if not the most important, drivers of value for the incumbent. These levers can include mechanisms such as price caps (which control the rate at which baskets of regulated services must change in price from year to year), rebalancing of local prices (usually entailing the raising of local access prices either for monthly subscriptions or for per-minute call rates and lowering of long-distance prices), and compensation for access deficits (i.e., for explicit subsidies to keep local tariffs low, such as those used in the U.S.[4]). As mobile networks grow in importance (and hence market power), they are increasingly attracting the sort of price regulation applied to fixed incumbents. For example, in 2001 the European Union (EU) launched an investigation of nine mobile operators in the U.K. and Germany following allegations of illegal price fixing of international roaming fees (in both countries) and of wholesale interconnection fees (in Germany only).

Figure 6: **International Comparison of Price Cap Regimes**



*Although France has a single basket with an overall price cap, it has distinct floors for the various regulated services
Source: McKinsey

An example of how pricing policies differ across countries is shown in Figure 6. Both the number of baskets that are defined by the regulator and the price restrictions applied within each basket show significant differences. However, most countries apply similar x-factors.[5]

Interconnection is the single most important means of controlling competitive entry. This is because it defines the physical and logical link among public communications networks, and transfer prices among competing networks. As such, it is an essential feature of telecommunications competition simply because entrants need functional access to the incumbent's network. The levers within this category are multiple and extremely complex. They include: the details of the rights and obligations to interconnect, the structure and pricing of services, service definitions (what interconnection services must be provided by the incumbent on a cost-oriented basis), physical points of interconnection, access deficit compensation, and rules for colocation and infrastructure sharing. Some countries chose to include unbundling with interconnection (mostly the U.S., due to stronger emphasis on local-to-local competition), but most countries have chosen not to tie it in.

The regulation of mobile networks demands additional policies that can vary significantly from country to country. Among these may be: price caps on interconnection services (e.g., Vodafone and Cellnet in the U.K.), requirements for national roaming (allowing a subscriber of one mobile operator to use the services of another mobile operator in the same country), or resale access for mobile virtual network operators (MVNOs) to the network of existing mobile operators.[6]

The customer access category includes those levers that determine the ease with which a customer can switch to, and access, a preferred service provider. These levers include the details of the numbering plan and access for competitors to the allocation of numbers, number portability (the ability of customers to keep their number when switching among competitors), length and ease of carrier access codes (for dialing to indirect access competitors), and subscription mechanisms (such as call-by-call or preselection).

Universal service defines those levers that support universal access, guaranteeing that persons in remote locations or so-called unprofitable customers have access to telephone services (e.g., public payphones or community calling centers). It may

Figure 7: **Levers Used to Achieve Different Objectives**

Relevant ➡ Less relevant ⇨ Not relevant —

	Regulatory levers					
Objectives	Industry structure	Pricing	Inter-connection	Customer access	Universal service	Performance
Increase benefits to customers	⇨	➡	⇨	➡	⇨	⇨
Develop an efficient and competitive telecommunications industry	➡	⇨	➡	⇨	—	—
Proceeds for the government	➡	➡	⇨	—	⇨	—
Universal access to phone services	—	➡	⇨	—	➡	—
Attract investments to enhance infrastructure	➡	⇨	➡	—	➡	—
Stimulate networked readiness	➡	➡	➡	—	➡	⇨

Source: McKinsey

also be extended to, or include, universal service. This dictates that a minimum service level should be available to all persons at an affordable cost, upon request. In developing countries, this is one of the most important levers. The build-out requirements related to universal service can have a significant impact on the economics of an operator and thus the likelihood of successful market entry.

The performance levels category consists of those levers that ensure market participants meet specific performance criteria (e.g., quality of service, coverage, investment conditions) in exchange for their participation in the market. Service performance norms may be imposed as part of licensing conditions, or with other regulations. Alternatively, regulators may create incentive schemes, whereby those operators who meet specific targets are granted benefits (e.g., expansion of a geographic franchise). As the incumbent is likely to be the dominant player for some time after liberalization, performance levers are also central to securing an improvement in service for the large majority of customers.

Levers used in the pursuit of multiple objectives

It is important to note that more than one lever can be applied to reach a particular objective, and that the levers can be used in various ways, depending on the goal that has been prioritized. (See Figure 7.) This holds for all levels of economic wealth. An example is the industry structure lever. Placing an emphasis on proceeds for the government implies a more protective regime for the incumbent, and a delay in competitive entry or a cap on the number of new entrants. This was the case in the first phases of sector reform in Argentina, Chile, and the U.K. Increasing benefits to customers is usually achieved by introducing more intense competition, as was the case in Germany and in the second phase of the Chilean reform. In addition, while increasing benefits to customers would suggest allowing resellers into the market, attracting investments implies emphasizing facility-based competition.

Not all levers need to be used. For example, Poland started to rebalance in 1998 by imposing direct price adjustments. Price caps will be introduced only from 2003 onwards. On the customer access lever, the U.K. maintained call-by-call selection as the competitive voice call service, and introduced carrier preselection only in 2000.

Regulation can be international

While most of the value impact of telecommunications sector reform is still determined at the national level, international institutions and organizations have also played an important role as catalysts for sector reform at the national level.

On the global level, the WTO requires signatories to recent agreements on opening their telecommunications markets to competition. Its "Agreement on Basic Telecommunications Services," which came into effect in 1998, includes a reference paper that binds countries to adopt policies ensuring transparent and nondiscriminatory licensing, interconnection, universal service, and allocation of scarce resources and calls for the establishment of an independent regulator. The paper does not, however, specify details of implementation.

At the regional level, the EU has pursued the goal of creating a common market for telecommunications services, shaping telecommunications policy in its member countries through legally binding instruments. The liberalization of fixed voice telephony services in most member states was based on the regulatory package of the EU. The EU has established a detailed framework for regulatory policies addressing all regulatory levers. For example, the Licensing Directive provides that there should be no limitation on the number of licenses granted for a particular type of service or network, and the Interconnection Directive requires that operators apply similar interconnection terms and conditions to all operators offering similar types of service. (This applies to their own activities.) For all these directives, however, the detailed terms and conditions (such as the classes of service providers and network operators to be licensed, their rights and obligations to interconnection, and the specific cost charged for interconnection or licenses) are defined and approved on the national level.

Differences in execution are relevant

This section highlights how apparently analogous regimes can achieve different results through subtle differences in the application of regulatory levers. It also provides evidence on how regulatory outcomes are affected when policies are not aligned with objectives and there is a lack of execution rigor.

Subtle differences in policy choice can create major impact: France versus Germany

While Germany and France both opened their national public fixed telephony markets to competition on January 1, 1998 (in line with the first telecom regulatory package of the EU), the application of key policy levers in the two countries has varied considerably. Germany adopted a rather aggressive approach to liberalization, while France took a more conservative stance. The differing aims can be seen in a number of levers.

German regulation of interconnection, for example, set low thresholds for qualifying for cost-based interconnection from the incumbent; Deutsche Telekom (DT) was also required to offer double tandem origination services[7] to qualifying operators. In contrast, French service providers faced more difficult qualification criteria (although significant entry still occurred), and no double tandem origination was included in France Telecom's interconnection offer.

The impact of these subtle differences was significant. Operators in Germany could enter the German market with minimal infrastructure requirements and offer a national service by simply piggy-backing on DT's network, whereas in France an operator who wished to offer a country-wide service had to connect multiple France Telecom points of presence (PoPs, generally a central office switching location). (See Figure 8.)

Germany went further on several other levers. On customer access, Germany introduced carrier preselection and number portability from 1998, in addition to call-by-call carrier selection; France introduced preselection and number portability to meet the EU deadline in 2000. In addition, the German incumbent operator faced the requirement of billing customers for the services of indirect access operators and service providers.

The lack of tariff rebalancing in Germany allowed new entrants a considerable margin with which to engage in long-distance price competition. In France, tariff rebalancing was launched in 1994, prior to market opening, to prevent the massive entry of rent-seeking new entrants.

As a result of how the regulatory levers were applied, in Germany, network operators—resellers in particular—had favorable entry and operating conditions, and new entrants in Germany have made significantly higher market share gains than in France. Although the German regulator was aware that all the policies would encourage entry, such a dramatic evolution and the resulting market structure was probably unexpected. German long-distance prices fell by a dramatic 60 percent within the first year of liberalization.

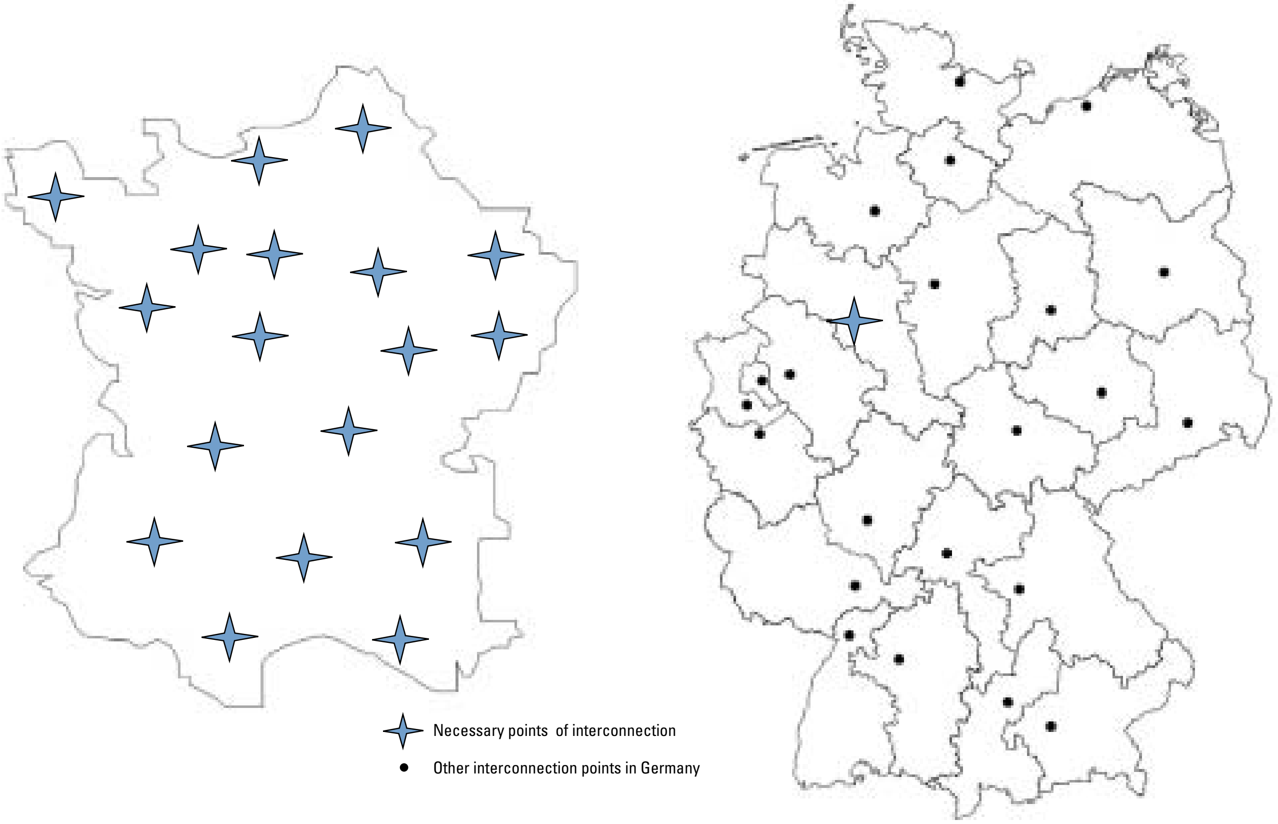
The importance of aligning regulatory policies with objectives: Hungary versus Poland

By contrasting the initial phases of telecom reform in Hungary and Poland and the market outcomes that resulted, one can observe the importance of matching the regulatory levers to the policy objectives. Hungary and Poland began the transition from centrally planned to market economies in 1990. Both countries emphasized enhancing universal service early in the reform process, and both licensed local telecom operators (LTOs) in the mid-1990s to further increase teledensity (the number of phone lines per hundred inhabitants). Hungary created reasonably favorable conditions for local competition; Poland, however, was far less successful.

Hungary influenced the sector by defining industry structure. LTOs in Hungary were granted monopoly rights to provide access lines and local service in localities. These rights excluded Matav, the incumbent operator. The initial licensing fees imposed were relatively low, as were annual fees. In Poland, LTOs were awarded licenses to compete in a duopoly with TPSA, the incumbent operator. Licenses were auctioned, which often resulted in capital depletion and left less capital for network investments for the winning LTOs.

To ensure improvements in teledensity and universal service, the Hungarian LTOs and Matav had to commit to increasing line density by 15.5 percent per annum in their first six years of operation, and to reducing the waiting times for line installation. Poland imposed no density requirements.

Figure 8: **Interconnection Policy and Infrastructure Build-out**



France
Single-tandem call origination requires competitive operators to connect at switches in each of the 18 interconnection zones

Germany
Double-tandem call origination allows competitive operators to provide national service by connecting to a single switch in one of the 23 interconnection zones*

*Operator required to add further points of interconnection if traffic in switch exceeds a specified Erlang limit
Source: Ovum; McKinsey

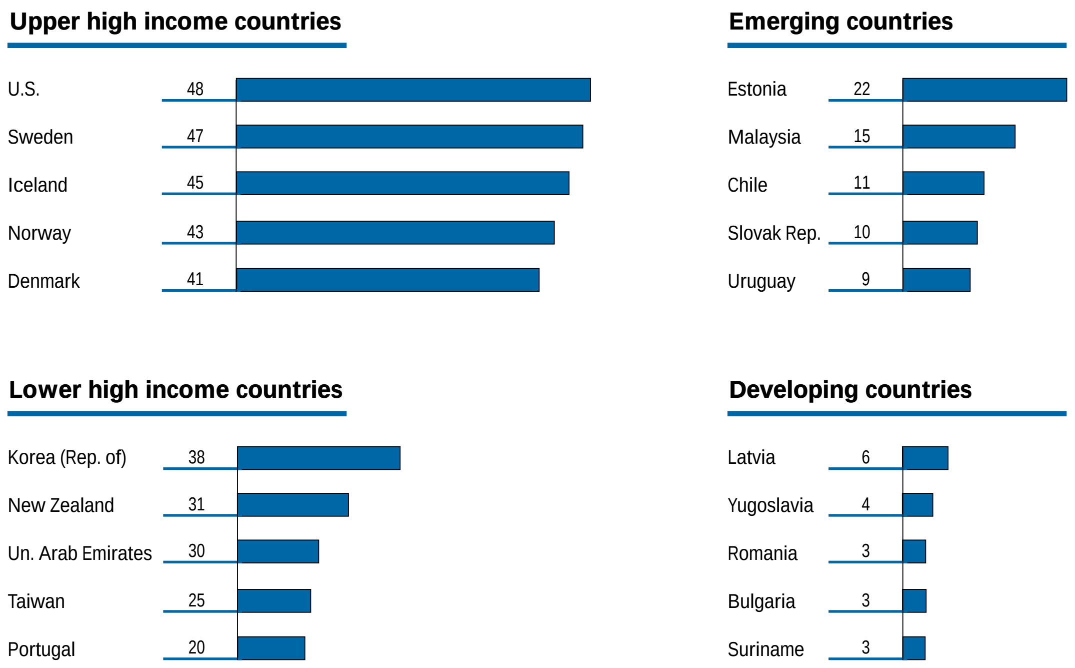
When LTOs entered business in 1995, the Hungarian government began tariff rebalancing to increase Matav's line rental and local call prices while, at the same time, efforts were made to decrease the interconnection payments LTOs paid to Matav (although the policy probably did not go far enough until Matav aggressively rebalanced in 2000). This policy mix allowed the LTOs to increase revenues and improve their return on investment. In Poland, TPSA's line rental fees and local call tariffs were significantly below cost, and allowed to remain so until initial tariff rebalancing in 1998. In the absence of a clear interconnection policy, TPSA was able to manage the regulatory process to its advantage, both delaying agreements and charging relatively high interconnection rates until 1998.

As a result of the regulatory regime in Hungary, LTOs there made a higher contribution to increasing fixed-line teledensity and investments than did their Polish counterparts. Between 1995 and 1998, fixed teledensity in Hungary increased by thirteen lines per hundred inhabitants (from twenty-one to thirty-four per hundred). In Poland, fixed teledensity increased by eight lines per hundred (from fifteen to twenty-three per hundred). Hungarian LTOs contributed five of the thirteen lines per hundred installed (or 38 percent), whereas in Poland, only one of the eight lines per hundred installed (or 13 percent) was added by the LTOs.

Advanced Networked Readiness can be influenced by several specific policy choices

In most countries, improving advanced Networked Readiness has not, so far, been an explicit objective of sector reform. As a result, it is difficult to evaluate the effectiveness of policies designed to promote it. In addition, as was the case for the more traditional objectives of telecommunications sector reform, countries have applied multiple approaches. Some countries have, however, made greater progress than others. As shown in Figure 9, between 1996 and 2000 the U.S. (an upper high income country), South Korea (lower high income), Estonia (emerging), and Latvia (developing) were among the most successful countries in improving Networked Readiness.[8] Patterns in the policies followed by these countries can be

Figure 9: **Leading Internet Countries: Growth in Internet Users per 100 Inhabitants from 1996–2000**



Source: ITU; NielsenNetRatings; World Economic Forum; McKinsey

identified, and provide useful lessons on how to approach the promotion of advanced Networked Readiness.

Learning from the leaders

The U.S. and South Korea both separated voice telecommunications from information services, and therefore, ISPs from telecommunications providers. Neither country placed any restrictions on providing a service license to ISPs. South Korea, in fact, does not even issue a license; it is sufficient to notify the regulatory authority of the existence of the ISP. In addition, neither country imposes restrictions on foreign participation in ISPs, a policy that is in stark contrast with the telecommunications market. Estonia is another example of a country that does not apply restrictions on licenses for ISPs. However, in Estonia the incumbent is allowed to provide information services, which has made it the largest ISP in the country.

While the U.S. has applied flat rate pricing for local calls, South Korea and Estonia have not implemented this regime. South Korea increased its local rates through a cabinet decision in 1993, but as of 1999 the country still had the lowest rates in the OECD. The Estonian government imposed a 50 percent price reduction on local calls in 1999 after prices had increased by 40 percent between 1996 and 1998 (as a function of overall price increase powered by the strong economic growth of the country). Internet calls are priced at lower rates than telephone calls.

The U.S. ensured the provision of key infrastructure, such as dial-up access and leased lines, by incumbents to ISPs at reasonable interconnection rates. This allowed the new entrants to be profitable. Furthermore, regulators have created safeguards to keep incumbent operators from suffocating competitive ISPs.[9] In South Korea, dominant telecommunications providers are obliged to provide cost-based interconnection services to other operators and value-added service providers, such as ISPs.

Estonia made Internet access for every citizen a constitutional right. As a result, the country has been very active in applying universal service targets on its incumbent operator. For example, all schools in the country are connected to the Internet. In addition, Estonia disposes of more than 200 public access points in libraries and municipal buildings. South Korea did not impose universal service obligations until 2000, but exceptions from universal service obligations among information service providers were planned in order to stimulate the growth of the information sector. This is similar to the U.S. approach, in which information service providers are not subject to either universal service obligations or contributions to universal service funds.

Latvia is the highest-ranked developing country. It is, however, strongly placed to transition to an emerging country. So far, Latvia has only privatized the incumbent operator. Government has imposed low local access fees, and set the target of fully digitalizing the telephone network by the end of 2001. The country also created a particular fund for developing a uniform municipal information system, following its current focus on improving communication between communities.

Designing a process to encourage advanced Networked Readiness

The case examples suggest several regulatory process designs for governments that want to focus on Networked Readiness, particularly in emerging and developing countries.

These regulatory processes include the following goals: promote a more rapid opening to competition, and where intervention takes place, set strict performance targets; intervene where necessary, with a focused minimalist approach to resolve the market failure that may prevent adoption (e.g., PC penetration in Korea, usage costs in Estonia); finally, adopt an aggressive stance towards encouraging the entry and growth of competitive ISPs. The applicability of each of these options is obviously dependent on the conditions in a country, but they do point to some areas where governments can take steps to encourage Networked Readiness.

In addition to the government steps noted above, other regulatory levers can be used to encourage readiness. Separating service provision and subsidizing Internet access through long distance services appears to have been effective in both developed and emerging countries. However, while separation may work as well for developing countries, subsidizing may not be possible if there are insufficient sector revenues.

In addition, countries that lack basic communications infrastructure should focus on basic interconnection, universal service, and customer access. They should also look at how best to increase overall industry value. In these countries, ISP interconnection or peering agreements would be a secondary and less critical objective.

Implications for Key Stakeholders

The analysis presented thus far has provided a general perspective on the design of the sector reform process, assuming a country perspective. However, the outcomes of reform affect all stakeholders. Of these stakeholders, telecommunications operators and equipment providers are particularly important in ensuring that sector reform progresses towards the desired objectives. It is, therefore, necessary that governments and regulators as well as operators and equipment providers understand the implications of sector reform.

The implications for operators and equipment providers in particular often conflict with those of governments and regulators. Some of the implications for stakeholders presented hereafter may therefore sound provocative. However, they reflect the reality in telecommunications markets. One of the main tasks of a regulator is to ensure the commitment of operators and equipment providers to the reform process by appropriately accounting for their interests.

Implications for governments and regulators

Governments and regulators in developed countries and emerging countries with relatively mature sector reform processes require continuing reform and ongoing management and refining. Although it is not yet known what direction refinement may take, several issues appear to be emerging. These involve:

- Understanding and reacting to differences in performance among countries
- Evolving regulation towards regulatory parity between the incumbent and attackers
- Fine-tuning the regulatory process to enhance the impact of reform
- Evaluating where to reduce and where to extend regulatory oversight.

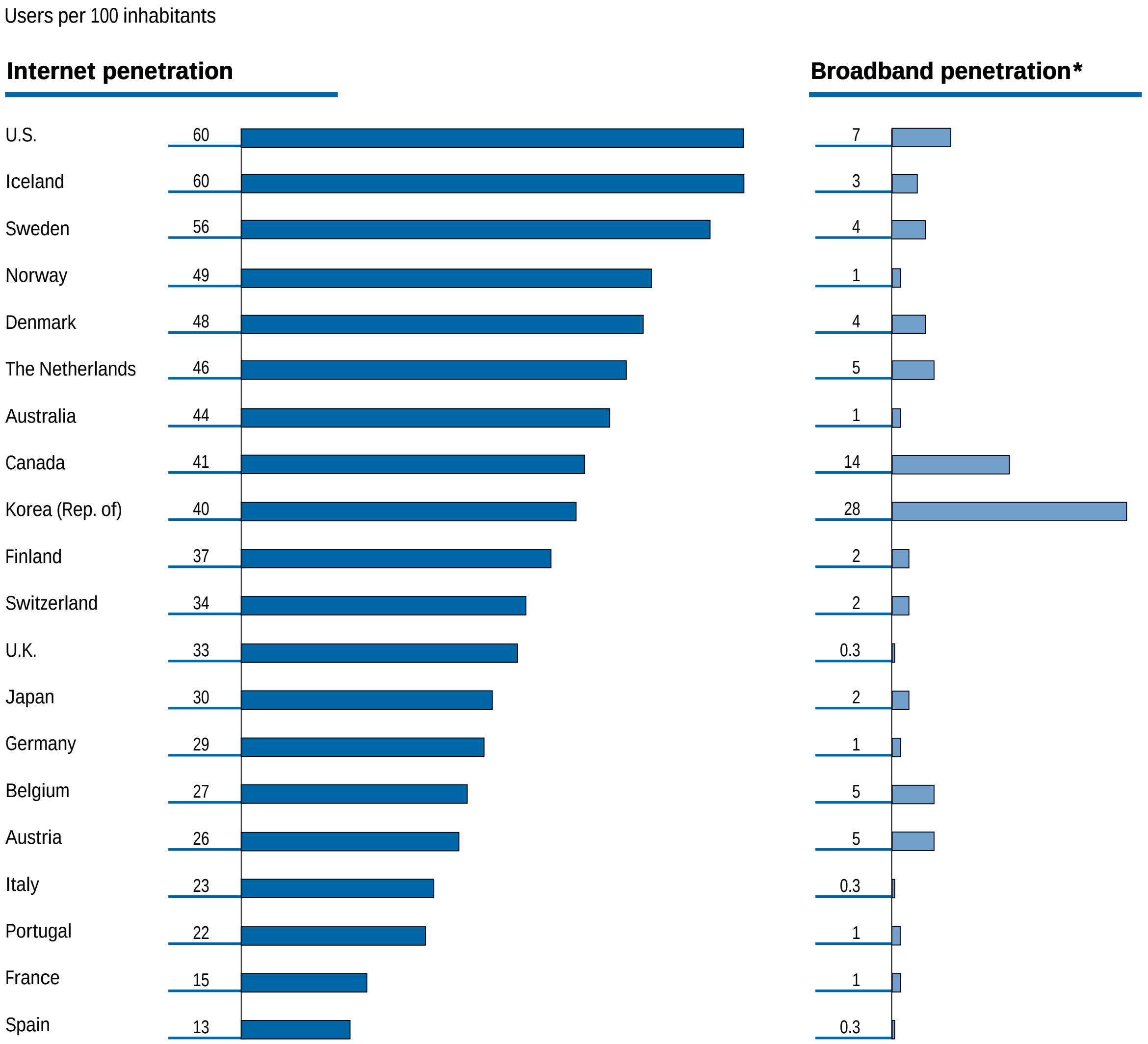
In emerging and developing countries where sector reform was started recently or has yet to be undertaken, policy must be focused on unlocking the value inherent in the sector. To do this, governments must act in multiple dimensions. This involves:

- Putting in place a credible legal framework as well as a capable and adequately resourced regulator
- Creating policies that attract adequate private investment into the sector
- Developing a regulatory regime consistent with the eventual dynamics and economic incentives of market processes
- Ensuring that critical regulatory levers are clearly defined and reflect a reasonable compromise among key industry players
- Defining a regulatory agenda with clear, well-understood objectives for sector evolution.

Fine tuning regulation and addressing the key drivers of differences

Countries with an advanced reform process need to understand that there are still differences in performance with regard to making progress towards the objectives of sector reform that need to be assessed in order to understand how to best develop the telecommunications sector. For example, Germany allowed for up to six UMTS licenses to be auctioned in 2000, with build-out requirements attached to each. The dynamics of the auctioning process itself were influenced by general euphoria in the industry; however, an assessment of competition in mobile markets around the world would have suggested reducing the number of possible entrants. The German regulator has employed the corrective measure of allowing license holders to share part of their infrastructure.

Figure 10: **Internet and Broadband Penetration, 2000**



* January 2001, comprises DSL and cable modem connections. Assumption: 3 users per connection
Source: ITU; NielsenNetRatings; The Economist

Regulators will need to fine-tune regulatory policy because regulatory details that appear innocuous before reform can turn out to have far-reaching effects once the process is underway. For example, the lower economic performance of LTOs in Poland, and their resulting lack of contribution to the country's infrastructure build-out had not been foreseen at the inception of reform. Similarly, significant mobile substitution for fixed lines is becoming a real factor in wireline operators' economics, and many regulations (such as cost-based interconnection or regulated access prices) take fixed-line performance for granted based on historical benchmarks. Regulation must, therefore, be modified to reflect reality. Such unexpected developments require that governments continually evaluate the impact of regulation and be prepared to revise their policy as necessary.

Regulators must evaluate the potential for changing regulation imposed on the incumbent over time. Most of the focus of initial reform is on the question of how long to protect the incumbent from competition in preparation for new entry; once entry has taken place, the question becomes how to impose asymmetric regulation on the incumbent to correct for its market power and hence level the playing field. As reform matures and the relative market power of incumbents declines relative to entrants, there is less need to impose significantly asymmetric regulation to correct for that market power. In many cases, this may mean eliminating regulations (such as price caps) where market forces may be adequate.

Governments and regulators need to assess if and when the emergence of new technologies and services require the extension of regulatory oversight. For example:

- As the mobile market grows and potentially exceeds the size of the fixed market, regulatory intervention in mobile, similar to that in fixed telephony, may grow with it. This development could come earlier in developing nations, where fixed networks are proportionally smaller. The size of mobile networks can, therefore, quickly reach or surpass that of fixed networks.

- Even when the total Internet penetration level seen in two countries is similar, differing quality of that penetration (i.e., narrowband vs. broadband) can mean that the countries advance at different rates. Figure 10 illustrates the significant differences among developed countries in regards to both total penetration and the quality of penetration. Governments need to look beyond pursuing overall Internet objectives and decide on which technology to focus. Including broadband access into universal service obligations, for example, could stimulate its penetration. Governments also need to ensure healthy infrastructure-based competition where there is sufficient market potential to enable competitive local entrants to survive economically. Where this is not the case, governments must impose strict targets on the incumbent operator.

Extending oversight may require modifications to the reform process. For example, in several Western European mobile markets where incumbent operators and new entrants maintain positions of significant market power, regulators have begun to investigate and determine the interconnection rates of these operators, on the pattern seen in fixed-line regulation of incumbents.

Increasing the quality of Internet penetration by promoting broadband technology means addressing a host of local loop and infrastructure-based regulatory issues. Such issues are typically not dealt with adequately in even the most developed markets (Beardsley and Enriquez 2001:13). In many markets this includes bringing cable operators into the regulatory scope. Interconnection also plays a role. For example, operators in Brazil are calling for “forced peering” by the regulator that would help them to achieve more favorable interconnection agreements for Internet access with the national long distance incumbent, which also controls the majority of Internet traffic. Fixed wireless access technologies are becoming economically more attractive and demand that the use of spectrum (that is, the frequency bands assigned to operators) be regulated. Key aspects of unbundling (which is an attempt to facilitate selective entry for access service competitors without replication of the incumbent’s existing infrastructure) must be addressed to ensure competition is economically viable for service line broadband access. (Unbundling requires local exchange companies to make the components of their service [such as the local loop, switching, operator assistance, and billing] independently available and separately priced features.) Although the success of this approach has been mixed (generally, entry has been harder and less attractive than hoped), it is a clear example of regulatory evolution. Given the substantial infrastructure investment required to develop broadband penetration deep into the market, regulators will face many critical issues in the coming years to fully unlock the potential of broadband.

Substantial value can be unlocked in developing and emerging countries with no, or recently started, reform

Sector reform could still unlock significant additional value in countries where reform has yet to take place. Sources of value are improved incumbent performance, increased levels of access, the choice, range, and quality of services offered, lower prices to customers, and increased activity in the economy as a whole. Although precise estimates of these welfare gains are beyond the scope of this document, a few simple approximations, such as incumbent value and increased sector revenues, show that launching reform represents an untapped potential of approximately US$180 to US$220 billion in value.

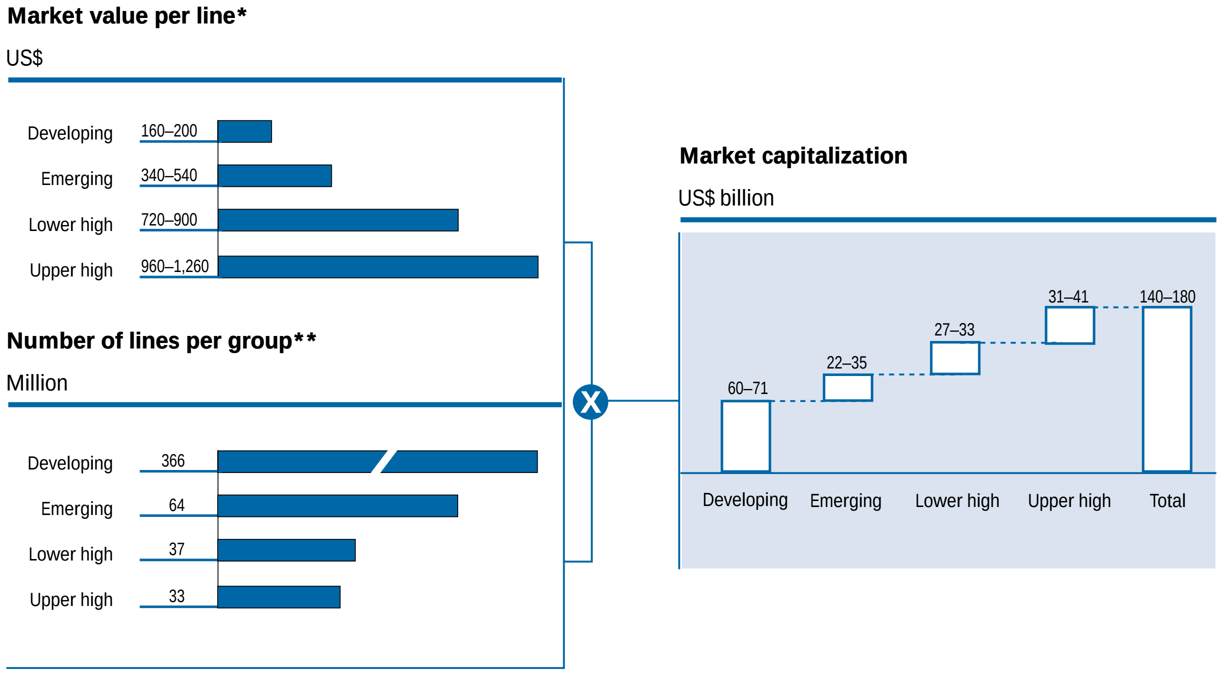
Of this value, US$140 to US$180 billion comes from additional market capitalization of incumbents from one hundred and fifteen countries that have not yet privatized their incumbent operator. (See Figure 11.)[10] This potential market capitalization is equivalent to 3 to 4 percent of those countries’ year 2000 real GDP. As can be observed, emerging and developing countries make up for approximately 60 percent of that total market value.

Introducing sector reform provides additional potential service revenues whose cumulative value between 2000 and 2005 is estimated at US$40 billion. (See Figure 12.) Based on the growth rate of telecommunications service revenues from 1996 to 1999, this document forecasts the base growth (i.e., growth that is not influenced by sector reform). In the previous chapter, “Telecommunications Sector Reform—A Prerequisite for Networked Readiness,” the growth premiums over this base rate for countries that either privatized or liberalized were determined.[11] As was shown in the previous chapter, privatization seems to have been more effective in developing countries (with a premium annual growth rate of 8.5 percent), whereas liberalization apparently has stimulated sector revenue growth more in emerging markets (annual growth premium of 1.5 percent). Applying these premiums to countries in the respective wealth categories that have not yet undergone reform leads to cumulative additional revenues of US$40 billion until the year 2005. The share of total revenues from all countries is relatively low because nonreformed countries represent approximately 10 to 15 percent of the total revenues of emerging and developing countries.[12]

If one includes countries where reform is in progress (such as China or India), the total impact of reform is even more significant. The estimated impact on revenues from countries that have already reformed is a cumulative US$64 billion from 2000 to 2005. This additional potential was calculated by applying

Figure 11: **Potential Market Capitalization of State Owned Incumbents**

Rough Estimate



*Range of weighted average values as of 29 December, 2000 and 31 August, 2001 for companies that are publicly traded

**Fixed and mobile lines, status end of 2000 of incumbents that have not yet gone public from 115 countries

Source: Bloomberg; Datastream; ITU; McKinsey

the growth premiums described in the previous paragraph to those countries where reform is in progress. To realize this potential, countries in which the reform process is underway must follow through with proper execution.

Governments need to evaluate how best to unlock this potential value; they must attract private money, ensure that a few basic elements are addressed, and provide a credible process through which sector reform may be executed.

Attracting private money from IPOs or strategic investors is key for emerging and developing countries. However, the current difficulties in financial markets are driving strategic investors to more carefully assess investment opportunities. This, combined with a reduced number of strong potential investors, means emerging and developing countries have to prove that they can offer investors a credible value-creation opportunity by preparing the telecommunications sector for sustainable growth. This is also true for countries that have begun privatization efforts and where governments want to sell part of or their entire stake in the incumbent. For example, India still wholly owns BSNL (the national nonmetro incumbent provider) and more than 50 percent of MTNL (the metro incumbent) and VSNL (the international service provider). Countries that do not carefully prepare the regulatory ground run the risk of being disappointed by the number of interested parties as well as by the amount of capital raised.

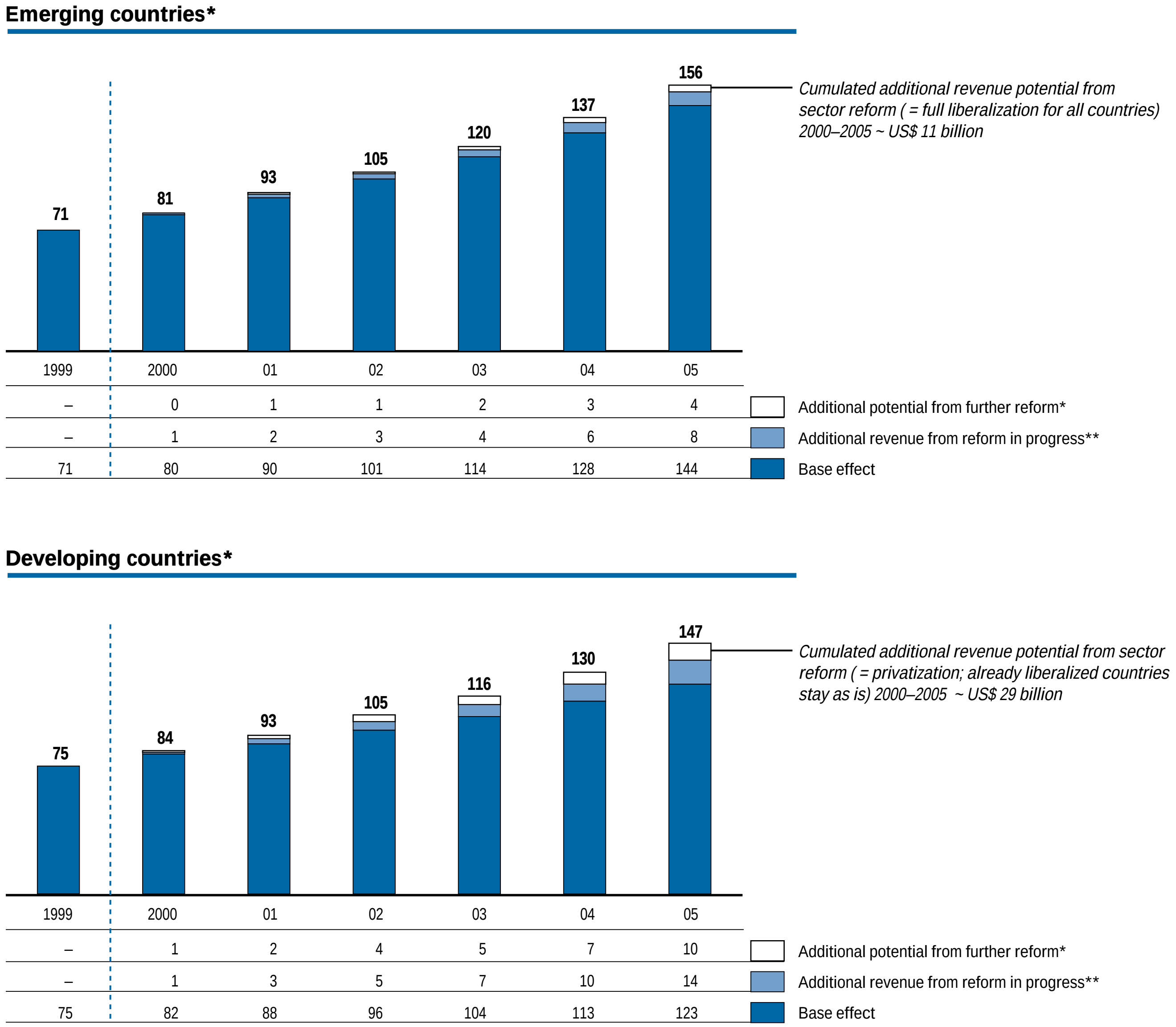
Even if the details of the reform process and the number of levers applied are country specific, a few basic elements appear to determine the overall market outcome and value distribution among major stakeholders, including the proceeds from privatization. Those elements are: industry structure, timing of liberalization, interconnection, and rebalancing.

- Industry structure. Licensing too many competitors can damage the profitability of the industry, prevent other targets from being met (such as privatization revenues or increased penetration), and potentially make entry unattractive. High licensing fees such as the US$130 billion collected in Europe's UMTS process[13] can transfer huge value from the shareholders to the government, and trigger industry-wide restructuring. At the other extreme, duopolies may have little or no effect on inducing competitive behavior on the incumbent (e.g., the U.K. from 1984 to 1989). As a result, regulators must understand the potential of the domestic market to support multiple competitors and define market structures that are consistent with that understanding.
- Timing. This is likely to be highly country-specific and will reflect multiple compromises between objectives and among stakeholders. Developing countries may postpone

Figure 12: **Telecommunications Revenue Potential from Sector Reform**

Rough Estimate

US$ billion



1999	2000	01	02	03	04	05	
–	0	1	1	2	3	4	☐ Additional potential from further reform*
–	1	2	3	4	6	8	▨ Additional revenue from reform in progress**
71	80	90	101	114	128	144	■ Base effect

1999	2000	01	02	03	04	05	
–	1	2	4	5	7	10	☐ Additional potential from further reform*
–	1	3	5	7	10	14	▨ Additional revenue from reform in progress**
75	82	88	96	104	113	123	■ Base effect

*Estimate and forecast based on countries with data available and extrapolations

**With respect to status 1999 as is

Source: ITU; McKinsey

market opening to both encourage network build-out and obtain a higher privatization price. It is common to allow the incumbent a period to prepare for competition (that is, an exclusivity period in which competitive entry into the most profitable markets is prevented). Timing decisions are also relevant when deciding which objectives to pursue in the course of the reform process.

- Interconnection. This is one of the most powerful tools that can be used to influence market structure and the evolution of competition, as the terms and conditions of interconnection directly influence both the entrant's economics and the speed at which regulators can launch effective nationwide competition to the incumbent. Because of the asymmetric market power between entrants and incumbents (entrants must gain access to the incumbent's network in order to reach customers), regulatory involvement is essential to ensure that entrants can compete.
- Rebalancing. Rebalancing of local tariffs is often the most significant value driver for an incumbent at the time of reform. Although political pressure often prevents govern-

ments from significantly increasing prices for local services, some rebalancing is generally required as part of reform. In addition, the regulatory flexibility to allow price increases for services outside a controlled service basket may allow for partial rebalancing.

Finally, governments need to install a credible process through which to execute reform. While reforming, they need to consider inputs from the industry, in particular at the outset. This would include realistic commitments to, and a process that seeks a balanced compromise among, stakeholders.

Implications for operators

Operators must focus on regulation and the reform process as a key driver of value, particularly in the early stages of reform. New entrants must evaluate the potential regulatory regime to determine if market entry is attractive, and if so, under what business model; incumbents must try to manage the regulator to ensure that their economic viability is not damaged as service prices change in response to competition. Typically, the importance of this is dramatically underestimated by the incumbent, and requires the incumbent to rapidly build a completely new organizational capability.

For fixed services, new entrants need to understand the likely evolution of industry structure. Central to defining this structure are the rules under which the incumbent will allow access to its infrastructure, and at what cost. Mobile services require an assessment of the impact of spectrum allocation, frequency blocks, and infrastructure build-out requirements.

Implications for operators in countries with a mature reform process

Successful management of the reform process demands that several critical elements be addressed. These elements apply, with varying levels of detail and urgency, generally to both incumbents and entrants.

First, operators must approach regulation as a strategic tool that can be deployed (albeit bluntly) to improve the competitive position of a business. Influencing the pace of reform going forward, by either accelerating attractive proposals or slowing down unattractive ones, must be a key focus of this approach. For example, the potential entry of regional local incumbents into the long distance market in the U.S. is a strategic issue for both local and long-distance incumbents. Entry by local companies is a key criterion for the incumbents for meeting several tests of openness in their local markets. Regulatory proceedings to determine such openness have been installed, with significant lobbying on each side. Although entry by local incumbents is probable in the future, timing can be a major value driver influencing the short run economics of the long haul business.

Second, operators must understand the details of regulatory regimes. For example, requiring DT to offer double tandem origination to competitors enabled a new entrant with limited infrastructure in only one part of Germany to reach the entire country through DT's network. Operators need to anticipate possible regulatory evolution and prepare fact-based arguments to support their position on key issues.

Third, operators must evaluate the economic trade-offs of regulatory levers and prioritize the highest value levers. Operators, but entrants in particular, need to understand how different regulatory regimes could influence the business for investments and new technologies (e.g., the impact of a universal service obligation for broadband access as opposed to market forces determining the penetration in a country). Facility-based entrants in Germany did not appear to have short-term advantages over resellers when the German market was liberalized in 1998. The ability to broadly use DT's network to carry traffic placed more importance on marketing and capturing customers than on deploying a large national network. Equally, regulation on issues such as unbundling or basic cable television prices will have a critical impact on the ability of attackers to develop an economically viable business model.

Finally, operators must continually manage the regulatory process and understand the political levers that can influence it. Regulation will remain a major determinant of value and rent sharing in the foreseeable future, not just in areas already covered by reform but also in areas where regulatory oversight is expanding (such as mobile telephony and local access). Therefore, understanding how to influence the process and proactively manage regulatory reform will be a key component of value creation in all business segments (fixed line, mobile, data, and Internet, to name the most important). This will also involve the education and analytical support of the regulatory staff.

Developing and emerging countries with no, or recently started, reform

In addition to the issues discussed above, operators in countries gearing up for reform must focus on several additional elements. For incumbents in particular, these elements are central in supporting the transition from a state-owned quasi-public service company to a competitive market player able to meet customer and competitor challenges. The elements are as follows:

- Focus on the critical levers to support the operator's economics, particularly rebalancing and interconnection. While this is similar to prioritizing levers in countries already reformed, it is critical to ensure that a few key levers are set correctly. Incumbents generally face competition when there is a distorted tariff structure characterized by multiple cross-subsidies (e.g., long-distance to local, business to residential). Competitive entry is likely to eliminate the ability to cross-subsidize, potentially damaging the viability of the operator. Among several levers, entrants entering into fixed long-distance markets must focus on interconnection, including long-distance access conditions, as they are critical to creating a viable business model.

- Develop a competitive cost base. At the time of liberalization, incumbents are likely to face two major cost issues: stranded investments due to past capital expenditure that will likely have no economic value in a competitive market, and inefficient levels of staffing in the organization. They need to prepare and execute major organizational transformation programs to address these issues.
- Reevaluate investment programs and appraisal processes. Incumbent investment decisions prior to reform often follow social or governmental objectives. Much of this investment is unlikely to be economically attractive. As this represents a potentially significant drain on its cash position, an incumbent operator must reevaluate its existing investment programs and impose financial or market criteria to evaluate additional investments.
- Reorganize for competition. Opening a market for competition results in challenges for the incumbent. It must transform itself from a quasi-government institution into a customer-responsive business. A first step towards this involves reorganizing the incumbent in order to align incentives and to create business units that are better able to identify and respond to market needs.
- Develop regulatory organization capability. Most operators undergoing sector reform have little or no regulatory capability within the organization, because these are not important under a complete monopoly. During sector reform these capabilities are absolutely vital and must be built quickly and effectively. Many attackers fully recognize that regulation is the single most important value lever. Therefore, they try to catch the incumbent off-guard by employing world-class expertise familiar with sector reform elsewhere. Incumbent operators will be required to build a world-class regulatory organization capable of developing and executing the regulatory agenda at hand.

Implications for equipment providers

The potential value for equipment providers influenced by sector reform could translate into a minimum of US$200 to US$250 billion in cumulative equipment sales between 2001 and 2004. This number is derived from market forecasts for worldwide cumulative equipment revenues of US$2.4 trillion between 2001 and 2004 (Gartner 2001). If one applies the 8 to 10 percent share of total telecommunications service revenues influenced by sector reform, one can establish US$200 to US$250 billion as an approximation for the share of equipment revenues influenced by sector reform. Taking into account the fact that telecommunications service revenues include price decreases and that the underlying increase in traffic volumes (which ultimately determines how many pieces of equipment need to be installed) is higher than the increase in revenues, the final figure should be closer to the lower range of equipment revenues that are influenced by sector reform.

To ensure they realize the full revenue potential, equipment providers should become more actively involved in the reform process. Because the nature of their business is based disproportionately on new sales rather than on replacements, they have a strong interest in promoting further advancement of the telecommunications sector. This holds true at any level of development. Such advancement is always a combination of technology innovation and the need for growth (i.e., network expansion). Both are influenced by sector reform, and equipment providers need to actively manage the adoption and execution of objectives.

Regulatory policies ultimately have a large influence on equipment providers' revenues. Worldwide equipment sales are moving in tandem with the evolution of two key metrics of the state of the telecommunications sector: teledensity and Internet penetration. Equipment providers have a strong interest in encouraging reform to the extent that sector reform catalyzes increases in these two metrics and broadens diversity and choice of telecommunications services.

Equipment providers also need to understand how sector reform affects the telecommunications industry structure and the economics of their customers (i.e., incumbents and new entrants). For example, the capital constraints from the auctioning process for UMTS licenses in Germany and the U.K. have forced many operators, in particular incumbents, to reduce capital spending. The decision by Germany and the U.K. to allow UMTS licensees to share infrastructure means equipment providers' revenues will be reduced. Equipment vendors need to promulgate their positions with regulatory policymakers, and provide fact-based arguments.

Following from the previous paragraph, equipment providers also need to carefully assess where and when to provide vendor financing. Several equipment providers have found themselves in trouble because they provided extensive financing to new entrants. While the validity of business plans depends mainly on the skills and assets of the company, it is to a large extent influenced by the regulatory policy in a country. Understanding the impact of regulation therefore can provide valuable insights, and help in assessing a business case.

Developed countries and countries with a mature reform process

Where the total market potential of a country is sufficiently large, equipment providers should promote competition, since it ultimately increases provider revenues. They should also stimulate migration to new technologies. To this extent, a country pursuing Networked Readiness as an objective will require its operators to provide the necessary infrastructure, which results in new sales for equipment providers.

Players in the industry should support the move of developed countries towards advanced infrastructure, such as broadband. Equipment providers drive technological development and thus influence to a large extent the advancement of the telecommunications industry. To promote these advancements with regulators, providers need to think of innovative ways to stimulate adoption, for example, by sponsoring a study on how to promote Networked Readiness further in the EU. They also need to consider the overall economics of the value chain, and develop new revenue and cost-sharing models (e.g., creative vendor financing models) in order to develop infrastructure for a viable ecosystem. In addition, providers need to think through the regulatory implications of technological advancements so that they are better able to discuss the possible impact.

Developing and emerging countries with no, or recently started, reform

Although the underlying dynamics are the same, the challenge for equipment providers in these countries is to unlock value by promoting reform to encourage potential infrastructure investments. This requires that they carefully balance their interests between high initial sales, thus favoring liberalization, and medium- to long-term economic sustainability of a telecommunications market. This may be achieved by delaying competition. Deciding which approach to suggest to a government depends on an understanding of the economics of the respective market.

To stimulate reform in developing and emerging countries, equipment providers should think of providing incentives to governments. For example, they could introduce a vendor financing approach to governments that would allow for an initial support of universal service objectives; this would be repaid in the form of equipment sales during the course of the process.

Conclusion

Sector reform is the single most important lever determining the value of a country's telecommunications industry and the distribution of that value among the key stakeholders. The complexity of the regulatory process requires a careful assessment of the potential market outcomes of sector reform. It is therefore mandatory that stakeholders understand the importance of sector reform and the details of regulatory policy.

Ultimately, the economic viability of a country's telecommunications sector needs to be guaranteed—implicitly or explicitly—through policy and sector reform choices. Where the economic viability of a specific segment or product is not guaranteed (such as in rural areas), experience has shown that the market will not develop it unless an incentive is provided. Governments and regulators need to carefully assess which regulatory elements are the most critical in order to provide the right incentives, and thereby focus in particular on industry structure, interconnection, and pricing. Operators have to rethink their approach towards regulatory management, as this is the most important strategic tool. The regulatory department is typically not given enough attention and power and often is understaffed in countries that are initiating their process. Only over time is the importance of regulatory policy adequately recognized. During this initial period, however, much of a company's value can be destroyed. Equipment providers need to become proactively involved in the regulatory process; they need to understand how to best promote sustained infrastructure-based industry growth. This approach may require a tradeoff between high short-term sales and lower initial sales, but will lead to a solid medium- to long-term growth perspective.

All these assessments must be made based on the specific situation of a country, with much emphasis on the market potential. Pursuing consumer benefits (i.e., distributing value to consumers at the expense of service providers) is generally more effective the higher a country's economic wealth. For example, free local calls in the U.S. caused a tremendous shift of economic value to consumers. This was possible, however, because proceeds from long-distance services cross-subsidized this offering. In emerging and developing markets, these subsidies are usually not available.

References

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Endnotes

1 Full liberalization is defined as the introduction of one or more competitors for either fixed local or national long-distance service. What determines the time period is the dates at which the regulatory policy allowed for the entry of competition, not the date when entry really occurred. (In most cases, however, there has been no, or only a small, time difference between the two.)

2 Even if UMTS (Universal Mobile Telecommunications System) will most probably not provide the speeds promised initially for the years to come, a transmission rate of 64 kbps for mobile telephones, which is equivalent to the speed of a dial-up modem access, could be powerful enough to increase residential Internet use, provided it is economically viable in developing countries.

3 In developed countries, in many cases, investors have been local (especially for the incumbent operator); in emerging and developing countries, investment almost always is synonymous with foreign investment (due to the lack of domestic resources and skills).

4 With the exception of rural areas, these compensations are being phased out.

5 The "x" describes the productivity factor, which is based on an estimate of an operator's expected productivity increase over the duration of the price cap regime. In its simplest form, a price cap formula allows an operator to increase its retail prices for a given service or a basket of services annually by an amount equal to an inflation measure less the assumed productivity increase.

6 A mobile virtual network operator (MVNO) is an organization that offers mobile services to customers by possessing its own mobile network code, issuing its own SIM (subscriber identity module) card, and operating its own mobile switching center (including home location register), but uses the network of another operator at a wholesale price.

7 The term "tandem" refers to switches, circuits, or other network elements that allow other network elements to work together (e.g., a tandem switch interconnects central offices, but usually no end users directly). Double tandem call origination allows competitive operators to provide national service by connecting to a single switch in the area of the incumbent. Competitors can, therefore, provide services without the need to invest in extensive infrastructure.

8 This document applies a typology to distinguish countries that is based on economic wealth, thereby using their real GDP per capita as of 2000. Categories used are (GDP per capita): developed countries (above US$10,000), emerging countries (US$3,001 to US$10,000), and developing countries (below US$3,000). Developed countries are separated into upper high income countries (above US$20,000) and lower high income countries (US$10,001 to US$20,000). See also the previous chapter in this book, "Telecommunications Sector Reform—A Prerequisite for Networked Readiness."

9 This works well for Internet access via dial-up connections or high-speed private lines (which may be most relevant for emerging and developing countries). If infrastructure needs to be shared (in the case of DSL or cable modem access) the correct public policy is more difficult.

10 This excludes sixty smaller countries and islands for which no GDP data is available.

11 This chapter distinguishes three patterns related to telecommunications sector reform: no reform, privatization only (without introducing competition), and liberalization, i.e., the introduction of competition. The categories are based on fixed telephony, because in most markets mobile competition has been present for a longer period of time.

12 Countries such as China and India, for example, are considered to have already initiated sector reform because there is competition in these countries.

13 Countries include the EU member states with the exception of Greece, Ireland, and Luxemburg, where the licensing process is pending.

Country Profiles

Country Profiles

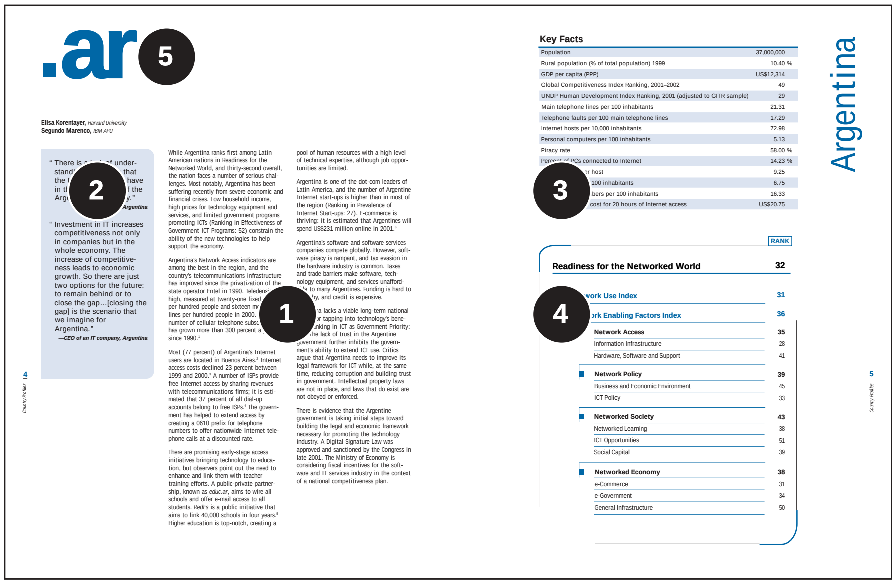
Country Profiles

How Country Profiles Work

This section presents a two-page Networked Readiness profile with selected data for each country included in the *Global Information Technology Report 2001-2002*.

To increase the relevance and level of insight in each profile, researchers at the Center for International Development at Harvard University identified (in most cases) in-country experts to serve as coauthors or reviewers. Collaborators come from different sectors and backgrounds, but are united by their profound understanding of the Networked Readiness landscape in their respective countries. Reviewers are distinguished from coauthors by the “with” designation before their names. The country profiles describe the Networked Readiness situation as of the fall of 2001. Obviously, the situation in some countries will have changed only somewhat by our January 2002 press date, but in others (such as Argentina, in which the results of recent political and economic turmoil are yet to be determined), it may change dramatically.

In such short profiles, we do not pretend to have discussed every issue related to Networked Readiness—we have highlighted those elements that have seemed most relevant and noteworthy in each case, and sought to contextualize information and communication technology (ICT) initiatives and challenges within other national goals and interests. In particular, we have emphasized the use of ICTs to address social and economic development goals within each country. Our coauthors and reviewers were invaluable in ensuring accuracy, helping to identify the most important subnational trends and important issues, and in achieving a balanced discussion of both opportunities and challenges for each country.



.ar ⑤

Elisa Korentayer, *Harvard University*
Segundo Marenco, *IBM APU*

> “There is a [illegible] of under-standi [illegible] that the I [illegible] have in th [illegible] f the Arg [illegible] y.”
> [illegible] ***Argentina***
>
> “Investment in IT increases competitiveness not only in companies but in the whole economy. The increase of competitiveness leads to economic growth. So there are just two options for the future: to remain behind or to close the gap…[closing the gap] is the scenario that we imagine for Argentina.”
> ***—CEO of an IT company, Argentina***

②

While Argentina ranks first among Latin American nations in Readiness for the Networked World, and thirty-second overall, the nation faces a number of serious challenges. Most notably, Argentina has been suffering recently from severe economic and financial crises. Low household income, high prices for technology equipment and services, and limited government programs promoting ICTs (Ranking in Effectiveness of Government ICT Programs: 52) constrain the ability of the new technologies to help support the economy.

Argentina's Network Access indicators are among the best in the region, and the country's telecommunications infrastructure has improved since the privatization of the state operator Entel in 1990. Teledensi [illegible] high, measured at twenty-one fixed [illegible] per hundred people and sixteen mo [illegible] lines per hundred people in 2000. [illegible] number of cellular telephone subsc [illegible] has grown more than 300 percent a [illegible] since 1990.[1]

①

Most (77 percent) of Argentina's Internet users are located in Buenos Aires.[2] Internet access costs declined 23 percent between 1999 and 2000.[3] A number of ISPs provide free Internet access by sharing revenues with telecommunications firms; it is estimated that 37 percent of all dial-up accounts belong to free ISPs.[4] The government has helped to extend access by creating a 0610 prefix for telephone numbers to offer nationwide Internet telephone calls at a discounted rate.

There are promising early-stage access initiatives bringing technology to education, but observers point out the need to enhance and link them with teacher training efforts. A public-private partnership, known as *educ.ar*, aims to wire all schools and offer e-mail access to all students. *RedEs* is a public initiative that aims to link 40,000 schools in four years.[5] Higher education is top-notch, creating a pool of human resources with a high level of technical expertise, although job opportunities are limited.

Argentina is one of the dot-com leaders of Latin America, and the number of Argentine Internet start-ups is higher than in most of the region (Ranking in Prevalence of Internet Start-ups: 27). E-commerce is thriving: it is estimated that Argentines will spend US$231 million online in 2001.[6]

Argentina's software and software services companies compete globally. However, software piracy is rampant, and tax evasion in the hardware industry is common. Taxes and trade barriers make software, technology equipment, and services unafford- [illegible] le to many Argentines. Funding is hard to [illegible] by, and credit is expensive.

[illegible] na lacks a viable long-term national [illegible] r tapping into technology's bene- [illegible] nking in ICT as Government Priority: [illegible] The lack of trust in the Argentine government further inhibits the government's ability to extend ICT use. Critics argue that Argentina needs to improve its legal framework for ICT while, at the same time, reducing corruption and building trust in government. Intellectual property laws are not in place, and laws that do exist are not obeyed or enforced.

There is evidence that the Argentine government is taking initial steps toward building the legal and economic framework necessary for promoting the technology industry. A Digital Signature Law was approved and sanctioned by the Congress in late 2001. The Ministry of Economy is considering fiscal incentives for the software and IT services industry in the context of a national competitiveness plan.

4 | *Country Profiles*

Key Facts

Population	37,000,000
Rural population (% of total population) 1999	10.40 %
GDP per capita (PPP)	US$12,314
Global Competitiveness Index Ranking, 2001–2002	49
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	29
Main telephone lines per 100 inhabitants	21.31
Telephone faults per 100 main telephone lines	17.29
Internet hosts per 10,000 inhabitants	72.98
Personal computers per 100 inhabitants	5.13
Piracy rate	58.00 %
Percent of PCs connected to Internet	14.23 %
[illegible] er host	9.25
[illegible] 100 inhabitants	6.75
[illegible] bers per 100 inhabitants	16.33
[illegible] cost for 20 hours of Internet access	US$20.75

③

Argentina

	RANK
Readiness for the Networked World	**32**
[illegible] work Use Index	31
[illegible] rk Enabling Factors Index	36
Network Access	**35**
Information Infrastructure	28
Hardware, Software and Support	41
Network Policy	**39**
Business and Economic Environment	45
ICT Policy	33
Networked Society	**43**
Networked Learning	38
ICT Opportunities	51
Social Capital	39
Networked Economy	**38**
e-Commerce	31
e-Government	34
General Infrastructure	50

④

5 | *Country Profiles*

① The central component of each profile consists of an executive summary of the country's Networked Readiness situation. Each Readiness snapshot highlights the major trends and events within the country, and makes reference to particularly important elements from the Networked Readiness Index and its subindexes and micro-indexes.

② Each profile presents two quotations by national ICT and business and policy leaders that lend insight into a country's national Networked Readiness situation. These quotations in most cases were gathered using our Global Information Technology Survey, which was distributed to several thousand ICT leaders around the world in the summer of 2001.

③ The Country Profiles section includes key facts and results for each country that either relate directly to Networked Readiness or help place the discussion in a broader social and economic development context. These facts include GDP per capita, total population, and a country's ranking on both the Growth Competitiveness Index, developed jointly by the CID and the World Economic Forum, and the Human Development Index of the United Nations Development Programme. It is important to note that not all of the listed key facts were considered in the calculation of the Networked Readiness Index and rankings.

④ We include in the profile the country's ranking within the Networked Readiness Index, the component indexes (Network Use and Enabling Factors), the subindexes, and the micro-indexes. The rankings are organized by index, subindex, and micro-index name.

⑤ In keeping with the development of the Networked Readiness identity of each country, we also have included the top-level country code Internet domain for each country.

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Elisa Korentayer, *Harvard University*
Segundo Marenco, *IBM APU*

> “ There is a lack of understanding of the role that the IT industry could have in the development of the Argentinean economy.”
>
> ***—IT executive, Argentina***

> “ Investment in IT increases competitiveness not only in companies but also in the whole economy. The increase of competitiveness leads to economic growth. So there are just two options for the future: to remain behind or to close the gap...[closing the gap] is the scenario that we imagine for Argentina.”
>
> ***—CEO of an IT company, Argentina***

While Argentina ranks first among Latin American nations in Readiness for the Networked World, and thirty-second overall, the nation faces a number of serious challenges. Most notably, Argentina has been suffering recently from severe economic and financial crises. Low household income, high prices for technology equipment and services, and limited government programs promoting ICTs (Ranking in Effectiveness of Government ICT Programs: 52) constrain the ability of the new technologies to help support the economy.

Argentina’s Network Access indicators are among the best in the region, and the country’s telecommunications infrastructure has improved since the privatization of the state operator Entel in 1990. Teledensity is high, measured at twenty-one fixed lines per hundred people and sixteen mobile lines per hundred people in 2000. The number of cellular telephone subscribers has grown more than 300 percent a year since 1990.[1]

Most (77 percent) of Argentina’s Internet users are located in Buenos Aires.[2] Internet access costs declined 23 percent between 1999 and 2000.[3] A number of ISPs provide free Internet access by sharing revenues with telecommunications firms; it is estimated that 37 percent of all dial-up accounts belong to free ISPs.[4] The government has helped to extend access by creating a 0610 prefix for telephone numbers to offer nationwide Internet telephone calls at a discounted rate.

There are promising early-stage access initiatives bringing technology to education, but observers point out the need to enhance and link them with teacher training efforts. A public-private partnership, known as *educ.ar*, aims to wire all schools and offer e-mail access to all students. *RedEs* is a public initiative that aims to link 40,000 schools in four years.[5] Higher education is top-notch, creating a pool of human resources with a high level of technical expertise, although job opportunities are limited.

Argentina is one of the dot-com leaders of Latin America, and the number of Argentine Internet start-ups is higher than in most of the region (Ranking in Prevalence of Internet Start-ups: 27). E-commerce is thriving: it is estimated that Argentines will spend US$231 million online in 2001.[6]

Argentina’s software and software services companies compete globally. However, software piracy is rampant, and tax evasion in the hardware industry is common. Taxes and trade barriers make software, technology equipment, and services unaffordable to many Argentines. Funding is hard to come by, and credit is expensive.

Argentina lacks a viable long-term national vision for tapping into technology’s benefits (Ranking in ICT as Government Priority: 54). The lack of trust in the Argentine government further inhibits the government’s ability to extend ICT use. Critics argue that Argentina needs to improve its legal framework for ICT while, at the same time, reducing corruption and building trust in government. Intellectual property laws are not in place, and laws that do exist are not obeyed or enforced.

There is evidence that the Argentine government is taking initial steps toward building the legal and economic framework necessary for promoting the technology industry. A Digital Signature Law was approved and sanctioned by the Congress in late 2001. The Ministry of Economy is considering fiscal incentives for the software and IT services industry in the context of a national competitiveness plan.

Argentina

Key Facts

Population	37,000,000
Rural population (% of total population) 1999	10.40 %
GDP per capita (PPP)	US$12,314
Global Competitiveness Index Ranking, 2001–2002	49
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	29
Main telephone lines per 100 inhabitants	21.31
Telephone faults per 100 main telephone lines	17.29
Internet hosts per 10,000 inhabitants	72.98
Personal computers per 100 inhabitants	5.13
Piracy rate	58.00 %
Percent of PCs connected to Internet	14.23 %
Internet users per host	9.25
Internet users per 100 inhabitants	6.75
Cell phone subscribers per 100 inhabitants	16.33
Average monthly cost for 20 hours of Internet access	US$20.75

	RANK
Networked Readiness Index	**32**
Network Use component index	**31**
Enabling Factors component index	**36**
■ **Network Access**	**35**
Information Infrastructure	28
Hardware, Software, and Support	41
■ **Network Policy**	**39**
Business and Economic Environment	45
ICT Policy	33
■ **Networked Society**	**43**
Networked Learning	38
ICT Opportunities	51
Social Capital	39
■ **Networked Economy**	**38**
e-Commerce	31
e-Government	34
General Infrastructure	50

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Indran Ratnathicam, *Harvard University*
with **Howard Quenault,** *CMT Computer Management Techniques Pty., Ltd.*

> “ There has been a good strategic approach in Australia to date towards ICTs in education, access and business support, though we’re just starting to get going.”
>
> ***—Australian IT consultant***

> “ Our small, geographically dispersed market has been an obstacle in the private-side growth of the Internet.”
>
> ***—Australian IT lawyer***

The Australian national ICT strategy, under the stewardship of the National Office for the Information Economy (NOIE), is designed to introduce Australia as a competitive, Networked Economy. In its implementation, the NOIE is taking a multi-pronged approach, mixing government-led projects, industry initiatives, and funding and support for private projects with policy recommendations to the central government. Australia ranks fourteenth overall in Readiness for the Networked World.

Equal access was the number one priority in the 1998 NOIE ICT Strategy document. Gaps in Australian Internet access exist along both economic and geographical lines. Australians earning more than US$25,000 annually were more than twice as likely to have Internet access in November 2000 as those under that income level. Similarly, metropolitan citizens were one-third more likely to have access than their rural counterparts.[1]

NOIE has directed a broad set of initiatives ranging from funding infrastructure to policy review. One aspect of the program has been to provide funding for projects to increase community access. Some examples include Internet cafés, telecenters, and public venue kiosks. In addition to funding, the Digital Data Service Obligation legally guarantees digital services on an equal and reasonable basis in all supported geographies, helping Internet services reach all Australians (Ranking in Public Access to the Internet: 11).

At the elementary and secondary school levels, Australia ranks among the highest in use of Internet in schools. Nearly 100 percent of schools are connected to the Internet (Ranking in Internet Access in Schools: 8). The advanced ICT workforce is a product of high-quality, globally competitive training facilities found nationwide (Ranking in Quality of IT Education: 18). To date, lack of access to high-speed Internet and cutting-edge content has limited university-level innovation and ICT research capabilities.

Privatization of Telstra, the nation’s largest telecommunications operator, began in 1997. Some political forces have pushed for complete privatization of the company, but critics feel more comfortable with government control because of the company’s soaring profits, lack of competition, and continued monopoly power in most markets. A Universal Service Obligation (USO), in effect since 1999, mandates that Telstra or any terrestrial provider must provide standard telephone service and payphone facilities in all geographic areas on a reasonable and equitable basis (Ranking in Effect of Telecommunications Competition: 21).

Another aspect of the NOIE strategy has been the movement of government services online, primarily through outsourcing projects to Australian ICT businesses (Ranking in Online Government Services: 14). Although there have been some complaints that the bidding process is too costly to allow smaller companies to compete for the jobs, the initiative has received accolades for using government purchasing power to fuel industry growth.

In spite of global slowing of growth in ICT investment, Australia appears poised to begin its B2B e-commerce revolution. The market for B2B e-commerce transactions is expected to grow from US$3 billion in 2000 to US$39 billion in 2004[2] (Ranking in e-Commerce micro-index: 18). Small and medium enterprises are also becoming more sophisticated online and Networked Ready, and they are expected to outsource many ICT services and applications. Thirty percent are expected to outsource at least one-fourth of their operations by 2005.[3]

Australia

Key Facts

Population	19,200,000
Rural population (% of total population) 1999	15.30 %
GDP per capita (PPP)	US$25,758
Global Competitiveness Index Ranking, 2001–2002	5
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	2
Main telephone lines per 100 inhabitants	52.40
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	843.52
Personal computers per 100 inhabitants	46.46
Piracy rate	33.00 %
Percent of PCs connected to Internet	18.16 %
Internet users per host	5.21
Internet users per 100 inhabitants	43.95
Cell phone subscribers per 100 inhabitants	44.63
Average monthly cost for 20 hours of Internet access	US$18.85

	RANK
Networked Readiness Index	**14**
Network Use component index	**13**
Enabling Factors component index	**16**
Network Access	**14**
Information Infrastructure	20
Hardware, Software, and Support	8
Network Policy	**13**
Business and Economic Environment	13
ICT Policy	13
Networked Society	**20**
Networked Learning	11
ICT Opportunities	32
Social Capital	18
Networked Economy	**17**
e-Commerce	18
e-Government	15
General Infrastructure	19

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Magda Ismail, *Harvard University*
Mridul Chowdhury, *Harvard University*
Rudolf Lichtmannegger, *Austrian Economic Chamber*

> “ The Internet has offered a great source of efficiency and has promoted new kinds of services in Austria’s travel industry.”
>
> ***—Austrian business analyst***

> “ The total bandwidth of the international backbones is too small.”
>
> ***—Manager of Austrian ISP***

Austria’s overall ranking of ninth in the Index of Readiness for the Networked World is a good indicator of the country’s transition from dependence on tourism and more traditional industries to greater reliance on ICTs and the high-tech sector. The Austrian ICT industry is becoming an increasingly important component of the country’s economy.

One of the main drivers of Austria’s accelerated Networked Readiness has been the growth of its mobile telephony market, which boasts one of the highest rates of mobile penetration in the world, a result of an effective regulatory environment and fierce competition (Ranking in Effect of Telecommunications Competition: 7). However, liberalization efforts have not been as successful in the fixed telephony market, where the former monopoly provider, Telekom Austria, continues to dominate the numerous smaller providers that have emerged since market liberalization took place in 1998.

E-commerce is developing gradually in Austria, with large enterprises taking the lead (Ranking in e-Commerce micro-index: 20). However, B2B e-commerce on a national level is still at a relatively nascent stage. Although a vast majority of enterprises have access to the Internet, most are unwilling to use it for sophisticated business purposes. The promising sectors in Austrian B2C e-commerce have been online travel services, media, and trading. Prospects for more rapid growth of e-commerce are stifled by relatively high telephone costs and subscription fees and concerns over online security.

With high mobile penetration and booming use of Short Messaging Service (SMS), coupled with relatively low PC and PC-based Internet penetration, many observers feel that opportunities for mobile e-commerce are ripe in Austria. WAP-enabled phones are becoming increasingly available, although inadequate content and security concerns are credited with slowing overall demand. Six third-generation (3G) UMTS cellular telephony licenses were awarded in 2000, and there was noticeable disappointment within the Austrian government that total revenue from the auction was significantly less than that raised in nations such as Britain and Germany, where 3G licenses were sold at exorbitant prices.[1]

Several initiatives, such as *@21* and the *Osterreich Digital Initiative*, are public-private partnerships that are leading the nation in Networked Readiness.[2] The Austrian government has also developed several e-government initiatives (Ranking in e-Government micro-index: 14), implementation of which is challenged by the highly decentralized government structure and inadequate coordination among national agencies. One of the main platforms for online government services, at <http://help.gv.at>, gives information on basic services and provides access to some legal systems and databases (Ranking in Online Government Services: 17). With enforcement of an electronic signature law already in place, the government plans to create an electronic identity card for government-citizen interaction.

Compared to its neighbors, Austria has a fairly large rural population (35 percent of the country’s total populace), a situation that has made universal access and use of rural telecommunications services a high government priority. The Internet portal of the Agricultural Department[3] and *Netvillage*[4] are two major initiatives to promote the use of ICTs in rural areas (Ranking in Public Access to the Internet: 19). Austrian schools are generally well-equipped with PCs and LANs and most have access to the Internet.

Austria

Key Facts

Population	8,211,000
Rural population (% of total population) 1999	35.38 %
GDP per capita (PPP)	US$26,314
Global Competitiveness Index Ranking, 2001–2002	18
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	14
Main telephone lines per 100 inhabitants	47.36
Telephone faults per 100 main telephone lines	6.27
Internet hosts per 10,000 inhabitants	588.49
Personal computers per 100 inhabitants	27.65
Piracy rate	37.00 %
Percent of PCs connected to Internet	21.29 %
Internet users per host	4.35
Internet users per 100 inhabitants	25.58
Cell phone subscribers per 100 inhabitants	78.55
Average monthly cost for 20 hours of Internet access	US$16.30

	RANK
Networked Readiness Index	**9**
Network Use component index	**11**
Enabling Factors component index	**13**
Network Access	**17**
Information Infrastructure	13
Hardware, Software, and Support	20
Network Policy	**13**
Business and Economic Environment	17
ICT Policy	8
Networked Society	**9**
Networked Learning	12
ICT Opportunities	8
Social Capital	6
Networked Economy	**16**
e-Commerce	20
e-Government	14
General Infrastructure	15

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Mridul Chowdhury, *Harvard University*
with **Dr. Ananya Raihan,** *Center for Policy Dialogue*

> “ The performance of our university students in international programming contests clearly indicates that Bangladesh has world-class IT skills.”
>
> ***—Computer science professor, Bangladesh***

> “ There is very little cooperation between the government and the private sector in formulating national IT strategies. It seems that we are always having to fight to get the government’s attention.”
>
> ***—Executive of Bangladeshi IT company***

In Bangladesh, Networked Readiness, like overall social and economic development, is hampered by massive overpopulation, a low literacy rate, and frequent natural disasters. But the nation is making progress on these fronts with improved disaster prediction and management systems, reduced population growth, less dependence on foreign aid, and increased export revenues. The primary bottleneck continues to be rampant bickering among political parties. The nation ranks seventy-third in overall Networked Readiness.

Bangladesh is taking initial steps toward exporting software, and is widely acclaimed for its pioneering efforts to take communication technologies to the poor. GrameenPhone is the best-known example, with its venture to introduce cellular payphones in villages. The government is particularly hopeful about the prospects of an ICT industry to help diversify the economy and reduce its dependence on garment export, which currently represents the bulk of export revenues. However, substantial challenges remain to be overcome before optimism is translated into concrete results.

Two of the most ubiquitous hindrances to ICT development in Bangladesh are the nation’s largely inadequate telecommunications infrastructure and a lack of effective telecommunications regulation (Ranking in Effect of Telecommunications Competition: 67). Telephones are scarce, expensive, and highly concentrated in affluent sections of urban areas. As a consequence, there has been rapid growth in the mobile telephony market, with many business institutions owning more mobile telephones than fixed-line telephones. The Internet is also becoming more popular, but it is affordable to only a small urban section of the population. Although the government has recently taken some positive steps, such as deregulation of VSAT, the absence of an independent telecommunications regulator largely contributes to Bangladesh’s having some of the highest telecommunications costs in Asia.

There are signs of increasing activity in the ICT sector. More than 200 software companies have sprouted up over the last four years, relying on cheap labor, basic English-language skills, and favorable support from the government in terms of tax relief and financing options. A majority of the companies are small, with fewer than 15 employees, and some of the bigger ones are engaged in limited software export, but the total amount is still negligible by international standards.

One of the most immediate barriers to software development is the lack of availability and low quality of ICT education. Nationally, fewer than 2,000 computer science/computer engineering students graduate annually.[1] Although all universities have introduced computer science departments, most are in dire need of qualified teachers, a consequence of the massive brain drain of ICT skilled personnel (Ranking in IT Brain Drain: 74). The exploding demand for ICT education is being satisfied by mushrooming growth in the number of ICT training centers, a majority of which have little quality control (Ranking in Quality of IT Education: 73).

In the emphasis on software export in the national ICT agenda, the potential of ICT in the domestic market has had little attention. As a result, the development of e-commerce and e-government in Bangladesh has been quite limited. B2B e-commerce is almost nonexistent, while many B2C e-commerce sites are mostly targeted toward expatriate Bangladeshis. A few government institutions are quite progressive in the use of ICT, but no concerted effort toward e-government exists yet.

Bangladesh

Key Facts

Population	137,000,000
Rural population (% of total population) 1999	76.04 %
GDP per capita (PPP)	US$1,561
Global Competitiveness Index Ranking, 2001–2002	71
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	73
Main telephone lines per 100 inhabitants	0.34
Telephone faults per 100 main telephone lines	17.32
Internet hosts per 10,000 inhabitants	0.25
Personal computers per 100 inhabitants	0.09
Piracy rate	NA
Percent of PCs connected to Internet	2.31 %
Internet users per host	16.67
Internet users per 100 inhabitants	0.04
Cell phone subscribers per 100 inhabitants	0.14
Average monthly cost for 20 hours of Internet access	US$25.46

	RANK
Networked Readiness Index	**73**
Network Use component index	**71**
Enabling Factors component index	**75**
■ **Network Access**	**73**
Information Infrastructure	72
Hardware, Software, and Support	74
■ **Network Policy**	**75**
Business and Economic Environment	75
ICT Policy	75
■ **Networked Society**	**74**
Networked Learning	73
ICT Opportunities	75
Social Capital	75
■ **Networked Economy**	**72**
e-Commerce	69
e-Government	73
General Infrastructure	73

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Mridul Chowdhury, *Harvard University*
with **Thierry Hoffait,** *Steria sa/nv*

> "The regional competition in Belgium is a driving force for accelerated growth of IT in the country."
>
> ***—Manager of Belgian IT company***

> "One of the main problems of doing IT business in Belgium is lack of laws, protection, and regulations—especially IT business regulations for citizens and companies—[these] are almost nonexistent."
>
> ***—Belgian IT executive***

Belgium's acceleration towards Readiness for the Networked World began later than in most other OECD countries. However, with an overall Networked Readiness Index ranking of eighteen, the nation is gradually catching up with other, more advanced European countries. Efforts to integrate Belgium into the Networked World have been initiated at the federal and regional levels, with independent ICT initiatives in the regions of Flanders and Walloonia. At the federal level, an umbrella policy, *Action Plan for the Information Society,* gives cohesion to national ICT efforts (Ranking in Effectiveness of Government ICT Programs: 26).

Belgium's Internet use received a substantial boost with the introduction of free Internet access in 1999. Today, a majority of home Internet users have free subscriptions.[1] Belgium's advanced cable infrastructure and high cable penetration (even by OECD standards) have provided the foundation for rapid diffusion of cable-based broadband (Ranking in Availability of Broadband: 7). Cable companies are increasingly upgrading their network infrastructure to provide Internet as well as telephony services.

In e-commerce and e-government, Belgium is making rapid progress, but still lags behind most major OECD countries. Many Belgian companies are engaging increasingly in electronic B2B e-commerce exchanges internationally and also within the country's borders. Belgium's domestic B2B e-commerce marketplace, called *3B Trade*, is a popular Internet-based auction for noncapital goods. The nation's innovative lead in electronic banking and wide use of an "electronic purse," known as the *Proton*, have helped boost B2C e-commerce[2] (Ranking in Use of Internet-based Payment Systems: 19). A number of e-government initiatives are also underway. The Belgian government, in its *Declaration of Federal Policy*, has emphasized the role of ICTs in modernizing public administration, and an ICT manager for federal public administration has been appointed to coordinate e-government activities (Ranking in e-Government micro-index: 29).

Regional initiatives have been undertaken to encourage ICT diffusion into Belgian society. One project developed by the Flemish region, called *e-Television*, focuses on using TV as a digital platform for interactive learning.[3] The Walloon government has established the *Cyberécoles* (*Cyberschools*) network and, as of August 2000, provided schools in the region with more than 400 cyber media centers[4] (Ranking in Internet Access in Schools: 22). One challenge in creating a Networked Society is the Belgian population's diversity in language, making Internet content issues more challenging than in European countries where fewer languages are spoken.

One of the major hurdles to Belgian ICT development remains the telecommunications regulatory situation. Telecommunications costs remain high in Belgium, in spite of some major positive changes over the past three years, including opening fixed telephony service to competition; partial privatization of Belgacom, the main telecommunications operator; and reforms in telephony price structure (Ranking in Effect of Telecommunications Competition: 21). Due to a lack of an effective independent regulatory authority, Belgacom still retains much of the market share and a dominant influence on telecommunications price setting. Progress in improving the regulatory framework has been slow, particularly in unbundling the local loop, revenue collection models, and interconnection pricing. However, conforming to EU legislation on telecommunications liberalization should be a significant incentive for Belgium to hasten reforms in the sector.

Belgium

Key Facts

Population	10,200,000
Rural population (% of total population) 1999	2.76 %
GDP per capita (PPP)	US$26,958
Global Competitiveness Index Ranking, 2001–2002	19
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	5
Main telephone lines per 100 inhabitants	49.93
Telephone faults per 100 main telephone lines	4.00
Internet hosts per 10,000 inhabitants	295.44
Personal computers per 100 inhabitants	34.45
Piracy rate	33.00 %
Percent of PCs connected to Internet	8.58 %
Internet users per host	8.99
Internet users per 100 inhabitants	26.57
Cell phone subscribers per 100 inhabitants	54.88
Average monthly cost for 20 hours of Internet access	US$5.59

	RANK
Networked Readiness Index	**18**
Network Use component index	**22**
Enabling Factors component index	**17**
Network Access	**17**
Information Infrastructure	16
Hardware, Software, and Support	18
Network Policy	**22**
Business and Economic Environment	22
ICT Policy	22
Networked Society	**13**
Networked Learning	18
ICT Opportunities	6
Social Capital	14
Networked Economy	**22**
e-Commerce	24
e-Government	29
General Infrastructure	13

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Colin Maclay, *Harvard University*
Brian Reale, *IFX Networks, Bolivia*

> “ Investment in new IT projects is practically nonexistent, as the only financing is through banks that require physical guarantees and charge rates of 14 to 16 percent in dollars.”
>
> ***—Bolivian IT manager***

> “ The market opening should bring significant benefits to the common Bolivian businessperson due to price reductions in communications...making the entire country more competitive.”
>
> ***—Bolivian IT executive***

The Networked Readiness environment in Bolivia changed monumentally on November 27, 2001, with the opening of telecommunications markets and an end to long-standing monopolies on international data transmission, long-distance telephony (national and international), and local telephony. Efforts are underway to address core national needs for greater economic and educational opportunity with technology. This new landscape confronts a deficient communications infrastructure, remote and inhospitable terrain, culturally diverse and poor population with high illiteracy, small market, and difficult business environment. Bolivia ranks sixty-seventh overall in the Networked Readiness Index.

In 1994, the government ceded 51 percent of state-run ENTEL and granted long-distance exclusivity to Telecom Italia in exchange for a US$610 million investment in ENTEL. Nine cooperatives around the country enjoyed local telephony monopolies within their respective regions.

Deregulation was regarded as transparent, in contrast to repeated allegations of corruption and regulatory shortcomings in Bolivia’s telecommunications history. Regulator SITTEL will issue licenses within four years to all parties agreeing to cover Bolivian towns with more than 10,000 inhabitants, provide some free Internet connectivity to public schools, and put up a cash guarantee.

Long distance services include voice, data, or video between departments or internationally, so licensees can also offer data and Internet. Traditional niche players, such as Telecel (cellular) and ITS (cable television), can capitalize on their existing user bases and offer new services. Many existing cooperative telecommunications companies have united to form Boliviatel to leverage their local presence and compete against larger players ENTEL, AES, and COTAS (the largest cooperative outside Boliviatel).

Companies plan a postderegulation mix of new and existing infrastructure; some are investing in fiber cable, but most are planning to mount Voice over Internet Protocol (VoIP) service on existing fiber and satellites. Cable broadband and DSL are becoming available in Bolivia, but have few users (Ranking in Availability of Broadband: 64).

The public education system offers very little access to ICTs, and primary and secondary education is generally poor despite reforms (Ranking in Internet Access in Schools: 65). Although Bolivian curricula are often out of synch with private-sector needs, higher education is of higher quality, but unreachable for most of the populace.

The dial-up Internet market has stagnated due to Bolivia’s economic recession, but Bolivia fares well globally with respect to public Internet access (Ranking in Public Access to the Internet: 23), because people prefer public-access points to expensive PCs and cooperative telephone lines (US$1,500 to purchase a line in La Paz). As a result of competition, new Service Level Agreements for data allow customers to shop for price and previously unavailable quality, but Internet use will grow slowly unless the economy improves.

Bolivia has undertaken significant macroeconomic reforms in recent years, but suffers from an unwelcoming business environment fraught with red tape, limited access to capital, and corruption (Ranking in Business and Economic Environment micro-index: 67). There are successful software services companies, but market size, lack of credit cards, and archaic commercial procedures have impeded e-commerce.

Most government organizations are online or in the process of becoming so, which is improving transparency and information availability, and will likely continue.

Bolivia

Key Facts

Population	8,329,000
Rural population (% of total population) 1999	38.10 %
GDP per capita (PPP)	US$2,408
Global Competitiveness Index Ranking, 2001–2002	67
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	66
Main telephone lines per 100 inhabitants	6.17
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	1.59
Personal computers per 100 inhabitants	1.20
Piracy rate	81.00 %
Percent of PCs connected to Internet	0.95 %
Internet users per host	82.28
Internet users per 100 inhabitants	0.96
Cell phone subscribers per 100 inhabitants	5.16
Average monthly cost for 20 hours of Internet access	US$9.07

	RANK
Networked Readiness Index	**67**
Network Use component index	**52**
Enabling Factors component index	**69**
Network Access	**68**
Information Infrastructure	63
Hardware, Software, and Support	72
Network Policy	**66**
Business and Economic Environment	67
ICT Policy	64
Networked Society	**66**
Networked Learning	71
ICT Opportunities	69
Social Capital	59
Networked Economy	**72**
e-Commerce	74
e-Government	71
General Infrastructure	72

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Elisa Korentayer, *Harvard University*
Marcelo Coutinho, *Ibope—Nielsen Net Ratings*

> "We need a more clear view of the IT space as being an 'enabler' of the rest of the economy."
>
> ***—IT executive, Brazil***

> "[Since 1996] the number of citations of Brazilian scientists has grown three times faster than the worldwide level...we are determined to do everything we can to encourage [the continuation of] that process...because we realize that research is good business."
>
> ***—Brazilian government official***

With Latin America's largest consumer market, Brazil ranks fourth among Latin American nations in Readiness for the Networked World and thirty-eighth overall in this year's Index. While the Brazilian ICT sector responds well to the needs of the country's wealthy users, the challenge remains to extend the benefits of ICT to the majority of the population. Over the last decade, Brazil has been an attractive destination for foreign direct investment; this is expected to decline significantly in the coming year, however. Brazil also has a large, developed industrial sector, due in part to the size of its internal market and the sizeable presence of multinational corporations.

The 1997 privatization of Telebras, the state-owned telecommunications monopoly, led to more telephone lines, higher-quality service, and lower tariffs. By preventing Telebras from becoming an Internet Service Provider, the Brazilian government promoted competition among ISPs, which has helped keep prices low (Ranking in Effect of ISP Competition: 26). In spite of the subsequent network boom, Internet access is still limited primarily to the wealthy, creating concentrated distributions of service in affluent urban areas (Ranking in Public Access to the Internet: 54).

However, the Internet is being adopted quickly, with no small encouragement from *novellas* (soap operas), which have established the Internet as an essential element of Brazilian popular culture. The density of Internet hosts expanded rapidly and is now 0.5 hosts per hundred inhabitants. ISPs are in almost every regional center. Sophisticated service provision offers consumers a great variety of price and service packages, ranging from twenty hours of dial-up at an average of US$14.73 to unlimited broadband packages at US$40 per month.

There is a flurry of activity encouraging technology in education at the state and local levels, which, in the future, may help to alleviate the current shortage of qualified workers for the telecommunications and technology industries. Internet use is high for businesses and increasing for individuals. About 3 percent of Brazil's population used the Internet in 2000, and this proportion is expected to surpass 10 percent in 2004[1] (Ranking in e-Commerce micro-index: 18). It is estimated that Brazilians will spend more than US$1 billion on e-commerce in 2001.[2]

The Brazilian economy has to overcome a number of obstacles before it can fulfill its potential. In 2001, a long-predicted energy crisis hit industrial users hard. High taxes for computers and ICT products compound the already high costs of technology. Foreign investment is slowing. Nevertheless, Brazil's hardware and software industries are doing well despite the challenges of piracy and the gray market (Ranking in Availability of Local IT Services: 16).

Until recently, the Brazilian government had lacked effective long-term policies for industry and government, but it has taken steps to remedy this. The Ministry of Science and Technology launched the Information Society Initiative in 2000, an ambitious plan to coordinate and leverage all government initiatives on the Internet. During the past few years, the quality and high use of online tax systems and other e-government initiatives have garnered international attention (Ranking in e-Government micro-index: 15).

Brazil

Key Facts

Population	170,000,000
Rural population (% of total population) 1999	19.28 %
GDP per capita (PPP)	US$7,389
Global Competitiveness Index Ranking, 2001–2002	44
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	50
Main telephone lines per 100 inhabitants	18.17
Telephone faults per 100 main telephone lines	2.81
Internet hosts per 10,000 inhabitants	51.53
Personal computers per 100 inhabitants	4.41
Piracy rate	58.00 %
Percent of PCs connected to Internet	11.69 %
Internet users per host	11.23
Internet users per 100 inhabitants	5.78
Cell phone subscribers per 100 inhabitants	13.63
Average monthly cost for 20 hours of Internet access	US$14.73

	RANK
Networked Readiness Index	**38**
Network Use component index	**40**
Enabling Factors component index	**34**
Network Access	**39**
Information Infrastructure	41
Hardware, Software, and Support	36
Network Policy	**42**
Business and Economic Environment	55
ICT Policy	28
Networked Society	**40**
Networked Learning	36
ICT Opportunities	25
Social Capital	60
Networked Economy	**30**
e-Commerce	18
e-Government	15
General Infrastructure	58

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Alzhan Braliev, *Harvard University*
with **Veni Markovski,** *Internet Society of Bulgaria*

> “ Lack of financial sources and IT education in schools are some of the current challenges.”
>
> ***—General Manager, Bulgarian software and hardware company***

> “ The government should think about forming a separate ministry or government office responsible for national IT strategy and policy. Right now, there is no clear engagement or policy coordination from the government.”
>
> ***—IT executive, Bulgaria***

Since the beginning of the 1990s, remnants of Bulgaria’s past as a socialist economy have been holding the country back. Some Bulgarians view investment in and growth of the ICT sector as a way to overcome this challenge. Because Bulgaria is being considered in the second round for entrance into the European Union, the country must undertake specific actions to comply with EU standards. This incentive has provided a reason for major investment and a renewed commitment to the progress of national ICT development. Bulgaria ranks fifty-third in the Networked Readiness Index.

Bulgarian ICT leaders feel their country could become a regional leader in the Networked World. However, major challenges—the existing bureaucracy, corruption, a fragile democracy, and financial constraints in both the government and private sectors—are impeding successful economic development and affecting technological growth.

The infrastructure to support ICT growth is underdeveloped and outdated, with many people still sharing fixed telephone lines, one result of Bulgaria’s delayed telecommunications liberalization (Ranking in Effect of Telecommunications Competition: 67). The small national ICT market also suffers from insufficient investment. Because of this lack of infrastructure, more and more people are choosing wireless solutions, leading to increased investments in wireless networks such as MobilTel’s plan to launch General Packet Radio Service.

Despite the high level of literacy in Bulgaria (Ranking in Social Capital micro-index: 32), the level of ICT literacy is still low; only a relatively small percentage of the population works with computers. To strengthen national ICT skills, the previous government allocated funds specifically for ICT education in schools. These funds are sufficient to provide PCs for half the high schools in the country. Broader connectivity and accompanying training are not yet on the horizon (Ranking in Internet Access in Schools: 51). Because ICT specialists seldom receive large salaries, the skilled workforce either chooses non-ICT jobs or goes abroad (Ranking in IT Opportunities micro-index: 74), making brain drain an acute problem (Ranking in IT Brain Drain: 73).

Bulgaria’s Readiness for the Networked World is hindered by large numbers of people who cling to old views and thinking. By contrast, in recent years, the Internet has gained popularity among younger generations, and the private sector has embraced the advent of e-mail. There is no free Internet access available in Bulgaria, but unlimited monthly access can cost as little as US$7. ISDN is available, and more urban residents have started using digital telephone connections to the Internet.

Internet use is not common in the public sector. While there are governmental restrictions on radio and television content, there are no restrictions on the Internet. A recent change in the Telecommunications Law freed voice over Internet (VoIP) service from Bulgaria Telecom’s monopoly. This law officially allows the population to choose an alternative Internet telephone service. Another reform was won in 1999, when a lawsuit against the government freed ISPs from licensing or registration. More liberalized legislation in the ICT field is expected from the newly formed Parliament. B2B and B2C e-commerce are also limited but are developing rapidly.

Bulgaria

Key Facts

Population	8,225,000
Rural population (% of total population) 1999	30.72 %
GDP per capita (PPP)	US$5,469
Global Competitiveness Index Ranking, 2001–2002	59
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	44
Main telephone lines per 100 inhabitants	35.03
Telephone faults per 100 main telephone lines	4.20
Internet hosts per 10,000 inhabitants	22.41
Personal computers per 100 inhabitants	2.67
Piracy rate	78.00 %
Percent of PCs connected to Internet	7.24 %
Internet users per host	14.72
Internet users per 100 inhabitants	2.83
Cell phone subscribers per 100 inhabitants	8.97
Average monthly cost for 20 hours of Internet access	US$10.74

	RANK
Networked Readiness Index	**53**
Network Use component index	**45**
Enabling Factors component index	**61**
Network Access	**61**
Information Infrastructure	61
Hardware, Software, and Support	60
Network Policy	**59**
Business and Economic Environment	56
ICT Policy	61
Networked Society	**57**
Networked Learning	64
ICT Opportunities	74
Social Capital	32
Networked Economy	**56**
e-Commerce	66
e-Government	55
General Infrastructure	46

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Indran Ratnathicam, *Harvard University*
with **Eli Turk,** *Alcatel Canada*

> “ Small and medium enterprises need help to learn about and take advantage of e-commerce tools.”
>
> ***—Software start-up CEO, Canada***

> “ Canada is on the leading edge of broadband and telecenters—there are few countries that can match our connectivity over such a vast region.”
>
> ***—Canadian IT observer***

Canada’s high level of Readiness for the Networked World has been shaped in recent years by Connecting Canadians, a cohesive ICT strategy and private-public partnership. The strategy, which combines ICT-related funding with that of existing national improvement programs, is aligned along several of Canada’s major development goals: inclusion of diverse cultures across a diverse geography; proliferation of Canada’s many government services; and strengthening of the economy. Canada ranks twelfth overall in Readiness for the Networked World.

Canada has a highly developed communications infrastructure and service sector (Ranking in Information Infrastructure micro-index: 6). Beyond high levels of access to Internet, telephone, and mobile services, advanced offerings such as broadband and Application Service Provision (ASP) are available at a reasonable price to consumers and businesses (Ranking in Availability of Broadband: 2). Connecting Canadians has made it a priority to extend ICT opportunities to rural and economically challenged areas, based on the realization that market forces would service most of the 85 percent of Canadian citizens who live within 100 miles of the southern border. Canada has thus become a global leader in rural telecenters: through initiatives such as Smart Community and the Community Access program, more than 10,000 rural and urban community Internet access sites have been opened to the Canadian community[1] (Ranking in Public Access to the Internet: 8).

Canada is perceived by many to be a global leader in e-commerce (Ranking in e-Commerce micro-index: 6), but some domestic business leaders feel that untapped potential remains. Large Canadian businesses are comparable to U.S. and Finnish firms in technological sophistication. The ICT industry has gained a strong reputation, as several hardware manufacturers have established international presences. Locally, however, small and mid-size businesses have been slower in their migration to the Internet.[2] Growing consumer adoption of B2C e-commerce also trails that of other countries with similar connectivity, hindered by Canada’s weak domestic online offerings and surcharges by U.S. companies for Canadian delivery.

A public-private partnership, dubbed the e-Business Roundtable, was established to identify and mobilize levers for ICT growth in Canada. In addition to raising awareness for the potential of ICT adoption by industry, the Roundtable has proposed corporate tax rate reductions of 7 percent between 2000 and 2005, which would put corporate taxes below comparable U.S. tax levels.[3] The government supports this initiative and appears interested in other measures that will accelerate the progress of Canadian e-commerce.

One issue that has caused considerable debate within Canada concerns the extent to which its best university graduates and skilled workers emigrate to more lucrative engagements in the U.S. and elsewhere (Ranking in IT Brain Drain: 22). Canadian school connectivity (Ranking in Internet Access in Schools: 2) and ICT training are considered strong (Ranking in Quality of IT Education: 8). However, U.S. firms and, to some degree, U.S. universities, lure many highly qualified Canadians across the border. To make Canadian salaries more attractive, Canadian capital gains tax laws were changed in 2000, equalizing rates with those of the U.S. Additionally, shortages of ICT labor have been improved by passing immigration laws that encourage skilled workers from the global community to enter and augment Canada’s workforce.

Key Facts

Population	30,800,000
Rural population (% of total population) 1999	22.98 %
GDP per capita (PPP)	US$27,783
Global Competitiveness Index Ranking, 2001–2002	3
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	2
Main telephone lines per 100 inhabitants	67.65
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	768.78
Personal computers per 100 inhabitants	39.02
Piracy rate	38.00 %
Percent of PCs connected to Internet	19.70 %
Internet users per host	5.37
Internet users per 100 inhabitants	41.30
Cell phone subscribers per 100 inhabitants	28.45
Average monthly cost for 20 hours of Internet access	US$14.64

Canada

	RANK
Networked Readiness Index	**12**
Network Use component index	**16**
Enabling Factors component index	**9**
Network Access	**9**
Information Infrastructure	6
Hardware, Software, and Support	11
Network Policy	**8**
Business and Economic Environment	9
ICT Policy	7
Networked Society	**13**
Networked Learning	6
ICT Opportunities	23
Social Capital	9
Networked Economy	**7**
e-Commerce	6
e-Government	6
General Infrastructure	10

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Carlos Osorio, *Harvard University*

> “ Political will is not enough. We need to change the national vision with a country-wide project.”
>
> ***—Chief Executive, Chilean NGO***

> “ It is extremely difficult to get financing for emerging companies. Institutional investors should be required to invest in venture capital not only for the benefit of companies, but also for their own benefit, [to diversify] their portfolios.”
>
> ***—CEO, Chile***

Chile was the first country in Latin America to develop an advanced telecommunications infrastructure (Ranking in Information Infrastructure micro-index: 27), but this relative advantage in Networked Readiness has diminished quickly because the Chilean economy and society have not made as productive use of their networks as many of their international peers. The high quality of Chilean infrastructure contrasts with low levels of sophistication of Network Use. The nation ranks second in Latin America, and thirty-fourth overall, in the Networked Readiness Index.

Chile has one of Latin America's lowest illiteracy rates (4.6 percent), and educational attainment of 98.3, 86.9, and 27 percent for primary, secondary, and postsecondary education, respectively.[1] Additionally, educational system reform programs and the quality of Chilean higher education have helped to create a highly skilled workforce, although hardly bilingual (Ranking in Social Capital micro-index: 47). In the incorporation of ICTs into education, the *Enlaces* project has already connected 60 percent of Chilean primary and secondary schools, in which about 90 percent of the country's students are enrolled.[2] *Enlaces* has now moved beyond its initial emphasis on basic school connectivity to focus on training teachers, enriching content, and reaching the poorest rural schools.

Chile has one of the region's highest per capita incomes, but there is marked economic inequality. This trend is reflected in Internet use. Approximately 26 percent of households, representing about 50 percent of the national income, accounts for roughly 68 percent of Internet users.[3] There are a number of efforts to extend Internet access. One noteworthy nonprofit initiative is *El Encuentro*, a community Internet access center located in a modest municipality in Santiago that focuses on issues beyond Internet access and provides community empowerment.

There are increasing private and public efforts to help small and medium enterprises (SMEs) to adopt e-commerce, but problems such as lack of sophisticated management techniques and customer service culture and financial problems threaten the profitable adoption of Internet-based operations. Despite these challenges, B2B e-commerce totaled US$426 million in 2000, and B2C e-commerce rose to US$35.7 million in the same year (57 percent of which went to local online retailers).[4]

While almost all government agencies have websites, few offer sophisticated Internet-based operations. The best-known e-government initiative is the online income tax system (http://www.sii.cl/). There are also such initiatives as a Web portal to reduce bureaucratic procedures and government websites oriented to the needs of SMEs and larger businesses (Ranking in Online Government Services: 14).

In keeping with its openness toward foreign direct investment (FDI) and market competition, the Chilean government was among the first in the world to liberalize its telecommunications market, leading to relatively low costs of access for telephony and Internet (Ranking in Effect of Telecommunications Competition: 3). To create greater competition, SUBTEL, the telecommunications regulator, ordered the unbundling of the local loop. Now Chilectra, the major electricity distributor, is planning to enter the telecommunications market by offering voice and fast data transmission services over power lines, which would bring about utility convergence in the country. SUBTEL also started a dialogue to design a regulatory framework for convergence.

The Chilean Economic Development Agency (CORFO) and the Chilean Foreign Investment Committee created the Invest@Chile Program, in the hopes of increasing FDI in ICTs and creating new sources of national comparative advantage (Ranking in Business and Economic Environment micro-index: 31).

Chile

Key Facts

Population	15,200,000
Rural population (% of total population) 1999	14.56 %
GDP per capita (PPP)	US$9,187
Global Competitiveness Index Ranking, 2001–2002	27
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	34
Main telephone lines per 100 inhabitants	22.12
Telephone faults per 100 main telephone lines	52.00
Internet hosts per 10,000 inhabitants	0.49
Personal computers per 100 inhabitants	8.55
Piracy rate	49.00 %
Percent of PCs connected to Internet	5.75 %
Internet users per host	23.52
Internet users per 100 inhabitants	11.55
Cell phone subscribers per 100 inhabitants	22.36
Average monthly cost for 20 hours of Internet access	US$17.88

	RANK
Networked Readiness Index	**34**
Network Use component index	**34**
Enabling Factors component index	**30**
Network Access	**31**
Information Infrastructure	27
Hardware, Software, and Support	35
Network Policy	**26**
Business and Economic Environment	31
ICT Policy	21
Networked Society	**32**
Networked Learning	28
ICT Opportunities	20
Social Capital	47
Networked Economy	**36**
e-Commerce	35
e-Government	24
General Infrastructure	49

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Mridul Chowdhury, *Harvard University*
Tao Wenzhao, *Harvard University*
with **Xu Zhiqun,** *Shanghai Bell Co. Ltd.*
Steve Yeung, *Computer and Technologies Holdings Ltd.*

> “With China entering the WTO, the Chinese IT sector will get a boost.”
>
> ***—Executive of Chinese IT company***

> “The interior provinces have been largely left out from the benefits of the Internet boom in China...Economic disparity between the coastal and interior provinces has grown worse over the years and IT growth has followed a similar trend.”
>
> ***—Professor of government and public administration, China***

There is tremendous international interest in the ICT sector in China, as foreign investors and technology multinationals jockey for position to enter the large Chinese market. The Chinese government itself has a dual policy on ICT. On the one hand, it perceives ICT as a powerful tool that can contribute to the country’s continuing economic development (Ranking in ICT as Government Priority: 13). On the other hand, the government is wary of the potentially disruptive social and political impact of ICT, particularly the Internet, if its use is left unchecked. This delicate balance between aiming for maximum diffusion of ICT and maintaining strict control on its applications is a daunting task for the government and a primary focus of national debate. China ranks sixty-fourth in overall Networked Readiness.

The Chinese government has recognized ICT as a major driver of China’s global competitiveness (Ranking in Effectiveness of Government ICT Programs: 15). This commitment is demonstrated by its heavy investment in telecommunications infrastructure, particularly fiber-optic cables, throughout the 1990s, and significant growth in teledensity. Along with this, the government has actively supported the growth of the mobile telephony market, which recently surpassed the size of the U.S. market in number of subscribers. However, ensuring equitable distribution of access to ICT has proved to be a substantial challenge in a country that accommodates a sixth of the world’s population and is characterized by islands of prosperity in a sea of destitution.

While broadband is not common in China (Ranking in Availability of Broadband: 64), a substantial user base has been created that accesses the Internet mainly through dial-up and leased lines. The government actively supports and often invests in B2B e-commerce ventures. Many export-oriented sectors and the financial sector have begun to embrace e-commerce, although it is generally still in a nascent stage (Ranking in e-Commerce micro-index: 46). The *Government Online Project*—the national e-government initiative in China—has also begun to provide basic information and services on the Internet (Ranking in e-Government micro-index: 44). ICT-mediated distance education is becoming a popular mode of educating the large and dispersed population in China and is increasingly being offered on the Internet.

The government has set ambitious targets for software export and has offered different incentives for the software industry in the form of tax provisions and access to credit. Revenues from China’s software exports are currently about one-thirteenth of India’s. This reflects a fundamentally different Networked Readiness strategy. In contrast to India, where most software is destined for export, most software companies in China target the domestic market only (Ranking in Availability of Local IT Services: 51) because of the growing home demand, insufficient competence in English, and lack of financial resources to market internationally.

Behind all the optimism surrounding ICT, the government is very restrictive about information exchange on the Internet. It routinely blocks selected websites of foreign media and human rights organizations and covertly monitors chat rooms and online message boards. China has only one gateway to the World Wide Web, which is guarded by ChinaNet, the government-run ISP. Internet cafés use filtering software to restrict use of the Internet to avoid potential government crackdowns.

China

Key Facts

Population	1,300,000,000
Rural population (% of total population) 1999	68.38 %
GDP per capita (PPP)	US$3,953
Global Competitiveness Index Ranking, 2001–2002	39
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	60
Main telephone lines per 100 inhabitants	11.11
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	0.54
Personal computers per 100 inhabitants	1.59
Piracy rate	94.00 %
Percent of PCs connected to Internet	0.34 %
Internet users per host	319.64
Internet users per 100 inhabitants	1.74
Cell phone subscribers per 100 inhabitants	6.58
Average monthly cost for 20 hours of Internet access	US$6.64

	RANK
Networked Readiness Index	**64**
Network Use component index	**70**
Enabling Factors component index	**56**
Network Access	**63**
Information Infrastructure	55
Hardware, Software, and Support	71
Network Policy	**49**
Business and Economic Environment	44
ICT Policy	54
Networked Society	**54**
Networked Learning	54
ICT Opportunities	40
Social Capital	68
Networked Economy	**48**
e-Commerce	46
e-Government	44
General Infrastructure	55

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Colin Maclay, *Harvard University*
with **Jorge Aramburo S.,** *PSL*

> "Currently the most pervasive problem is the poor performance of the economy which affects investment in the industry."
>
> ***—IT manager, Colombia***

> "Underdevelopment is not an economic problem, it is a cultural one, especially in knowledge-based industries. Colombia has started to understand this."
>
> ***—Colombian business executive***

Civil strife and economic crisis have challenged Colombia's growth potential by forcing many of its people and businesses, and capital abroad. There are numerous ICT-related initiatives by government, private sector and nongovernmental organizations. The government's Connectivity Agenda, which developed one of Latin America's first national ICT strategies, has achieved some success, although most observers believe it has not engaged the private sector adequately (Ranking in Effectiveness of Government ICT Programs: 55). There has been progress in developing ICT industry competitiveness, information infrastructure, ICT education, electronic government, and ICT policy, but challenges remain, including rural-urban differences, a weak financial system, uneven computer science education, and the need for greater telecommunications competition. The nation ranks fifty-seventh in overall Networked Readiness.

The second half of the 1990s saw the number of telephones per hundred people increase by half, giving Colombia the continent's third highest teledensity. There is good access to the international gateway, a Network Access Point (NAP), a vibrant mobile wireless sector, and a good electricity supply.

There are serious interrelated infrastructure challenges related to disconnected rural areas and network sabotage. Teledensity in rural areas barely exceeds 3 percent, while the teledensity in cities is ten times that.[1] Half of rural areas have no lines. There have been repeated attacks on infrastructure, and many ISPs host abroad for fear of NAP vulnerability.

The wealthiest telephone users subsidize the poorest, and a flat-rate tariff was introduced in 2001 to encourage dial-up Internet use by discounting Internet calls and limiting monthly charges. Previously, there were complaints about customs duties on ICT goods, but with reduced tariffs and PCs under US$1,500 tax exempt, low income remains the major problem in increasing PC penetration.

With illiteracy below 10 percent, good higher education, and technology and learning initiatives underway, Colombia has some bright spots, but 30 percent of its children do not reach fifth grade, and 84 percent lack tertiary education.[2] Rural areas are particularly hard hit. Some attempts to use ICT in learning are financed by a budget set aside by the government. In Bogotá, hundreds of schools were connected to the Internet (Ranking in Internet Access in Schools: 42), and hundreds of teachers were trained in informatics. Computer labs were placed in more than 750 schools nationwide.[3]

Despite economic problems, Internet users and domains continue to grow rapidly. Internet use has become more common around the country, but most users in 1999 were in Bogotá and Medellín. Medellín's public utility company subsidizes up to 200,000 PCs and unlimited Internet access for $US30 per month,[4] and the city boasts a major public access program (Ranking in Public Access to the Internet: 37).

Regardless of the difficulty in accessing capital and the insecure climate, ICT businesses are growing and benefiting from strong private-sector leadership and increasing government support. Top universities are adapting curricula, and even requiring fluent English, for an undergraduate computer science degree. Companies are embracing the world's best practices and standards (ISO 9000 and CMM), and universities have launched several software engineering research programs with the private sector (Ranking in Quality of IT Education: 60).

National government ministries are online and accessible through the national portal, which supports transactions (Ranking in Online Government Services: 37). Medellín's government is directing business toward its IT companies, offering tax incentives and guaranteeing necessary infrastructure.

Colombia

Key Facts

Population	42,300,000
Rural population (% of total population) 1999	26.52 %
GDP per capita (PPP)	US$5,923
Global Competitiveness Index Ranking, 2001–2002	65
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	46
Main telephone lines per 100 inhabitants	16.91
Telephone faults per 100 main telephone lines	59.90
Internet hosts per 10,000 inhabitants	11.06
Personal computers per 100 inhabitants	3.31
Piracy rate	53.00 %
Percent of PCs connected to Internet	2.90 %
Internet users per host	18.75
Internet users per 100 inhabitants	2.07
Cell phone subscribers per 100 inhabitants	5.33
Average monthly cost for 20 hours of Internet access	US$14.00

	RANK
Networked Readiness Index	**57**
Network Use component index	**53**
Enabling Factors component index	**60**
■ **Network Access**	**51**
Information Infrastructure	59
Hardware, Software, and Support	43
■ **Network Policy**	**52**
Business and Economic Environment	63
ICT Policy	41
■ **Networked Society**	**59**
Networked Learning	55
ICT Opportunities	62
Social Capital	61
■ **Networked Economy**	**59**
e-Commerce	60
e-Government	49
General Infrastructure	69

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Elisa Korentayer, *Harvard University*
Pablo Jenkins Villalobos, *Intel Corporation*

> "In 1985, without any expectation, PCs suddenly became affordable in Costa Rica. In the next few years, primary school children started using computers every week, businessmen joined together to gain understanding at the IT Research Club, and universities forged ahead with Internet precursors."
>
> ***—IT professional, Costa Rica***

> "There are only two ways to work in IT—with Intel or on your own."
>
> ***—Costa Rican IT professional***

In recent years, Costa Rica has become well known for its progressive policies toward high-tech investment. The country ranks fifth in Networked Readiness within Latin America and forty-fifth overall. Costa Rica's high quality service industry, ICT workforce, and advanced investment policies have attracted Intel and others, which, in turn, has significantly increased and diversified the country's export revenue. However, Costa Rica's appeal as a base for technology companies belies such internal challenges as lagging telecommunications policies and substandard ICT access for the average citizen.

Observers are quick to point out that the Instituto Costarricense de Electricidad (ICE) leverages its telecommunications monopoly to subsidize its electricity monopoly. The quality and speed of telecommunications services overall are limited (Ranking in Effect of Telecommunications Competition: 65). Many critics feel that opening ICE up to private-sector competition is essential for progress on the technology front.

Overall teledensity is high, particularly when compared to Costa Rica's Central American neighbors, but there is a long wait for new lines (Ranking in Business Telephone Lines: 70). The quality of Internet service is poor, with high connection fees and slow connection speeds. In response to increased demand, the ICE and the Ministry of Science and Technology have launched a pilot program to connect fiber rings throughout the country. They also plan to deploy 100,000 DSL lines at US$40 per month with download speeds of 128 Kbps and 256 Kbps.[1]

To further improve education and augment high literacy rates, the government has established aggressive "ICT in the classroom" policies. Fifty percent of elementary schools and 100 percent of high schools have computer labs (Ranking in Internet Access in Schools: 35).[2] Education outside of San José, the capital city, is poor. Higher education institutions offering ICT instruction focus on theoretical coursework, leaving significant instruction to private companies. The Instituto Tecnológico offers more applied instruction and provides internships (Ranking in Quality of IT Education: 26).

Incentives for foreign technology companies include low customs tariffs, free zones with tax holidays of twelve to eighteen years, and reinvestment incentives. Intel, Microsoft, Motorola, and other well-known multinational ICT firms have Costa Rican facilities.

Costa Rica's internal technology market is small and predominantly foreign. The local venture capital community is still in its early stages. Most companies finance themselves with loans and operating income, making investment in research and development difficult. Minimal incubation opportunities and a low level of managerial and business preparation in technology start-ups limit dot-com competition (Ranking in Dot-com Competition: 66) and e-commerce prevalence (Ranking in e-Commerce micro-index: 56). Costa Rica's 150 software companies are beginning to export more within the Latin American region.

The government and business community rate technology as a national high priority. CINDE, the national investment board, has strong government support for marketing Costa Rica and attracting foreign investment. The country still lacks a long-term plan for addressing many internal challenges and fares relatively poorly in e-government initiatives (Ranking in e-Government micro-index: 48).

Costa Rica

Key Facts

Population	4,023,000
Rural population (% of total population) 1999	52.40 %
GDP per capita (PPP)	US$9,236
Global Competitiveness Index Ranking, 2001–2002	35
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	35
Main telephone lines per 100 inhabitants	24.94
Telephone faults per 100 main telephone lines	42.10
Internet hosts per 10,000 inhabitants	18.29
Personal computers per 100 inhabitants	9.94
Piracy rate	68.00 %
Percent of PCs connected to Internet	1.87 %
Internet users per host	33.98
Internet users per 100 inhabitants	6.21
Cell phon e subscribers per 100 inhabitants	5.19
Average monthly cost for 20 hours of Internet access	US$20.00

	RANK
Networked Readiness Index	**45**
Network Use component index	**48**
Enabling Factors component index	**45**
Network Access	**52**
Information Infrastructure	64
Hardware, Software, and Support	40
Network Policy	**49**
Business and Economic Environment	40
ICT Policy	57
Networked Society	**33**
Networked Learning	33
ICT Opportunities	24
Social Capital	42
Networked Economy	**54**
e-Commerce	56
e-Government	48
General Infrastructure	57

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Carlos Osorio, *Harvard University*
Geoffrey Kirkman, *Harvard University*

> “ Companies in the Czech Republic are not educated enough about e-commerce advantages and see the new technologies as untrustworthy...[the] solution is very problematic, since the business people’s mentality is difficult to change.”
>
> ***—Czech Internet executive***

> “ Currently [an] Internet connection is not affordable for the general public due to its high [per] minute rate, making the Internet a tool just for certain income groups. Immediate liberalization of the telecommunications market should drop the prices for dial-up connections or bring new alternatives, like xDSL.”
>
> ***—IT executive, Czech Republic***

Since the breakup of its federation with the Slovak Republic, the Czech Republic has focused on its transition to capitalism. This process has prompted the liberalization of markets and the privatization of state-owned companies, steps that are required by European Union regulations.[1] Czech entrance into the EU remains a strong incentive for reform. The Czech Republic has proven to be a leader in Networked Readiness in Central and Eastern Europe, with its twenty-eighth overall ranking in the Readiness Index behind only Estonia within the region.

The country took the first steps to reform the telecommunications sector in 1995, when state-owned monopoly SPT sold about a third of its shares to KPN Dutch Telecom. Now called Cesky Telecom, the former SPT is still under government control (which owns 51 percent of the company), but is expected to be privatized in the near future, along with liberalization of both the local loop and long-distance telephony (Ranking in Effect of Telecommunications Competition: 38).

In the face of high costs, long waiting lists, and other barriers in the fixed telephony market, there has been a tremendous boom in mobile telephony, driven by foreign investment and competitive prices.

To extend public access to the Internet, Cesky Telecom recently announced plans to install public Internet kiosks in thirty cities across the country.[2] Facing declining revenues from public telephones as mobile telephony has become more popular, the company identified the need to compete more actively with the burgeoning Internet café culture (Ranking in Public Access to the Internet: 27).

The Czech Republic has proven to be particularly attractive to foreign companies because of the country’s well-educated and computer-literate workforce (Ranking in Social Capital micro-index: 16) and low relative cost of labor compared to other OECD countries.

Electronic commerce in the Czech Republic started relatively early, but slow growth of the Internet, high telephone rates, and unreliable postal service have hindered its development (Ranking in e-Commerce micro-index: 32). The first Czech e-ventures emerged between 1994 and 1995, as e-commerce sites such as Web-based mall Shop.cz, and virtual employment office Jobs.cz were launched. Internet penetration at the time was still limited, however. Currently, with almost 10 percent of the population having Internet access, there are highly sophisticated ventures such as eCity, a “dot-cz” that has been used by more than 25 percent of the country’s Internet users for online banking (which has become especially popular), online auctioning, and shopping.[3]

There is currently a moratorium on e-commerce taxation in the Czech Republic. This is likely to change, along with the intellectual property regime, with Czech entrance into the EU.

There is a general lack of ICT knowledge and awareness in the Czech business community as a whole, especially among small and medium enterprises (SMEs) that could benefit from e-commerce. This has limited the number of companies that have gone online. To provide greater incentives for e-commerce, the government granted a subsidiary to Cesky Telecom to build e-marketplaces. In 2000, the Czech government also created Central Address, an online one-stop shop for all information for public tenders and public auctions. As a result of another e-government initiative, 80 percent of customs declarations are now submitted electronically.[4]

Czech Republic

Key Facts

Population	10,200,000
Rural population (% of total population) 1999	25.34 %
GDP per capita (PPP)	US$13,721
Global Competitiveness Index Ranking, 2001–2002	37
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	28
Main telephone lines per 100 inhabitants	37.79
Telephone faults per 100 main telephone lines	20.27
Internet hosts per 10,000 inhabitants	155.52
Personal computers per 100 inhabitants	12.20
Piracy rate	43.00 %
Percent of PCs connected to Internet	12.75 %
Internet users per host	6.28
Internet users per 100 inhabitants	9.76
Cell phone subscribers per 100 inhabitants	42.42
Average monthly cost for 20 hours of Internet access	US$19.01

	RANK
Networked Readiness Index	**28**
Network Use component index	**28**
Enabling Factors component index	**27**
Network Access	**29**
Information Infrastructure	31
Hardware, Software, and Support	26
Network Policy	**34**
Business and Economic Environment	33
ICT Policy	34
Networked Society	**20**
Networked Learning	23
ICT Opportunities	22
Social Capital	16
Networked Economy	**29**
e-Commerce	32
e-Government	30
General Infrastructure	25

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Indran Ratnathicam, *Harvard University*
with **Tomas Krag,** *Mostly Harmless, Denmark*

> “ The IT industry hasn’t been as tied up in the dot-com bubble as the IT industries in some of Europe’s other nations, and therefore hasn’t suffered quite as much in the recent downturn.”
>
> ***—Danish Internet executive***

> “ The international strength of the Danish IT industry is largely fueled by a very broad-based education system, as well as the early development of the mobile telecoms sector.”
>
> ***—IT executive, Denmark***

Denmark’s early preparations to enable its population to take advantage of information and communication technologies are paying off in a high level of Networked Readiness, as reflected by the country’s seventh overall ranking in the Networked Readiness Index.

Denmark’s telecommunication infrastructure is highly sophisticated (Ranking in Network Access subindex: 5). Telecommunications deregulation began in 1996, two years before Denmark needed to comply with the EU liberalization mandate, giving all subsectors a competitive boost. Mobile and Internet penetration rates are among the highest in the world. Currently, more than 13 percent of Danes are connected to the Internet via broadband (Ranking in Availability of Broadband: 14), primarily using DSL.[1]

To maximize the benefits of the infrastructure advantage built by the private sector, the public sector in Denmark, with NGO participation, recently introduced innovative programs designed to extend a network benefits to all Danes. Solicom, a pilot joint effort between Denmark and the European Commission, gives underrepresented minority groups a chance to participate in their own ICT-inclusion strategies by submitting project proposals online. In another example of public access ingenuity, a toll-free voice portal offers callers the same information that is found on public information websites.[2] In addition, public libraries are required by law to offer free Internet access and digital media to their patrons.

In education, the government is pushing ICT beyond ample Internet access, into content and ICT training. More than 80 percent of all schools in Denmark have access to the Internet (Ranking in Internet Access in Schools: 6), and resources have been allocated to connect the remaining schools.[3] The IT Driver’s License, a teaching certification program, is being developed for primary, secondary, and continuing education teachers. In addition, a partnership with Radio Denmark is developing digital teaching media for teachers and students.[4]

The Danish electronics and hardware design and manufacturing industry is well regarded worldwide, and exports over 85 percent of its total production.[5] This industry is composed primarily of hundreds of small and medium enterprises, many of which have partnered successfully with academic researchers to produce diverse leading-edge products, ranging from optical networking infrastructure to medical devices. More than one-fourth of these and other Danish companies have incorporated B2B e-commerce systems into both sales and procurement.[6] It is hoped that as the government moves more of its large annual procurement spending online, B2B e-commerce will become even more popular. While such an initiative has received widespread endorsement, it is still in the formative stage.

Consumers have yet to shop online with the regularity of similarly networked countries. Digital signature laws and security technology facilitate transactions, but B2C e-commerce does not represent the same opportunity for convenience in densely populated Denmark as it does in areas with more sparsely located retail outlets. However, online banking is highly popular, through both PCs and mobile telephones. An industry-government partnership has cooperated to develop e-commerce guidelines and standards for sales and marketing that, it is hoped, will increase consumer uptake.

Denmark

Key Facts

Population	5,330,020
Rural population (% of total population) 1999	14.74 %
GDP per capita (PPP)	US$27,120
Global Competitiveness Index Ranking, 2001–2002	14
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	14
Main telephone lines per 100 inhabitants	75.25
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	626.60
Personal computers per 100 inhabitants	43.15
Piracy rate	26.00 %
Percent of PCs connected to Internet	14.52 %
Internet users per host	7.73
Internet users per 100 inhabitants	48.41
Cell phone subscribers per 100 inhabitants	60.99
Average monthly cost for 20 hours of Internet access	US$18.07

	RANK
Networked Readiness Index	**7**
Network Use component index	**7**
Enabling Factors component index	**6**
■ **Network Access**	**5**
Information Infrastructure	3
Hardware, Software, and Support	6
■ **Network Policy**	**13**
Business and Economic Environment	10
ICT Policy	15
■ **Networked Society**	**8**
Networked Learning	8
ICT Opportunities	10
Social Capital	5
■ **Networked Economy**	**9**
e-Commerce	12
e-Government	9
General Infrastructure	7

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Geoffrey Kirkman, *Harvard University*

> “ There is poor telecommunications deployment over the country, and most of the population doesn’t have access to technology or Internet.”
>
> ***—Senior executive, Dominican Bank***

> “ Our primary setback is education.”
>
> ***—Sales executive, Dominican IT company***

There is a growing desire in the Dominican Republic to build on a decade of economic success and to become a service-oriented, Networked Ready economy. The nation faces a number of major challenges, particularly in rural-urban disparities, education, income distribution, and effective coordination between the government and the private sector. The Dominican Republic ranks forty-seventh overall in the Networked Readiness Index, and eighth within Latin America.

In general, information infrastructure in the Dominican Republic is fairly well developed in affluent and urban locales, but poor elsewhere (Ranking in Information Infrastructure micro-index: 45). The country has good international connectivity, driven largely by the demand for communication with the large Dominican diaspora in the United States.

Many ICT business leaders want greater dialogue with the government to improve Networked Readiness (Ranking in ICT as Government Priority: 45). The recent establishment of Indotel, a quasi-independent telecommunications regulatory agency, was a positive step toward creating a competitive telecommunications environment (Ranking in Effect of Telecommunications Competition: 11). The local, long-distance, cellular, and ISP markets are dominated by the former state monopoly, CODETEL. The cellular sector is the most competitive, and mobile telephony has boomed in recent years.

There are only three major ISPs operating in the Dominican Republic. Although DSL service was rolled out during 2001, broadband is almost nonexistent (Ranking in Availability of Broadband: 38). There is very little Internet use outside of Santo Domingo and Santiago, the nation’s two largest cities.

Reliability of the electricity supply is poor, even in urban areas. Many ICT users have had to invest in their own power generators and universal power supply units to protect their ICT equipment against blackouts (Ranking in General Infrastructure micro-index: 64).

The Dominican government has initiated several innovative ICT projects. The Little Intelligent Communities (LINCOS) program focuses on establishing community ICT centers that offer telephone and Internet access as well as telemedicine, community-oriented ICT applications, and Internet radio. The Santo Domingo Cyber Park and the Instituto de las Américas were established to attract foreign direct investment in the ICT sector and to train workers in ICT skills. Finally, computer laboratories were established in several hundred high schools.

There is very little e-commerce, in either the B2C or B2B sectors (Ranking in e-Commerce micro-index: 55). This is due primarily to the low penetration of PCs in both the commercial and consumer markets, a lack of credit card use, the small middle class, and high cost of access. Limited financing sources and high interest rates discourage start-up businesses, especially nascent ICT-related companies.

Many in the Dominican private sector feel it is difficult to find and attract qualified ICT workers. The university-level ICT curriculum remains outdated, and rigid curriculum revision guidelines hamper efforts to introduce the latest ICT skills. Many ICT graduates leave the country for the higher wages they can find elsewhere (Ranking in IT Brain Drain: 43). Computers are common in private schools at the primary and secondary levels, but, in the public schools, there are serious deficiencies in the ICT curriculum, teacher training, and student access to computers (Ranking in Internet Access in Schools: 57). Most Dominican schools continue to grapple with more fundamental needs, such as basic supplies, electricity, and qualified teachers.

Dominican Republic

Key Facts

Population	8,372,695
Rural population (% of total population) 1999	35.64 %
GDP per capita (PPP)	US$5,962
Global Competitiveness Index Ranking, 2001–2002	50
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	59
Main telephone lines per 100 inhabitants	10.39
Telephone faults per 100 main telephone lines	133.20
Internet hosts per 10,000 inhabitants	9.44
Personal computers per 100 inhabitants	NA
Piracy rate	68.00 %
Percent of PCs connected to Internet	NA
Internet users per host	3.80
Internet users per 100 inhabitants	0.30
Cell phone subscribers per 100 inhabitants	7.73
Average monthly cost for 20 hours of Internet access	US$30.42

	RANK
Networked Readiness Index	**47**
Network Use component index	**42**
Enabling Factors component index	**51**
Network Access	**38**
Information Infrastructure	45
Hardware, Software, and Support	31
Network Policy	**48**
Business and Economic Environment	58
ICT Policy	38
Networked Society	**54**
Networked Learning	55
ICT Opportunities	45
Social Capital	63
Networked Economy	**58**
e-Commerce	55
e-Government	56
General Infrastructure	64

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Karen Coppock, *Harvard University*
Colin Maclay, *Harvard University*
with **Luis Adriano Calero,** *Oracle Ecuador S.A.*

> “ We (public and private sector) need to sell an Ecuador of business opportunities and economic stability.”
>
> ***—Ecuadorian IT manager***

> “ There are no policies and strategies for IT within the government.”
>
> ***—Ecuadorian IT manager***

Recent political turbulence, including four presidents in five years, popular protest, and dollarization of the economy, has strained Ecuador’s economy and reputation, and is reflected in the nation’s overall seventy-first ranking in Networked Readiness.

Ecuador is projected to have the hemisphere’s highest inflation rate in 2001 (29 percent), and poverty has leapt from the Latin American average of 40 percent to 69 percent.[1] Despite having one of the world’s higher economic growth rates in 2001 (5 percent),[2] Ecuador continues to face such challenges as an inadequate education system, uneven ICT infrastructure, and heterogeneous population. The government created the National Connectivity Commission in August 2001 to foster cost-effective and universal access to ICT for social and economic development (Ranking in ICT as Government Priority: 67). Community and business leaders also have been working to support ICT adoption broadly, although the scope of cooperation with government is unclear, partly due to the early stage of the government’s Connectivity Agenda.

Over 60 percent of telephones are in Quito, Guayaquil, and Cuenca, although these cities account for only one-third of the country’s population.[3] Teledensity in urban areas is almost four times greater than in rural areas, where 36 percent of Ecuadorians live.[4] High combined telephone and Internet access costs and two PCs per hundred people have driven the trend toward community access. In June 2000, the government formally legalized cyber cafés (Ranking in Public Access to the Internet: 49), including limited use of Voice over Internet Protocol (VoIP) service.

The chief regulator predicts that teledensity will double in two years, and that mobile telephony, which has benefited from fixed line deficiencies, should increase by 300 percent. Recent double-digit growth in cellular telephony indicates telecommunications demand. To improve service and facilitate domestic Internet traffic, private-sector providers have teamed with the regulator to create Latin America’s sixth Network Access Point (NAP).

The government has focused on improving the quality of education and increasing literacy but has disregarded the potential role of information technology. Public and rural educational institutions have little access to advanced technologies (Ranking in Internet Access in Schools: 57). Private and higher education institutions are far more likely to use technology. Private companies have done little to build internal ICT capacity, believing that it will not yield benefits.

While Internet access rates are low, and very little of Ecuador’s society and economy uses ICT, dial-up Internet accounts grew by about 55 percent in 2000.[5] FODETEL, a government telecommunications development fund financed by revenues from the state’s two main telecommunications providers, has slated initial projects for access in remote areas.

Networked Readiness is still elusive in Ecuador, but there are businesses producing software and services for domestic and export markets (Ranking in Availability of Local IT Services: 55). The government does not conduct business via the Internet, yet there is a Web portal for the state, and many agencies have established an online presence offering varied information resources.

After a decade of failing to privatize state-owned telecommunications companies (Ranking in Effect of Telecommunications Competition: 71), the National Modernization Commission announced that, instead of selling them outright, it would seek partners to increase their efficiency (for a management fee) to make them more attractive to investors. Concerns remain about the general business climate in Ecuador, due to limited access to capital, difficulty in starting new businesses, and an insecure legal environment, all of which deter foreign investment.

Ecuador

Key Facts

Population	12,600,000
Rural population (% of total population) 1999	35.70 %
GDP per capita (PPP)	US$3,068
Global Competitiveness Index Ranking, 2001–2002	68
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	58
Main telephone lines per 100 inhabitants	10.00
Telephone faults per 100 main telephone lines	48.00
Internet hosts per 10,000 inhabitants	0.18
Personal computers per 100 inhabitants	1.98
Piracy rate	65.00 %
Percent of PCs connected to Internet	0.77 %
Internet users per host	789.47
Internet users per 100 inhabitants	1.42
Cell phone subscribers per 100 inhabitants	3.81
Average monthly cost for 20 hours of Internet access	US$20.61

	RANK
Networked Readiness Index	**71**
Network Use component index	**73**
Enabling Factors component index	**67**
Network Access	**62**
Information Infrastructure	62
Hardware, Software, and Support	61
Network Policy	**69**
Business and Economic Environment	72
ICT Policy	66
Networked Society	**63**
Networked Learning	65
ICT Opportunities	67
Social Capital	57
Networked Economy	**68**
e-Commerce	72
e-Government	65
General Infrastructure	66

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Magda Ismail, *Harvard University*
Mohamed El Nawawy, *Egyptian IT consultant*

> “ Egypt could naturally be the sort of Arabic content and software development hub in the region, like it has always been for other industries, such as the movie or TV industries.”
>
> ***—Egyptian government IT official***

> “ You can finish high school without seeing a computer. You could very well finish college without seeing a computer: that’s the education problem. The students are not going to be citizens of the world if they don’t know how to use new, world order machines.”
>
> ***—Independent consultant, Egypt***

Notwithstanding its recent efforts, Egypt continues to struggle with Networked Readiness, as reflected by its overall sixtieth ranking in the Networked Readiness Index. Issues such as education, poverty, and intermittent instability due to attacks on tourists in the past years present challenges to overall development and to ICT-related success.

ICT development in Egypt has been driven within the government by the Cabinet of Ministers Information Decision and Support Center (Ranking in Effectiveness of Government ICT Programs: 4). This entity played a key role in institutionalizing the ICT industry and encouraged use of the Internet through provision of free Internet accounts to commercial companies in the early 1990s.[1]

A new regulatory framework for telecommunications was put in place in 1998, which established the Telecommunications Regulatory Authority (TRA) and corporatized Telecom Egypt (TE), the state telecommunications monopoly. In a transitional phase, the TRA is not yet fully independent. TE is the largest incumbent telecommunications operator in the Arab region; it maintains a monopoly over all fixed and international telephony (Ranking in Effect of Telecommunications Competition: 43).

A new Ministry of Communications & Information Technology (MCIT), created in September 1999, proposed a National ICT Plan that focused on human resource development, development of the information and communications infrastructure, and building local demand for ICT. MCIT’s strategy concentrates on building partnerships with the private sector via working groups to produce new initiatives and projects for the ICT market.

The overall user base in the ICT sectors is expected to continue to grow in 2002, with the introduction of free Internet and the emergence of a third mobile provider. Egypt also leads the Arab region in mobile banking applications.[2]

There are several major projects in the making, such as the Smart Village project, which aims to create an “Egyptian Silicon Valley” to attract foreign and local investment, and the Egypt Cyber Center, the first data center in the Middle East. Nonetheless, the private sector faces continuous challenges, particularly because of a lack of a predictable legal framework around consumer rights and electronic transactions.

To address the issue of limited human resource ICT capacity within Egypt, partly due to many well-educated Egyptians leaving the country for employment (Ranking in IT Brain Drain: 36), MCIT has launched several training projects in coordination with multinational ICT companies.

On the e-commerce front, the electronic marketplace continues to evolve on an experimental basis, due mainly to the lack of a financial and logistical infrastructure. Citizen-to-administration efforts have been hindered thus far by overlap among government bodies, yet there has been greater success on the B2B e-commerce side. (Ranking in e-Government micro-index: 51).

Egypt is emerging as a regional software content hub, with 80 percent of its software exported to the Arab world.[3] Although software offerings in Arabic are generally still limited, many feel that Egypt is in a strong position to capitalize on its role as the entertainment capital of the Arab world.

Egypt

Key Facts

Population	63,500,000
Rural population (% of total population) 1999	54.96 %
GDP per capita (PPP)	US$3,602
Global Competitiveness Index Ranking, 2001–2002	51
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	67
Main telephone lines per 100 inhabitants	8.63
Telephone faults per 100 main telephone lines	6.87
Internet hosts per 10,000 inhabitants	0.35
Personal computers per 100 inhabitants	2.21
Piracy rate	56.00 %
Percent of PCs connected to Internet	0.16 %
Internet users per host	200.89
Internet users per 100 inhabitants	0.71
Cell phone subscribers per 100 inhabitants	2.14
Average monthly cost for 20 hours of Internet access	US$12.91

	RANK
Networked Readiness Index	**60**
Network Use component index	**69**
Enabling Factors component index	**52**
■ **Network Access**	**50**
Information Infrastructure	48
Hardware, Software, and Support	52
■ **Network Policy**	**47**
Business and Economic Environment	54
ICT Policy	39
■ **Networked Society**	**57**
Networked Learning	61
ICT Opportunities	37
Social Capital	74
■ **Networked Economy**	**46**
e-Commerce	45
e-Government	51
General Infrastructure	42

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Geoffrey Kirkman, *Harvard University*
Carlos Osorio, *Harvard University*

> “ El Salvador is already worlds away from where it used to be.”
>
> *—University professor, El Salvador*

> “ In order to incorporate more of the population into an El Salvadoran Internet, the economic playing field must be leveled for all citizens.”
>
> *—IT observer, El Salvador*

While facing issues of physical insecurity, urban-rural discrepancies, and roughly a fifth of the population living in poverty, progressive regulatory policies and the industrious Salvadoran nature have led to rapid growth in a number of areas of Networked Readiness. Despite the legacy of years of war that continue to discourage tourism, the nation has embarked on a path of democracy and economic development. El Salvador ranks fifty-fifth overall in Readiness for the Networked World.

Salvadoran information infrastructure was severely damaged by Hurricane Mitch in 1993 and subsequent earthquakes, which slowed down the build-out of the already underdeveloped telecommunications infrastructure (Ranking in Information Infrastructure micro-index: 51).

The relatively dense population of El Salvador has been especially attractive to foreign investors in the telecommunications markets, mainly in cellular telephony. As fierce competition among mobile operators continues to fuel innovative pricing models and saturate the potential cellular telephone market, mobile wireless telephony has become the dominant telecommunications medium in El Salvador. The positive impact of the country’s telecommunications policies has been one of the bright spots in the country’s Networked Readiness situation (Ranking in Effect of Telecommunications Competition: 21).

Rural development of the Internet remains overshadowed by the urban concentration of El Salvador’s telephony. In 1998, about 80 percent of all lines were in the capital, and most departments outside of the San Salvador metropolitan area had fewer than five lines per hundred people.[1] Additionally, about half of the population lives in rural areas, where access to computers via libraries, schools, or Internet kiosks or telecenters is very rare.

While the country is small, transport infrastructure remains poor and hinders internal movement in the country: less than 15 percent of Salvadoran highways are paved. Nevertheless, twenty-five public-access Internet centers have opened in various cities and large towns (Ranking in Public Access to the Internet: 40).[2] This movement has added value to the government and Punto.com initiative of providing free e-mail addresses to all citizens.[3]

Foreign investments have contributed to improved telecommunications networks, thanks to current ICT policy initiatives (Ranking in Effectiveness of Government ICT Programs: 35). Before the privatization of Compañía Telecomunicaciones de El Salvador, the state-owned telecommunications firm (now called TELECOM), customers had to wait for years for installation of a line; today the wait is only days.

With a little more than 20 percent of the population living in extreme poverty, many Salvadorans do not have the income, let alone a reason, to access the Internet.[4] Additionally, competition among ISPs is increasing. Free Internet access providers are starting to make inroads. However, due to high charges for local telephone calls and a time-metered billing system, frequent (and affluent) Internet users are turning increasingly to fixed-price cable packages with higher speeds and lower overall costs (Ranking in Effect of ISP Competition: 37).

E-commerce is still in its infancy. The public sector also remains behind in e-government initiatives. Most government agencies have helpful websites, and a number of newspapers offer the daily news online. However, due to a lack of local critical mass of users, local content remains a shortcoming.

Education has been recognized as a key development factor in recent years; just under 30 percent of the population over age fifteen has no schooling. In 1998, members from different organizations formed *Conectándonos al Fúturo* (Linking Ourselves to the Future), a group to study the best ways to build a learning society in El Salvador (Ranking in Networked Learning micro-index: 52).

El Salvador

Key Facts

Population	6,276,000
Rural population (% of total population) 1999	53.72 %
GDP per capita (PPP)	US$4,477
Global Competitiveness Index Ranking, 2001–2002	58
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	63
Main telephone lines per 100 inhabitants	9.08
Telephone faults per 100 main telephone lines	36.70
Internet hosts per 10,000 inhabitants	0.92
Personal computers per 100 inhabitants	1.59
Piracy rate	79.00 %
Percent of PCs connected to Internet	0.98 %
Internet users per host	41.03
Internet users per 100 inhabitants	0.65
Cell phone subscribers per 100 inhabitants	6.21
Average monthly cost for 20 hours of Internet access	US$19.13

	RANK
Networked Readiness Index	**55**
Network Use component index	**56**
Enabling Factors component index	**58**
Network Access	**58**
Information Infrastructure	51
Hardware, Software, and Support	65
Network Policy	**44**
Business and Economic Environment	51
ICT Policy	37
Networked Society	**58**
Networked Learning	52
ICT Opportunities	56
Social Capital	65
Networked Economy	**59**
e-Commerce	64
e-Government	51
General Infrastructure	61

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Alzhan Braliev, *Harvard University*
with **Tarmo Kalvet,** *Archimedes Foundation*

> “ In the process of the fast increase of IT business, Estonia continues to lack skilled IT specialists.”
>
> ***—Estonian government official***

> “ IT companies are relatively small and are not able to run big projects nor enter global markets. One possible solution can be to network [and] integrate existing small/medium IT companies.”
>
> ***—Estonian IT executive***

Estonia has been a leader among central and eastern European countries in liberalizing its fixed-lines telecommunications market. The nation is also the regional leader in Networked Readiness with its twenty-third overall ranking, comparable to France and Israel.

After reestablishing independence in 1991, Estonia made significant progress in reforming economic and social conditions in the country. Commitment to this reform process, and to a new rule of law, made it one of the first countries in the Baltic region to be included in EU accession negotiations (Ranking in ICT as Government Priority: 3). One of the country's major challenges has been to make the transition from its industrial dependence to a Networked Economy.

The Estonian telecommunications infrastructure is advanced and has been completely upgraded. There is state-financed Internet access in Estonia for government, education, and medical sectors and affordable dial-up Internet costs for the public (Ranking in Internet Price and Quantity: 21). Internet penetration is relatively high by European standards.

Despite an increasing number of students with ICT degrees, the country still lacks a skilled ICT workforce. Moreover, because of noncompetitive salaries, highly qualified ICT specialists have an increased tendency to work abroad (Ranking in IT Brain Drain: 29). To combat these trends, the government and various NGOs are introducing new initiatives to increase the ICT workforce. In the education sector, the Tiger Leap program[1] is aimed at connecting schools and increasing computer literacy among teachers and students.

Several national programs focus on Network Use and e-government. The Look@World initiative's[2] goal is to surpass Finland in Internet use in three years, and to reach an Internet penetration of more than 70 percent. A nationwide government project, e-Citizen,[3] was designed to provide better communication and cooperation between Estonian citizens and the public sector by introducing and supporting Internet services (Ranking in Online Government Services: 3).

Proximity to Finland and a reasonably good telecommunications business environment have influenced a rapid increase in the rate of mobile telephone penetration; mobile density now exceeds the teledensity of fixed lines. Several mobile companies have tested the third generation General Packet Radio Service (GPRS).

Liberal economic reforms have also created a favorable environment for foreign investment in Estonia. Estonia's government has become more connected and ICT-literate and is a global leader in integrating e-government practices into existing frameworks (Ranking in e-Government micro-index: 5). The Estonian administration is equipped with PCs and has Internet access, and the Prime Minister's office opened a website allowing visitors to provide their comments on and recommendations for drafts of future legislation.[4] Most notable, one of the initiatives that has garnered the most attention has been the Electronic Cabinet, which allows government ministers to review legislation, make comments and suggestions, and vote online.[5]

As part of B2C e-commerce development, the number of online banking transactions is increasing rapidly, and Estonians are taking advantage of more developed online activities such as trading equities, submitting tax declarations, buying drugs, purchasing ICT supplies, and accessing the latest news reports (Ranking in Internet-based Payment Systems: 2).[6] However, despite the presence of 400 ICT companies in Estonia, innovation in products and services is relatively low, and many Estonian businesses feel hampered by their country's small market.[7]

Estonia

Key Facts

Population	1,439,197
Rural population (% of total population) 1999	31.14 %
GDP per capita (PPP)	US$9,178
Global Competitiveness Index Ranking, 2001–2002	29
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	36
Main telephone lines per 100 inhabitants	36.32
Telephone faults per 100 main telephone lines	28.60
Internet hosts per 10,000 inhabitants	284.25
Personal computers per 100 inhabitants	13.55
Piracy rate	NA
Percent of PCs connected to Internet	15.44 %
Internet users per host	8.96
Internet users per 100 inhabitants	25.47
Cell phone subscribers per 100 inhabitants	38.70
Average monthly cost for 20 hours of Internet access	US$9.84

	RANK
Networked Readiness Index	**23**
Network Use component index	**21**
Enabling Factors component index	**24**
Network Access	**29**
Information Infrastructure	32
Hardware, Software, and Support	25
Network Policy	**21**
Business and Economic Environment	25
ICT Policy	16
Networked Society	**25**
Networked Learning	22
ICT Opportunities	31
Social Capital	23
Networked Economy	**25**
e-Commerce	25
e-Government	5
General Infrastructure	44

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Indran Ratnathicam, *Harvard University*

> “ The exceptionally well educated workforce and national dependence on IT, particularly communications technologies, have created a virtuous cycle of ICT development in Finland.”
>
> **—*Finnish software developer***

> “ Rare use of authentication techniques has hurt e-commerce. The techniques exist, but are not widely used in Finland.”
>
> **—*Finnish communications manager***

Finland, whose economy was traditionally based on heavy industry and forestry, has become a leader in the Networked World in recent years, ranking third overall in the Networked Readiness Index. Finland’s strength in economic competitiveness (as reflected in its number one ranking in this year’s Global Competitiveness Index) is deeply intertwined with the nation’s success in deploying and using information and communication technologies.

Finland’s strengths are evident in its extremely well developed information infrastructure, high-quality workforce, effective policy environment, and sophisticated use of ICTs. The Finnish ICT industry is so large and globally influential that Finland’s high-technology exports exceed imports, a unique phenomenon for an OECD country.

Although Finland’s commercial ICT success is often connected to the rise of telecommunications equipment manufacturer Nokia, it can also be traced to long-term, intense investment in national information infrastructure (Ranking in Information Infrastructure micro-index: 1), and in ICT-oriented public education programs. As a country that once was home to hundreds of telephone companies in the 1920s, Finland has a history of building out information infrastructure to connect its geographically dispersed population. The modern telecommunications industry has been progressively deregulated since 1985, and the resulting competition has spawned some of the lowest network operating costs in the world (Ranking in Effect of Telecommunications Competition: 1). There are robust broadband, mobile, and digital backbone networks throughout the country (Ranking in Availability of Broadband: 1).

In addition to a high penetration of Internet access in households and workplaces, Finland has a well developed infrastructure for public access to the Internet (PIAP) via libraries and other public places (Ranking in Public Access to the Internet: 2). Between 1995 and 1999, the government provided almost US$250,000 per year per village for rural areas to subsidize ICT equipment and personnel.[1] When considered together with regional programs such as *Tietotupa* (information huts), which provide communal access to the Internet and other technologies, an expansive system of access is evident throughout Finland.[2] The government has stressed the importance of its *Information Strategy for Education and Research 2000–2004*, created to provide ICT access and literacy training for those in need, with priority given to the poor and minority groups.[3]

All Finnish schools are connected to the Internet (Ranking in Internet Access in Schools: 1). These networked schools offer online administrative functions such as course enrollment and grading as well as online classes and tutorials at the high school and university levels. Computer facilities for games and learning are even provided in public daycare and preschool facilities.

Finland is also a leader in e-commerce (Ranking in e-Commerce micro-index: 2). The financial services industry implemented advanced payment, security, and verification internal IT systems in the early 1990s, enabling Finnish banks to be among the first in the world to offer online and mobile banking. Though Finnish consumers have been slower to adopt e-commerce for business and retail, evidence of the nation’s ICT sophistication can be found in car washes and soda machines paid via mobile phone. Online services are now used widely, and banking and information transfer remain the largest segments of e-commerce for both businesses and consumers.

Finland

Key Facts

Population	5,176,000
Rural population (% of total population) 1999	33.28 %
GDP per capita (PPP)	US$24,864
Global Competitiveness Index Ranking, 2001–2002	1
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	10
Main telephone lines per 100 inhabitants	54.69
Telephone faults per 100 main telephone lines	8.40
Internet hosts per 10,000 inhabitants	1022.53
Personal computers per 100 inhabitants	39.61
Piracy rate	29.00 %
Percent of PCs connected to Internet	25.82 %
Internet users per host	3.64
Internet users per 100 inhabitants	37.23
Cell phone subscribers per 100 inhabitants	72.64
Average monthly cost for 20 hours of Internet access	US$7.26

	RANK
Networked Readiness Index	**3**
Network Use component index	**3**
Enabling Factors component index	**1**
Network Access	**2**
Information Infrastructure	1
Hardware, Software, and Support	3
Network Policy	**2**
Business and Economic Environment	2
ICT Policy	1
Networked Society	**1**
Networked Learning	1
ICT Opportunities	2
Social Capital	1
Networked Economy	**3**
e-Commerce	2
e-Government	2
General Infrastructure	6

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Stephanie Hutchison, *Harvard University*
Stephen Minton, *International Data Corporation*

> “ France has some of the fastest growth rates for Internet usage, PC shipments, and overall IT spending by businesses, consumers, government, and education. The French government has been keen to promote Internet usage by business and education users.”
>
> ***—French IT executive***

> “ We need to build…the confidence in electronic payment systems to grow B2C e-commerce and get a computer on every desk at school.”
>
> ***—Executive, French software firm***

With PC penetration and Internet use below the EU average, the French are seen by many to be laggards in technology adoption. In reality, the country finds itself in a rapid transition state. France is ranked twenty-fourth overall in Readiness for the Networked World. The proliferation of the proprietary Minitel system in the early 1980s led to slower PC and Internet adoption than in many other nations. At the same time, recent government initiatives, greater involvement by foreign ICT multinationals, and integration in international ICT trade have encouraged greater adoption and use of standard international ICT products and services.

In 1982, France Telecom, the telecommunications monopoly at the time, introduced the Minitel, a proprietary network that charges users by the minute to access phone numbers, gather information, make travel reservations, conduct financial transactions, and purchase goods. Its simplicity has attracted an estimated 16 million users in France.[1] The Minitel's popularity delayed adoption of personal computers and related technologies by French households. Government and educational institutions also were slow to implement PC technologies.

Recent government initiatives have been launched to increase adoption of ICTs (Ranking in ICT as Government Priority: 26). In 1998, the French government launched a program to “prepare the entry of France into the Information Society” (PAGSI). The 218 measures of the PAGSI plan address needs in six key areas of ICT development—education, culture, business, local technological innovation, government services, and regulation.[2]

In 1998, only 2 percent of the French population used the Internet; this figure had risen to 10 percent by 2000. Seventy percent of French businesses now have Internet connections versus 28 percent in 1998.[3] In July 2000, the French government reviewed progress to date, revealing that 100 percent of high schools and 65 percent of middle schools were connected to the Internet (Ranking in Internet Access in Schools: 29).[4] France also made great progress in developing e-government services, with 78 percent of state services now online (Ranking in Online Government Services: 22).[5]

This furious pace of technology adoption shows no signs of abating. Although in 2001, PC sales are expected to fall by 4 percent in Europe as a whole, France's PC sales are expected to grow by 3 percent.[6] Total ICT spending is also expected to grow by 10 percent in France versus 8 percent in Europe as a whole.[7] Decreasing Internet access prices have helped to fuel Internet and technology adoption in France.[8] There has been a growing perception of tremendous activity in Internet-related businesses (France ranks among the top five nations in Dot-com Competition, Internet Start-ups, and VC Funding, driving its overall ranking in e-Commerce micro-index to eighth).

Despite this growth, use of the Internet's capabilities is still conservative. The Minitel aside, Internet-based B2C e-commerce has been slower to take hold. At the end of 2000, 2000 websites were e-commerce enabled, but only 20 percent had significant turnover.[9] Only 15 percent of French Internet users buy online versus 44 percent in the U.S., and only 4 percent of French households shop over the Internet versus 18 percent in the EU overall.[10]

France

Key Facts

Population	58,800,000
Rural population (% of total population) 1999	24.58 %
GDP per capita (PPP)	US$24,032
Global Competitiveness Index Ranking, 2001–2002	20
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	11
Main telephone lines per 100 inhabitants	58.01
Telephone faults per 100 main telephone lines	5.90
Internet hosts per 10,000 inhabitants	190.89
Personal computers per 100 inhabitants	30.48
Piracy rate	40.00 %
Percent of PCs connected to Internet	6.26 %
Internet users per host	7.57
Internet users per 100 inhabitants	14.46
Cell phone subscribers per 100 inhabitants	49.40
Average monthly cost for 20 hours of Internet access	US$18.86

	RANK
Networked Readiness Index	**24**
Network Use component index	**27**
Enabling Factors component index	**14**
■ **Network Access**	**13**
Information Infrastructure	14
Hardware, Software, and Support	12
■ **Network Policy**	**15**
Business and Economic Environment	18
ICT Policy	12
■ **Networked Society**	**19**
Networked Learning	26
ICT Opportunities	15
Social Capital	15
■ **Networked Economy**	**10**
e-Commerce	8
e-Government	19
General Infrastructure	3

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Mridul Chowdhury, *Harvard University*
with **Juergen K. Faust,** *A.I.M. Consultants, Germany*
Bernd Almstedt, *ASCARON Software GmbH*

> “ E-commerce in Germany experienced a dramatic setback in 2001, due to the inexperienced entrepreneurship of young German IT managers.”
>
> ***—German IT consultant***

> “ DSL has been growing fast in Germany in recent times. The flat rates are reasonably priced, thus a lot of home users have recently got and are getting (mid-) broadband access to the Internet, which opens new opportunities for B2C activities.”
>
> ***—Multimedia company executive, Germany***

Germany, with an overall Networked Readiness ranking of seventeen in this year’s Index, is a nation of interesting contrasts. While it has one of the world’s largest and most vibrant telecommunications markets, German Internet penetration and, to a lesser extent, mobile penetration, have progressed rather slowly compared to most other major OECD countries. Germany has established itself as a European leader in e-commerce, but has been less successful in e-government. Also, within its dynamic e-commerce sector, B2B e-commerce largely dominates, while B2C e-commerce shows a conservative growth pattern.

Germany has one of the most advanced information infrastructures in Europe (Ranking in Network Access subindex: 9) with the Regulatory Authority for Telecommunications and Post (RegTP) playing an effective role in regulating the telecommunications sector. Although some hindrances remain, such as the dominance of the local loop by the ex-monopoly provider, Deutsche Telekom, the German telecommunications sector is characterized by fierce competition that has led to dramatic price decreases since 1998 (Ranking in Effect of Telecommunications Competition: 3). Nevertheless, this competition has not led to a corresponding increase in Internet penetration, which is currently about half of that of the United States.

Despite relatively low Internet penetration, Germany has become an innovative B2B e-commerce leader and a pioneer in the production of knowledge-management software. The nation’s fast growth in B2B e-commerce has largely been driven by its vibrant venture capital community (Ranking in VC Willingness to Invest in e-Commerce: 1), energetic entrepreneurship in the dot-com sector (Ranking in Prevalence of Internet Start-ups: 2), and rapid adoption of sophisticated B2B e-commerce by internationally competitive industries, such as automotive, aerospace, chemicals, finance, and insurance. At the same time, B2C e-commerce has had only a modest uptake, hindered by distrust of online security, general reluctance among Germans to use credit cards, and inadequate consumer protection laws. Online banking and trading are popular among German Internet users. Germans are also leaders within Europe in Short Messaging Service (SMS) use.

In e-government, the German government has yet to demonstrate effective leadership in putting its services online (Ranking in Online Government Services: 31). Since unification of East and West Germany, equitable distribution of resources has been an important priority for the government. To that end, programs such as Internet for All and Germany 21 are designed to ensure widespread Networked Readiness throughout the nation.

One of the primary challenges in ICT development in Germany is the inadequate supply of an ICT-skilled workforce. Despite the growth of ICT jobs in Germany (Ranking in ICT Opportunities micro-index: 4), the nation is facing a grave manpower shortage. The Green Card Initiative to attract foreign workers and other campaigns to lure back expatriates have shown limited success so far.

In 2000, several telecommunications companies made heavy commitments at auction to invest in third-generation UMTS cellular telephony licenses in Germany; the excessive final bids precipitated painful restructuring processes and asset sales among the winners. RegTP is seeking ways to alleviate these companies’ financial risk by allowing them to share infrastructure.

Germany

Key Facts

Population	82,200,000
Rural population (% of total population) 1999	12.70 %
GDP per capita (PPP)	US$24,931
Global Competitiveness Index Ranking, 2001–2002	17
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	14
Main telephone lines per 100 inhabitants	60.11
Telephone faults per 100 main telephone lines	8.70
Internet hosts per 10,000 inhabitants	248.30
Personal computers per 100 inhabitants	33.64
Piracy rate	28.00 %
Percent of PCs connected to Internet	7.38 %
Internet users per host	11.76
Internet users per 100 inhabitants	29.21
Cell phone subscribers per 100 inhabitants	58.58
Average monthly cost for 20 hours of Internet access	US$24.81

	RANK
Networked Readiness Index	**17**
Network Use component index	**18**
Enabling Factors component index	**10**
■ **Network Access**	**9**
Information Infrastructure	12
Hardware, Software, and Support	5
■ **Network Policy**	**13**
Business and Economic Environment	15
ICT Policy	11
■ **Networked Society**	**10**
Networked Learning	17
ICT Opportunities	4
Social Capital	10
■ **Networked Economy**	**9**
e-Commerce	3
e-Government	22
General Infrastructure	1

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Alzhan Braliev, *Harvard University*
Nicholas Yatromanolakis, *The Kokkalis Program, Harvard University*

> “ Absence of a sophisticated legal framework and willpower for the regulation of competition between private sector companies impede ICT development in Greece.”
>
> ***—Senior consultant, IT company, Greece***

> “ The Greek cellular telephone market has been a success. There is big potential for wireless Internet.”
>
> ***—Professor of computer science, Greece***

The Greek ICT landscape is characterized by both delay and vibrancy. With only 12 percent of its population using the Internet, Greece lags behind the other EU nations, and ranks thirty-first overall in Readiness for the Networked World, just behind Hungary and Slovenia. Yet, the nation’s cellular phone penetration is one of the highest in the EU—almost 60 percent.[1] Greece is a Networked leader in the Balkans, pursuing public and private regional cross-border initiatives. European funding, coupled with pressure from the EU, is expected to spur development of the ICT sector.

E-government is at an initial stage in Greece (Ranking in e-Government micro-index: 54), but systems are beginning to be implemented. In February 1999, the Greek government issued *Greece in the Information Society: Strategy and Actions*, which identifies the major axes of ICT policy for the years 2000 to 2006. Some noteworthy results already have been achieved; Greek citizens can submit several government forms online and file their income taxes electronically.

The central government also intends to incorporate ICT into the education, health care, transportation, culture, and tourism sectors. Special emphasis will be given to the advancement of telemedicine and to public health facilities, where the goal is to achieve 100 percent connectivity by 2006. The educational priority is to provide schools and universities with Internet access, train all students and staff by 2003, and develop digital educational content for online use. Currently, only 1 percent of primary schools and 38 percent of secondary schools are connected to the Internet (Ranking in Internet Access in Schools: 55), while the students per PC ratios are 1,097:1 and 31:1 for primary and secondary schools, respectively.[2]

The private sector also has played a significant role in the development of Greek ICT infrastructure (Ranking in Information Infrastructure micro-index: 30). The banking sector, along with some major corporations (notably, former state telecom monopoly OTE, Hellenic Telecommunications Organization, and telecom equipment manufacturer Intracom), are the leading forces in Greece’s ICT market, due to their strong investment programs and in-house R&D. B2C e-Commerce in Greece is just beginning because of low Internet penetration, low credit card use, low purchasing power among the demographic group using the Internet, and suspicion of online security. The Go Digital and Get Connected programs of the Ministry for Development address some challenges such as connectivity for small and medium enterprises, development of a strong e-commerce environment for B2B and B2C, vocational training programs to increase computer/ICT literacy, and advancement of ICT R&D programs.

A key factor in Greek Networked Readiness efforts was the establishment of a regulatory framework. The Hellenic Commission on Telecommunications and Postal Services (EETT) is the main regulatory authority. EETT began operating in 1992 when the country’s first two cellular licenses were issued; since then, EETT has evolved into the liberalization vehicle of the telecommunications sector in Greece. Since 2001, EETT’s oversight has included the fixed lines infrastructure, and it is expected that lower fixed-line, dial-up and ISDN rates will contribute to increasing the number of Greeks connected to the Internet.

Greece

Key Facts

Population	10,600,000
Rural population (% of total population) 1999	40.08 %
GDP per capita (PPP)	US$16,326
Global Competitiveness Index Ranking, 2001–2002	36
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	22
Main telephone lines per 100 inhabitants	53.16
Telephone faults per 100 main telephone lines	17.00
Internet hosts per 10,000 inhabitants	103.91
Personal computers per 100 inhabitants	7.05
Piracy rate	66.00 %
Percent of PCs connected to Internet	14.75 %
Internet users per host	9.04
Internet users per 100 inhabitants	9.39
Cell phone subscribers per 100 inhabitants	55.90
Average monthly cost for 20 hours of Internet access	US$16.04

	RANK
Networked Readiness Index	**31**
Network Use component index	**30**
Enabling Factors component index	**35**
Network Access	**39**
Information Infrastructure	30
Hardware, Software, and Support	47
Network Policy	**43**
Business and Economic Environment	42
ICT Policy	43
Networked Society	**35**
Networked Learning	42
ICT Opportunities	29
Social Capital	35
Networked Economy	**41**
e-Commerce	47
e-Government	54
General Infrastructure	23

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Mark Lopes, *Harvard University*
with **Lester Echeverría,** *AGEXPRONT*

> “ Companies have no funds left for IT investment.”
>
> ***— IT consultant, Guatemala***

> “ Entrepreneurship with information technologies in Guatemala will rise if private companies provide affordable e-commerce solutions for small and medium businesses.”
>
> ***—Guatemalan IT entrepreneur***

The Guatemalan government is pursuing an integrated approach to incorporate the use of ICTs in the national social and economic development agenda. Successful government initiatives have served as models and helped to build public confidence. In the private sector, recent liberalization of the telecommunications industry has spurred growth, investment options, and increased local interest. Challenges related to widespread poverty, a linguistically and ethnically divided population, a small private sector, and inadequate educational opportunities are hindering Guatemala’s Networked Readiness. It is ranked sixty-eighth in the Networked Readiness Index.

Approximately 70 percent of the Guatemalan population lives in rural areas, yet 80 percent of the fixed-line connections are in Guatemala City.[1] Rural telephony development, therefore, is critical for truly national ICT development. Guatel (now called Telgua), the formerly state-owned telecommunications operator, was privatized in 1998. Since privatization, there have been improvements in service, coverage, and waiting time to obtain a new telephone line (Ranking in Effect of Telecommunications Competition: 47). However, urban and rural disparities remain marked, and this will continue to limit rural Internet adoption and the diffusion of services. Growth rates in wireless telephony between 1998 and 2000 reached more than 600 percent, but wireless penetration still remains low relative to the total population.[2] In 2000, there were approximately fifteen ISPs with an estimated 65,000 Internet users (Ranking in Public Access to the Internet: 59).

The government of Guatemala, together with the World Bank and UNDP, recently developed an integrated financial system website to improve administration and fiscal transparency (Ranking in Online Government Services: 54). The system reduces payment time by recording financial transactions in an online database. The next step will be to take this idea to municipalities and local governments. The project won the World Bank Excellency award in 1999 and has served as a strong model that has helped to build confidence in the value of public-sector investments in ICTs.

Although many Guatemalan businesses have begun using the Internet to acquire new clients, increase sales, and diversify markets, they have done so with limited success. E-commerce remains new to the business community (Ranking in e-Commerce micro-index: 65); exporters as well as local sellers have become more involved in recent years, but trade red tape, combined with the overall lack of diffusion of services, continues to limit opportunities. Even though most businesses have yet to become convinced of the Internet’s value as a marketing tool, most agree that having an online presence adds an image of prestige (Ranking in Business Websites: 62).

The Non Traditional Exporters Association and the Guatemalan Chamber of Commerce are promoting the use of the Internet for business, social, and educational development. They have collaborated to form business centers that offer Internet access and videoconferencing for business training and consultation. These groups hope to stimulate local businesses and increase access to foreign markets.

Many of the challenges that hinder broader economic development in Guatemala also hinder adoption of ICTs. Key issues are providing telephony access to the large rural population and developing a legal and regulatory framework conducive to Networked Readiness. Foreign investment remains restricted as a result of a lack of user-friendly foreign investment laws.

Guatemala

Key Facts

Population	11,400,000
Rural population (% of total population) 1999	60.52 %
GDP per capita (PPP)	US$3,784
Global Competitiveness Index Ranking, 2001–2002	66
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	70
Main telephone lines per 100 inhabitants	5.70
Telephone faults per 100 main telephone lines	45.20
Internet hosts per 10,000 inhabitants	4.92
Personal computers per 100 inhabitants	0.97
Piracy rate	77.00 %
Percent of PCs connected to Internet	1.61 %
Internet users per host	36.68
Internet users per 100 inhabitants	0.59
Cell phone subscribers per 100 inhabitants	3.04
Average monthly cost for 20 hours of Internet access	US$20.00

	RANK
Networked Readiness Index	**68**
Network Use component index	**62**
Enabling Factors component index	**66**
■ **Network Access**	**58**
Information Infrastructure	53
Hardware, Software, and Support	63
■ **Network Policy**	**64**
Business and Economic Environment	68
ICT Policy	60
■ **Networked Society**	**66**
Networked Learning	70
ICT Opportunities	56
Social Capital	73
■ **Networked Economy**	**67**
e-Commerce	65
e-Government	65
General Infrastructure	70

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Mark Lopes, *Harvard University*
with **Ralph Oberholzer,** *Grupo Financiero Ficohsa*

> “ The future depends on technology, and if we don’t lead our students toward it, we would be failing.”
>
> ***—Senior IT education administrator, Honduras***

> “ Many fear privatization of HONDUTel will not occur anytime soon.”
>
> ***—Honduran telecommunications executive***

As part of its reconstruction and transformation process after the devastating damage from Hurricane Mitch in 1998, Honduras invested heavily in infrastructure development. Yet, Honduran telecommunications and ICT infrastructure remains poor (Ranking in Information Infrastructure micro-index: 71) and, together with widespread poverty, an inadequate education system, and limited available funding, there are major challenges to Networked Readiness as indicated by its seventy-second overall ranking.

A very large percentage of the Honduran population, principally in rural areas, continues to lack access to basic fixed-line telephone services and electricity. Twenty private ISPs compete to provide services to an estimated 30,000 users. Internet dial-up fees are comparable to those in other Central American countries and, as in many other developing nations, represent a significant portion of individuals’ average monthly income.

Honduran institutions have made efforts to join and create regional networks to promote ICT diffusion. An example of this is the Red Hemisférica Universitaria de Ciencia y Tecnología (RedHUCyT), a network of academic and scientific institutions throughout Central and South America. Through RedHUCyT, with participation from HONDUTel, the national telecommunications company, and the Autonomous University of Honduras (UNAH), Honduran researchers have received greater access to communications equipment, network manager training, technical assistance, and knowledge sharing.[1]

A number of national-level initiatives are focused on extending connectivity to rural areas and schools, which is currently quite limited (Ranking in Internet Access in Schools: 71). Solar.net Villages is a collaborative effort with UNESCO (United Nations Educational, Scientific and Cultural Organization), and the National Council for Science and Technology (COHCIT) that, among other services, provides rural communities a connection to the Internet via satellite. The goal of the project is to create a model for sustainable development that can be replicated nationally. The environmentally sustainable villages aim to advance the community in health, education, and small-business development. The success of the first two communities in San Ramon (Choluteca) and San Francisco (Lempira) has led the government to request funds and plan for construction of hundreds more centers throughout the country over the next several years.[2] *Ampliando Horizontes,* another nationally coordinated project, launched in 1998, is a computer education initiative that is part of the National Education Plan. The project aims to connect 192 schools nationwide, using the computer as a pedagogical tool.[3]

Telecommunications in Honduras remain underdeveloped compared to other countries in the region. At fewer than five telephones per hundred inhabitants, Honduras has the second-lowest teledensity in Central America. Partly due to Hurricane Mitch, the partial privatization of HONDUTel was postponed again, this time until 2002 (Ranking in Effect of Telecommunications Competition: 74). Upon privatization, the winner is set to receive a monopoly on basic services through 2005 and a mobile PCS license. Although Honduras was one of the last Latin American countries to license cellular services, use of them is expanding rapidly. In the coming year, the national government will try to tackle the politically sensitive issue of reform in the electricity sector. Many hope these reforms will improve basic services, expand coverage throughout the country, and lay the groundwork for future Networked Readiness.

Key Facts

Population	6,485,000
Rural population (% of total population) 1999	48.34 %
GDP per capita (PPP)	US$2,469
Global Competitiveness Index Ranking, 2001–2002	70
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	69
Main telephone lines per 100 inhabitants	4.60
Telephone faults per 100 main telephone lines	24.00
Internet hosts per 10,000 inhabitants	0.20
Personal computers per 100 inhabitants	0.93
Piracy rate	68.00 %
Percent of PCs connected to Internet	0.20 %
Internet users per host	312.50
Internet users per 100 inhabitants	0.62
Cell phone subscribers per 100 inhabitants	2.39
Average monthly cost for 20 hours of Internet access	US$22.36

	RANK
Networked Readiness Index	**72**
Network Use component index	**72**
Enabling Factors component index	**71**
Network Access	**68**
Information Infrastructure	71
Hardware, Software, and Support	64
Network Policy	**73**
Business and Economic Environment	74
ICT Policy	71
Networked Society	**64**
Networked Learning	74
ICT Opportunities	48
Social Capital	69
Networked Economy	**70**
e-Commerce	70
e-Government	72
General Infrastructure	67

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Mridul Chowdhury, *Harvard University*
with **Steve Yeung,** *Computer and Technologies Holdings Ltd.*

> "Many Hong Kong services firms are intertwined with the manufacturing sector. The boundary between manufacturing and services is often blurred…making corporate functions intensely IT-dependent."
>
> ***—Business consultant, Hong Kong***

> "Hong Kong suffers from a major shortage of IT-skilled professionals. It is also difficult to retain good staff. We need to introduce creative remuneration packages, including performance-based salary."
>
> ***—Executive of Hong Kong IT company***

Over the last two decades, Hong Kong's economy has moved dramatically from manufacturing-based to service-based, particularly financial services. This shift paved the way for Hong Kong to push aggressively toward the Networked World because the financial sector is intensely information-dependent. The national ICT strategy, *Digital 21*, embodies the government's commitment to positioning the Hong Kong Special Administrative Region (HKSAR) as a leading "digital city in the globally connected world" to retain its competitive edge and to drive its overall economic expansion.[1] Impressive progress has been made in creating a solid base for that goal with respect to telecommunications infrastructure and diffusion of information technologies, driving the nation's overall Networked Readiness to be thirteenth.

Hong Kong ranks among the highest in Asia in terms of penetration of fixed-line telephones, cellular telephones, and the Internet. A number of factors have led to this scenario: the broad reach of its telecommunications infrastructure; the size and density of the region; and intense competition in the telecommunications sector. Hong Kong has one of the most developed telecommunications infrastructures in Asia (Ranking in Information Infrastructure micro-index: 9), with a broadband network covering all commercial buildings and more than 95 percent of households.[2] Hong Kong's telecommunications regulator is considered by many to be the most dynamic in Asia (Ranking in Effect of Telecommunications Competition: 3), marked by its creation in 1993 and efficient liberalization of the market throughout the 1990s.

Adoption of ICTs in Hong Kong is rising gradually. The private sector has moved increasingly to adopt e-commerce (Ranking in e-Commerce micro-index: 11); many financial services companies in particular have adopted ICTs heavily and now provide services through the Internet. More than a third of Hong Kong's Internet users have made online purchases. The government has been actively encouraging the use of ICTs by providing many of its services online and increasingly conducting its activities through networked platforms (Ranking in e-Government micro-index: 7).

The government is also making efforts to ensure equitable distribution of ICTs in society and in business. The government has installed "Cyber Points" at various public places throughout Hong Kong Island, Kowloon, and the New Territories. These provide free Internet services and access to the government Electronic Service Delivery (ESD) website that provides many government-to-citizen (G2C) and government-to-business (G2B) services. Several projects are underway to develop ICT education in schools as part of the Hong Kong Education City program. The government has also launched an ERP Highway program to help small and medium enterprises (SMEs) gain access to affordable Enterprise Resource Planning solutions.

One of Hong Kong's major hurdles is a severe lack of ICT-skilled human resources, a result of high levels of brain drain (Ranking in IT Brain Drain: 19) and insufficient ICT training programs (Ranking in Quality of IT Education: 18). Efforts are underway to enable a greater degree of mobility of ICT talent between mainland China and Hong Kong SAR. The success of the CyberPort project, a 240,000-square-mile high-tech hub being built for ICT companies, will depend on how Hong Kong deals with the lack of human resources.

Hong Kong SAR

Key Facts

Population	6,796,700
Rural population (% of total population) 1999	0.00 %
GDP per capita (PPP)	US$24,448
Global Competitiveness Index Ranking, 2001–2002	13
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	23
Main telephone lines per 100 inhabitants	57.76
Telephone faults per 100 main telephone lines	21.60
Internet hosts per 10,000 inhabitants	336.90
Personal computers per 100 inhabitants	34.72
Piracy rate	57.00 %
Percent of PCs connected to Internet	9.70 %
Internet users per host	9.97
Internet users per 100 inhabitants	33.59
Cell phone subscribers per 100 inhabitants	80.14
Average monthly cost for 20 hours of Internet access	US$16.50

	RANK
Networked Readiness Index	**13**
Network Use component index	**12**
Enabling Factors component index	**15**
Network Access	**16**
Information Infrastructure	9
Hardware, Software, and Support	22
Network Policy	**6**
Business and Economic Environment	7
ICT Policy	5
Networked Society	**25**
Networked Learning	15
ICT Opportunities	21
Social Capital	40
Networked Economy	**11**
e-Commerce	11
e-Government	7
General Infrastructure	16

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Alzhan Braliev, *Harvard University*
with **Tamas Andrasi,** *Bell Research, Hungary*

> “ Increasing capital investment in the ICT sector and narrowing the gap between research and education are the priorities for transition to a knowledge-based economy.”
>
> ***—Managing Director, Hungarian software company***

> “ There is a huge demand for up-to-date information and technologies. The Hungarian government considers the development of the Information Society a key element in ensuring the competitiveness of the country.”
>
> ***—Hungarian government official***

Hungary, compared to other former socialist countries, made the transition to the Networked World with a fairly sophisticated ICT infrastructure and a progressive political approach. This attitude and infrastructure helped Hungary to qualify in the first round for admittance into the European Union. The incentive of membership in the EU is a primary driving force in identifying national strategies and priorities to promote liberalization and further development of the ICT sector.

Hungary is one of the most technologically advanced countries in Central and Eastern Europe, as can be surmised by its overall thirtieth ranking in Readiness for the Networked World, behind regional leaders Slovenia, Czech Republic, and Estonia. The current government has shown enthusiasm for meeting the challenges that exist. High access costs are one major hurdle to widening Internet access, especially for private use.[1] Hungary has high teledensity for both fixed and mobile lines compared to other countries in the region. In addition to monthly telephone connection, citizens spend about one-ninth of their average monthly salary for Internet access alone.[2] With the end of the Matav fixed lines monopoly at the end of 2001, the markets for local, long-distance, and international calls were planned to be liberalized (Ranking in Effect of Telecommunications Competition: 36).

Despite current high access costs, incentives for Internet use are increasing as Hungarian online content increases: more newspapers, television channels, radio stations, corporate firms, and universities have been establishing their Web presence.[3] Nearly 200,000 websites currently have Hungarian content, and most professional websites also provide information in English.[4] In the workplace, the Internet is used primarily for e-mail. One government initiative to increase ICT literacy among the population is *Sulinet* (School Net), launched in 1996. As part of the program's first phase, *Sulinet* is establishing Internet connectivity in all secondary schools in Hungary. The second phase will provide Internet access to all of the elementary schools in the country (Ranking in Internet Access in Schools: 16). The initiative pays significant attention to distance learning, especially for people in rural areas.

E-commerce has been growing rapidly in recent years. Investments in Hungarian Internet companies speak to interest in the country's e-commerce potential. The turnover of Hungarian B2B e-commerce was about US$72 million in 2000, while B2C e-commerce performance was almost US$3.8 million.[5] Estimated revenues of the Hungarian telecommunications sector in 2000 were US$2.8 billion and are expected to grow by 20 percent in 2001.[6]

In 2000, the Office of the Government Commissioner for ICT established an institution with responsibility for working out a strategy for Hungarian ICT development. The result is outlined within the *Szechenyi Plan*,[7] a medium-term economic development strategy whose goal is to achieve sustainable economic growth and improve the competitiveness of the Hungarian economy (Ranking in ICT as Government Priority: 30). At the same time, priority projects on Networked Readiness are planned for completion before January 2003. The Hungarian government is also reviewing a new law on e-commerce and is working on a new unified telecommunications act, a prerequisite for the liberalization of the ICT market.

Hungary

Key Facts

Population	10,200,000
Rural population (% of total population) 1999	36.20 %
GDP per capita (PPP)	US$12,335
Global Competitiveness Index Ranking, 2001–2002	28
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	31
Main telephone lines per 100 inhabitants	37.09
Telephone faults per 100 main telephone lines	16.80
Internet hosts per 10,000 inhabitants	102.09
Personal computers per 100 inhabitants	8.51
Piracy rate	51.00 %
Percent of PCs connected to Internet	12.00 %
Internet users per host	6.85
Internet users per 100 inhabitants	6.99
Cell phone subscribers per 100 inhabitants	29.33
Average monthly cost for 20 hours of Internet access	US$20.74

	RANK
Networked Readiness Index	**30**
Network Use component index	**32**
Enabling Factors component index	**29**
Network Access	**29**
Information Infrastructure	29
Hardware, Software, and Support	29
Network Policy	**32**
Business and Economic Environment	28
ICT Policy	35
Networked Society	**27**
Networked Learning	21
ICT Opportunities	37
Social Capital	22
Networked Economy	**36**
e-Commerce	36
e-Government	25
General Infrastructure	48

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Indran Ratnathicam, *Harvard University*

> “ Word-of-mouth plays a very important role in a country as small as Iceland, and no one wants to lag behind. Also, Iceland is an egalitarian society, which makes it easier to implement new ideas.”
>
> ***—IT leader in Iceland***

> “ Not enough incentives exist for local content development given the limited size of the market.”
>
> ***—Icelandic IT analyst***

In spite of ranking second on the overall Networked Readiness Index, it is often forgotten that Iceland is one of the world’s most technologically sophisticated societies. Citizens of Iceland have readily embraced ICTs as a natural complement to their communicative but geographically isolated culture, and the government has done much to advance ICTs as a tool to improve the country’s internal services and economic connectivity to the rest of the world (Ranking in Effectiveness of Government ICT Programs: 4).

The people of Iceland have adopted new ICT services almost as quickly as they are offered. Iceland boasts the highest level of Internet connectivity in the world and the second-highest level of mobile connectivity (Ranking in Network Use component index: 1). The small, relatively concentrated population and high GDP per capita make infrastructure build-out less problematic (Ranking in Information Infrastructure micro-index: 8), and adoption of consumer technology more financially accessible, than in many other nations.

Iceland offers few barriers—legal, geographic, or economic—to the latest technological innovations, and is sometimes used as a test market for foreign companies. Advanced communications services have often reached Iceland before they are seen in most of the rest of the world. As in other Nordic countries, Iceland in the past two decades has adopted telebanking and other ICT infrastructures before the advent of mobile telephony or the Internet, and was able to migrate to subsequent technologies relatively quickly. Icelanders were among the first in the world to use text messaging, mobile bank transactions, and voice portals.

The Icelandic government has tailored its ICT policies to accommodate the population’s affinity for technology, with an eye toward using ICTs to improve the economic climate. By law, telephone calls in Iceland are offered point-to-point at a single, fixed rate, eliminating domestic long-distance and making communications more affordable in rural areas.

While the telecommunications market was officially deregulated in 1995, a law was enacted in January 2000, encouraged by an EU inquiry into telecommunications practice, mandating the opening up of Iceland Telecom’s telecommunications network to independent providers. In combination with the competition offered by alternative networks, such as the one operated by Lina.net (a communications provider backed by the state-owned power company), even greater competition has been stimulated in the market (Ranking in Effect of Telecommunications Competition: 16).

Broadband access is becoming increasingly widespread (Ranking in Availability of Broadband: 10). Many ISPs offer broadband connections in the greater Reykjavik area, and both government and private companies have made investments in broadband infrastructure outside the city.

While Iceland is already a global leader in e-commerce (the majority of the population conducts its banking online)[1] and e-government, the government has identified these as priority areas for development between 2000 and 2002. Beyond the addition of a national webmaster to oversee the continued development of the national website, the Icelandic government has initiatives for online voting, public-access terminals in government offices, and internal management systems.[2] In e-commerce, Iceland is taking its regulatory lead from the European Economic Area, which uses EU guidelines for adoption of digital signatures and ISP rights and obligations. The Icelandic government is also reviewing its security requirements and its need, as a small market, for national technical standards.

Iceland

Key Facts

Population	281,000
Rural population (% of total population) 1999	7.68 %
GDP per capita (PPP)	US$29,167
Global Competitiveness Index Ranking, 2001–2002	16
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	7
Main telephone lines per 100 inhabitants	67.73
Telephone faults per 100 main telephone lines	35.00
Internet hosts per 10,000 inhabitants	1419.96
Personal computers per 100 inhabitants	39.15
Piracy rate	NA
Percent of PCs connected to Internet	36.27 %
Internet users per host	4.21
Internet users per 100 inhabitants	59.79
Cell phone subscribers per 100 inhabitants	66.97
Average monthly cost for 20 hours of Internet access	US$11.24

	RANK
Networked Readiness Index	**2**
Network Use component index	**1**
Enabling Factors component index	**5**
Network Access	**13**
Information Infrastructure	8
Hardware, Software, and Support	17
Network Policy	**5**
Business and Economic Environment	4
ICT Policy	6
Networked Society	**7**
Networked Learning	4
ICT Opportunities	10
Social Capital	8
Networked Economy	**10**
e-Commerce	9
e-Government	3
General Infrastructure	17

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Venkatesh Hariharan, *Media Lab Asia*
Colin Maclay, *Harvard University*

> “ We must deliver speed, connectivity, bandwidth, and last mile connectivity to the users...private enterprise must be given incentives and a free hand in developing this at a frantic pace.”
>
> ***—Indian IT manager***

> “ There is not enough emphasis and R&D for local language applications, or enough emphasis [on] IT services from the government and industry.”
>
> ***—Indian IT manager***

The adage that India is a snake with its head in the twenty-first century and tail in the nineteenth holds true. India faces monumental social challenges and is hampered by bureaucracy, political strife, and the legacies of a planned economy. Yet, the nation is endowed with so many highly trained, ICT-savvy workers that many believe technology will launch India into the developed world. India ranks fifty-fourth overall in Networked Readiness.

In addition to terrible roads and an inadequate electricity supply, India has a weak information infrastructure (Ranking in Information Infrastructure micro-index: 65). The absence of a national backbone and limited access to the international gateway have resulted in high communications costs and poor service. Telecommunications are improving, but state monopolies still dominate (Ranking in Effect of Telecommunications Competition: 41). Private companies are laying fiber-optic cable, and international connections are coming online, but many projects have been delayed, service is still lacking due to infrastructure deficits, and new telecommunications companies are not meeting mandated rural service targets.

While cost and service are improving, most telephones and PCs are owned by businesses and located in cities, and nearly half of India’s villages have no telephones. People access telecommunications services primarily in the nation’s Public Call Offices (PCOs) and cyber cafés. For those who can afford them, mobile telephony (even in rural areas) and ISPs are widespread.

PCOs and cable television are renowned for reaching India widely, deeply, and rapidly. As the focus moved from teledensity to accessibility, almost one million PCOs were connected, and they now account for 25 percent of state telecommunications revenues.[1] Since 1992, mostly independent entrepreneurs rolled out approximately 50 million cable connections across the country, for each of which they charge less than US$3 per month.[2]

Public education is inadequate (Ranking in Social Capital micro-index: 71), although reform is leading to improvement in some states. Where ICT programs exist, they focus on computer science, not on integrating technology with the curriculum. Private schools, which offer better access to ICTs, are not limited to the elite.

Higher education provides good training and produces hundreds of thousands of math/science/engineering graduates annually. The Indian Institutes of Technology (IITs) are among the most selective universities in the world and well known in Silicon Valley. The IITs lack financial resources, and like other top technical institutions also have inflexible curricula. Omnipresent training institutes capitalize on widespread ICT enthusiasm and make basic skills attainable (Ranking in Quality of IT Education: 9).

Social obstacles to ICT use include poverty, illiteracy, and linguistic diversity. Indian language software and coding standards are lacking, but academic and private labs are creating hardware and software that address local needs better than many technologies from the U.S. and Europe.

With the ICT boom and economic liberalization of the 1990s, software exports became one of the country’s most profitable industries (growing from US$734 million in 1995 to US$6.2 billion in 2000).[3] Policy and economic incentives for export have resulted in underdevelopment of the domestic ICT market. Individuals and organizations are beginning to use information technology, but SMEs, people and businesses in rural areas (where 70 percent of the population lives), and poor communities risk being left behind. Central and state governments are promoting pilot efforts for Internet access, education, and e-government.

The combination of a weak telecommunications regulator and imperfect framework politics limits competition. Reform is ongoing, however, with promised legalization of VoIP, convergence of the IT and Communications ministries, and planned privatizations of state telecommunications firms.

India

Key Facts

Population	1,010,000,000
Rural population (% of total population) 1999	71.92 %
GDP per capita (PPP)	US$2,403
Global Competitiveness Index Ranking, 2001–2002	57
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	71
Main telephone lines per 100 inhabitants	3.20
Telephone faults per 100 main telephone lines	186.00
Internet hosts per 10,000 inhabitants	0.35
Personal computers per 100 inhabitants	0.45
Piracy rate	63.00 %
Percent of PCs connected to Internet	0.78 %
Internet users per host	139.63
Internet users per 100 inhabitants	0.49
Cell phone subscribers per 100 inhabitants	0.35
Average monthly cost for 20 hours of Internet access	US$6.66

	RANK
Networked Readiness Index	**54**
Network Use component index	**60**
Enabling Factors component index	**49**
■ **Network Access**	**50**
Information Infrastructure	65
Hardware, Software, and Support	34
■ **Network Policy**	**47**
Business and Economic Environment	57
ICT Policy	36
■ **Networked Society**	**52**
Networked Learning	31
ICT Opportunities	53
Social Capital	71
■ **Networked Economy**	**42**
e-Commerce	29
e-Government	33
General Infrastructure	63

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Mridul Chowdhury, *Harvard University*
with **Hermanto Murniadi, Ir.,** *Cisco Systems Indonesia*

> “ Indonesian telecommunications and IT companies are too dependent on foreign investment. Local financing options should be developed to reduce this dependence.”
>
> ***—Executive of IT company, Indonesia***

> “ We suggest that the politicians and government officials quit fighting each other and start building.”
>
> ***—Manager of Indonesian IT Company***

Indonesia’s gradual progress in laying the foundation for Networked Readiness was severely thwarted by the Asian financial crisis in 1997 and the political turmoil it precipitated. With dwindling GDP per capita and rising unemployment, the domestic market for ICT products and services shrank rapidly. Foreign investment in the IT and telecommunications sectors declined sharply. Political unrest seriously slowed implementation of the Nusantara 21 Project, the national initiative to connect Indonesia’s major islands and cities by satellite and submarine and terrestrial cable. However, as the country’s economy has gradually revived and the political situation has stabilized, enthusiasm and optimism surround the prospects for ICTs’ role in rebuilding Indonesia. The nation ranks fifty-ninth overall in Readiness for the Networked World.

There has been rapid growth of teledensity in Indonesia from very low levels at the beginning of last decade. However, telephone access is still highly concentrated in a few of the major cities. The dominance of two government-run fixed-line operators and lack of an independent regulator have contributed to keeping telephone charges unaffordable to a vast majority of Indonesians (Ranking in Effect of Telecommunications Competition: 48). Competition in the mobile sector has boosted growth in the mobile telephony market, but the level of penetration is still low compared to that of many of Indonesia’s neighbors.

Indonesia’s geographic makeup, comprising thousands of islands, renders particular challenges in developing a fiber-optic-based national infrastructure. Internet services are limited to a handful of cities. Fiber-optic cable is being laid out aggressively in the major cities. A relatively popular mode of household connectivity is a “set-top box” that connects television sets to the Internet through dial-up. With broadband access still rare, leased lines and VSATs typically provide high-speed Internet access to businesses.

The Internet has been heavily embraced by urban, middle-class Indonesians, particularly students. Due to low teledensity and low PC penetration, a majority of Internet users access the Internet through Warung Internet (Internet cafés), a booming phenomenon in the major cities. E-mail, Internet telephony, online chatting, and accessing news are the biggest uses of the Internet in the country. Since the Indonesian media was strictly controlled by the government for several decades during Suharto’s regime until 1998, a suppressed thirst for news and objective information has led to an explosion of demand for news portals on the Internet.

In business and government institutions, the Internet is still not generally perceived as any more than an efficient tool for basic information exchange such as e-mail. While, in theory, Indonesia’s demographic characteristics would seem to make the Internet an ideal medium to reach markets spread across numerous islands, e-commerce activities in Indonesia are rather limited (Ranking in e-Commerce micro-index: 39), except in multinational companies and some banks. In the government, greater use of ICTs is beginning to emerge with the use of *Siskom Dagri*, the national government network that connects the central government to district governments (Ranking in e-Government micro-index: 62).

Key Facts

Population	212,000,000
Rural population (% of total population) 1999	60.16 %
GDP per capita (PPP)	US$3,014
Global Competitiveness Index Ranking, 2001–2002	64
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	65
Main telephone lines per 100 inhabitants	3.14
Telephone faults per 100 main telephone lines	7.44
Internet hosts per 10,000 inhabitants	1.26
Personal computers per 100 inhabitants	0.99
Piracy rate	89.00 %
Percent of PCs connected to Internet	1.27 %
Internet users per host	54.25
Internet users per 100 inhabitants	0.68
Cell phone subscribers per 100 inhabitants	1.73
Average monthly cost for 20 hours of Internet access	US$6.67

	RANK
Networked Readiness Index	**59**
Network Use component index	**61**
Enabling Factors component index	**57**
Network Access	**55**
Information Infrastructure	42
Hardware, Software, and Support	68
Network Policy	**59**
Business and Economic Environment	62
ICT Policy	55
Networked Society	**47**
Networked Learning	49
ICT Opportunities	29
Social Capital	64
Networked Economy	**53**
e-Commerce	39
e-Government	62
General Infrastructure	59

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Indran Ratnathicam, *Harvard University*
with **T. Finbarr Livesey,** *GeoPartners Research Inc.*

> " In Ireland, from day one you think about exporting. Your domestic market is too small to matter."
>
> ***—Irish software CEO***

> " There's more to Ireland than the tax breaks. Companies already in Ireland realize that they like the lifestyle, the talent level is high, and even now wages are still competitive."
>
> ***—Irish software consultant***

Information and communication technologies led a transition in the Irish economy away from low-end manufacturing to hardware manufacture and software development, making Ireland one the strongest growth stories in the EU over the past decade, and giving the nation the nineteenth spot in the Networked Readiness Index. Heavy government spending on technical and tertiary institutions in the early 1980s led to a steady supply of highly skilled workers, and tax and trade regulations have created a welcoming environment for ICT companies.

Ireland is the home of European operations headquarters for many technology multinationals. The net inflow of foreign direct investment in 1999 was equal to 20 percent of GDP, the second highest in the world behind Sweden[1] (Ranking in Business and Economic Environment micro-index: 16). Locally spawned software companies have added to Irish software production, helping Ireland to become the world's second leading software exporter.[2] Additionally, Dublin has become a hub for European telephone call centers, which import language students to take advantage of in the city's well developed network infrastructure.

Reliance on global exports has made the Irish ICT sector especially susceptible to recent economic downturns. Slowing demand in the ICT sector in 2001 led to layoffs and worry in the country throughout the year. In the first eight months of 2001, it is estimated that more than 4,300 jobs were cut in the technology industry.[3]

While Ireland has enjoyed great success, it is also racing to bring its infrastructure and local economy to levels consummate with its international ICT industry. In late 1998, the Government of Ireland commissioned the Information Society (IS), a private-public partnership, to build and deliver an ICT vision for the people of Ireland (Ranking in ICT as Government Priority: 6). The IS has identified infrastructure, local e-commerce, and research as priorities for improvement, and action is already underway in each area.

At the beginning of 2001, the government completed rollout of a national fiber-optic network to more than 120 towns. This faster modernized network should provide a boost to recently liberalized Eircom, the incumbent state telecommunications provider, and its competitors (Ranking in Effect of Telecommunications Competition: 38). Ireland will also be the European node of a new transatlantic cable in the global backbone, improving international bandwidth by a factor of 15.[4, 5]

Though more than 96 percent of Irish companies had Internet access at the end of 2000, local businesses have been slow to move to e-commerce[6] (Ranking in e-Commerce micro-index: 23). The Government of Ireland has responded to the IS's recommendations and hopes to draw businesses online by moving all of its own procurement and business transactions to the Web—an estimated 50 percent of the nation's purchasing power. In addition, the E-business Act was passed in 2001, creating legal support for online transactions and digital signatures (Ranking in Legal Framework for IT Business: 12).

Many Irish university research programs are now connected to more than 170 U.S. universities with a dedicated fiber-optic line through the Next Generation Internet and Internet 2 research consortiums.

Ireland

Key Facts

Population	3,730,000
Rural population (% of total population) 1999	41.22 %
GDP per capita (PPP)	US$29,080
Global Competitiveness Index Ranking, 2001–2002	11
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	17
Main telephone lines per 100 inhabitants	42.62
Telephone faults per 100 main telephone lines	38.00
Internet hosts per 10,000 inhabitants	296.37
Personal computers per 100 inhabitants	36.46
Piracy rate	41.00 %
Percent of PCs connected to Internet	8.13 %
Internet users per host	9.41
Internet users per 100 inhabitants	27.88
Cell phone subscribers per 100 inhabitants	66.75
Average monthly cost for 20 hours of Internet access	US$19.10

	RANK
Readiness for the Networked World	**19**
Network Use Index	**20**
Network Enabling Factors Index	**18**
Network Access	**20**
Information Infrastructure	26
Hardware, Software, and Support	13
Network Policy	**22**
Business and Economic Environment	16
ICT Policy	27
Networked Society	**16**
Networked Learning	15
ICT Opportunities	15
Social Capital	17
Networked Economy	**23**
e-Commerce	23
e-Government	15
General Infrastructure	30

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Carlos Osorio, *Harvard University*
Geoffrey Kirkman, *Harvard University*

> “ The Israeli ICT community has become the nation’s vanguard, a symbol of the future.”
>
> ***—IT leader, Israel***

> “ The benefits of transforming traditional procedures into Web procedures are less appealing to small bricks and mortar companies.”
>
> ***—Israeli IT executive***

Israel ranks twenty-second overall in Readiness for the Networked World. For the past decade, Israel’s ICT sector has performed very well and attracted international acclaim, along with foreign investment and venture capital. Driven by a highly ICT-literate population, spillover in high-technology talent and research from the Israeli military, and strong ties to financial backers in the United States, the nation has shown itself to be an innovative ICT leader, particularly in software development. Nonetheless, the latest regional tensions and the changed global financial situation in late 2001 have markedly changed outlooks on the future of Israeli Networked Readiness.

Challenges in telecommunications regulation top the list of ICT priorities for the Israeli government. Privatization of Bezeq, the state-owned telecommunications firm, liberalization of the fixed-line domestic telephony market, and design of a regulatory framework that effectively promotes competition are all on the government’s agenda and slated to occur in mid-2002. Critics have argued that Bezeq’s monopoly has stifled Internet growth in Israel, although access prices have continued to fall, and service packages have become increasingly sophisticated (Ranking in Effect of Telecommunications Competition: 30). Broadband is on the increase; both DSL and cable operators have launched high-speed Internet services (Ranking in Availability of Broadband: 48). Outside the fixed-line market, vibrant competition has led to cellular penetration of more than 70 percent of the population.

The Computerisation Programme for the Educational System, led by the Ministry of Education, was initiated in 1994 with the goal of reaching a density of ten students per personal computer. Between the first and second phases of the program, almost 4,000 kindergartens and regular and special schools were equipped with computers and local area networks[1] (Ranking in Networked Learning micro-index: 19). To respond better to the demand for a highly skilled technological labor force, the government is hoping to increase the number of university professionals in engineering and computer sciences by more than 100 percent by 2003.[2] Government subsidies are also earmarked for commercialization of academic research in information technology.

Israel’s software industry has been one of the driving forces in the nation’s fast-growing ICT sector. Software exports grew from US$110 million in 1991 to US$2.6 billion in 2000, and total employment in the software industry exploded during the same period.[3] Israel’s domestic software industry has played a leading role globally in such areas as data security and Internet-related software. The Israeli software sector is perhaps best known for the success of ICQ, a pioneer in peer-to-peer computing and an internationally successful Internet chat software launched in 1996. Software piracy, as well poor protection of intellectual property rights for music and videos, remains high in Israel, an issue that has been highlighted in the past by the International Intellectual Property Alliance.

There has been fast adoption of ICTs in the Israeli private sector. Almost 80 percent of the more than 170,000 companies in Israel use computers, about 65 percent of which were connected to the Internet at the end of 2000[4] (Ranking in e-Commerce micro-index: 16).

Israel has shown innovation in electronic government as well. The Israel Government Gateway provides a common online access to information, forms, bids, and services, in addition to e-mail contacts for ministers, their spokespersons, and senior government executives (Ranking in e-Government micro-index: 26).

Israel

Key Facts

Population	6,269,600
Rural population (% of total population) 1999	8.90 %
GDP per capita (PPP)	US$19,577
Global Competitiveness Index Ranking, 2001–2002	24
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	21
Main telephone lines per 100 inhabitants	48.18
Telephone faults per 100 main telephone lines	12.00
Internet hosts per 10,000 inhabitants	287.52
Personal computers per 100 inhabitants	25.36
Piracy rate	41.00 %
Percent of PCs connected to Internet	11.34 %
Internet users per host	6.10
Internet users per 100 inhabitants	17.54
Cell phone subscribers per 100 inhabitants	70.17
Average monthly cost for 20 hours of Internet access	US$17.70

	RANK
Networked Readiness Index	**22**
Network Use component index	**24**
Enabling Factors component index	**19**
■ **Network Access**	**19**
Information Infrastructure	23
Hardware, Software, and Support	15
■ **Network Policy**	**22**
Business and Economic Environment	19
ICT Policy	24
■ **Networked Society**	**20**
Networked Learning	19
ICT Opportunities	17
Social Capital	25
■ **Networked Economy**	**21**
e-Commerce	16
e-Government	26
General Infrastructure	20

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Michael Putnam, *Harvard University*
Elena Scaramuzzi, *The World Bank*

> “ Technological solutions need to be tailored to the Italian market. We need partnerships between Italian and international firms, linking first-class products to deep knowledge of the industry.”
>
> ***—Chairman, Italian publishing firm***

> “ We are seeing a very positive trend, resulting from a cycle in which Italy is included in the group of countries moving into the Net economy. It is true, however, that conditions of uncertainty are also emerging today, tied to a decreased propensity of small enterprises to invest in IT, and a fall in household demand.”
>
> ***—Italian IT leader***

The Italian government recently established a new Ministry for Innovation and Technology, responsible for all ICT policies and projects for modernization of the Italian government. Like the liberalization of telecommunications in Italy, this signals high-level government commitment to more pervasive use of ICTs in Italian society.[1] Networked Readiness is restrained by several factors, including a lack of investment in ICTs by small and medium enterprises (SMEs) and a rigid education sector. Italy ranks twenty-fifth overall in the Networked Readiness Index.

Telecommunications is a bright spot. In 1997, the Italian government privatized the state-owned monopoly, renaming the incumbent telecommunications operator Telecom Italia and establishing a telecommunications authority with the task of ensuring competition. Following the EU agenda, the government liberalized fixed-line telephony in January 1998, completing a process that began in 1994.

As a result, telecommunications competition has been intensifying (Ranking in Effect of Telecommunications Competition: 13). Today, four operators offer mobile services in Italy and a number of companies offer fixed-line services, with more than 200 licenses awarded so far. Mobile telephone use in Italy has overtaken fixed-line telephony, with 46.8 million phones active in June 2001 and a 33 percent annual growth rate.[2]

An estimated 19.4 million Italians (34 percent of the population) used the Internet in September 2001,[3] and 1.5 million have made purchases online during the last year.[4]

At the end of 2000, ICTs represented 5.5 percent of Italian GDP, with a total estimated revenue of US$51.4 billion.[5] In June 2001, a 12.2 percent growth rate was estimated for the ICT sector as a whole.[6] The market is competitive, and at the end of 2000, roughly 64,000 companies totaling 533,000 employees were operating in the industry.[7]

A recent survey found significant challenges for ICT use among Italian SMEs. The survey found that 48 percent of these firms have ICT equipment, and of those, 40 percent have e-mail and 14 percent have a website. These figures were significantly lower for firms with fewer than ten employees, an important part of the Italian economy. Likewise, the survey found that use of e-commerce among SMEs was in the embryonic stage, with 0.59 percent of total turnover coming from online sales.[8]

While many consider the structure of primary and secondary education in Italy to be rigid and traditional, ICTs are gradually entering the Italian education system (Ranking in Internet Access in Schools: 46). To hasten ICT diffusion and use, the Italian Ministry of Education launched a Program for the Development of Education Technologies in 1997. The program promotes use of multimedia tools by teachers and students in public schools and seeks to modernize the educational system itself.[9]

Italy has also deployed e-government services, including an Electronic Tax Return Service, which began in 1999.[10] By the end of February 2000, the Ministry had received more than 27 million electronic tax returns (Ranking in e-Government micro-index: 28).

The state of Networked Readiness in Italy is mixed, showing areas of excellence as well as challenges. There is broad agreement that reforms aimed at fostering innovation in education, the government, and SMEs are necessary for advancement.

Italy

Key Facts

Population	57,300,000
Rural population (% of total population) 1999	33.08 %
GDP per capita (PPP)	US$23,304
Global Competitiveness Index Ranking, 2001–2002	26
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	19
Main telephone lines per 100 inhabitants	47.38
Telephone faults per 100 main telephone lines	16.20
Internet hosts per 10,000 inhabitants	177.97
Personal computers per 100 inhabitants	13.94
Piracy rate	46.00 %
Percent of PCs connected to Internet	12.76 %
Internet users per host	13.16
Internet users per 100 inhabitants	23.42
Cell phone subscribers per 100 inhabitants	73.72
Average monthly cost for 20 hours of Internet access	US$32.22

	RANK
Networked Readiness Index	**25**
Network Use component index	**19**
Enabling Factors component index	**26**
■ **Network Access**	**23**
Information Infrastructure	21
Hardware, Software, and Support	24
■ **Network Policy**	**32**
Business and Economic Environment	37
ICT Policy	26
■ **Networked Society**	**33**
Networked Learning	41
ICT Opportunities	25
Social Capital	33
■ **Networked Economy**	**23**
e-Commerce	21
e-Government	28
General Infrastructure	21

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Indran Ratnathicam, *Harvard University*
Dr. Daniel Coore, *University of the West Indies*

> “ Jamaica is already a latecomer in the IT race.”
>
> ***—CEO of Jamaican company***

> “ Jamaica has tremendous untapped talent in its young people...and their educational and technical programs provide us with a wealth of quality candidates for careers in electronic publishing.”
>
> ***—Electronic book publisher, Jamaica***

In the bottom third of the overall Readiness Index with a ranking of fifty-six, Jamaica is on the trailing edge of advanced Networked Readiness globally. Late but undaunted, the country is beginning to address ICT on its national agenda (Ranking in ICT as Government Priority: 22).

Jamaica has set in motion liberalization of its telecommunications sector, currently monopolized by Cable and Wireless, to be completed in 2002. It is hoped that increased competition will drive down the currently high costs of local and international long-distance telephony, as well as Internet provision, all of which are prohibitive for both individuals and businesses (Ranking in Effect of Telecommunications Competition: 49). The city of Kingston, along with the export processing zones, is fitted with a fiber-optic cable backbone, enabling better service quality there than in most other places on the island, which is generally poor (Ranking in Information Infrastructure micro-index: 67). Some ICT-oriented businesses are already using VSAT for international data and voice communications, while rural service is supplied in many cases with fixed wireless voice-only infrastructure.

Education and training of an ICT workforce is one of the highest priorities in both the national and ICT agendas. The Information Technology (INTEC) project, a private-public center for national ICT strategy, established a goal to create 40,000 new jobs by 2003 by developing ICT in industry, and there is a strong effort to increase educational capacity to meet the expected demand[1] (Ranking in Quality of IT Education: 40). The existing educational system provides a strong base from which to extend capabilities, responsible for an 86 percent literate, English-speaking populace.[2] Jamaica 2000, a private-public partnership in education, has established computer labs in 170 of 250 high schools and is expected to have all high schools wired by 2002[3] (Ranking in Internet Access in Schools: 51).

Higher education has taken a step forward with establishment of the Caribbean Institute of Technology in Montego Bay. The Institute offers courses in engineering, computer science, and software design, focused on preparing students to enter the ICT workforce. The University of Technology and the University of the West Indies have also improved their existing technical programs, taking advantage of government surtax relief to import hardware and software for classroom use.

To date, Jamaica’s primary successes in commercial use of ICT have been limited to customer service call centers and ICT Training. Seeking to follow the example of Singapore and Malaysia, INTEC would like to leverage the nation’s other assets, the existing FDI and manufacturing industry, and move into higher-value ICT production in hardware and software. Hoping to speed up industry growth, Jamaica has removed import tariffs on telecommunications equipment, allowing new companies to build competitive networks faster and more cheaply in all areas of telecommunications. However, a complete strategy to shift industry to using ICT has yet to materialize, and a shortage of local and international bandwidth continues to stifle private-sector ICT growth. Recent turmoil and violence in Jamaica in 2001 have also deterred foreign direct investment (Ranking in Business and Economic Environment micro-index: 46).

With a GDP per capita of US$3,560 in Jamaica, PCs and in-home connectivity will continue to be inaccessible for most Jamaicans. Recognizing this, the Government of Jamaica is sponsoring an initiative through INTEC to bring Internet connectivity to all Jamaicans. Post offices, including those in rural areas, are being networked as community access points, and post office employees are being trained as network administrators and teachers (Ranking in Public Access to the Internet: 66).

Jamaica

Key Facts

Population	2,576,085
Rural population (% of total population) 1999	44.38 %
GDP per capita (PPP)	US$3,657
Global Competitiveness Index Ranking, 2001–2002	52
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	54
Main telephone lines per 100 inhabitants	19.86
Telephone faults per 100 main telephone lines	79.20
Internet hosts per 10,000 inhabitants	5.71
Personal computers per 100 inhabitants	4.27
Piracy rate	NA
Percent of PCs connected to Internet	0.33 %
Internet users per host	163.49
Internet users per 100 inhabitants	2.34
Cell phone subscribers per 100 inhabitants	14.24
Average monthly cost for 20 hours of Internet access	US$23.74

	RANK
Networked Readiness Index	**56**
Network Use component index	**64**
Enabling Factors component index	**50**
■ **Network Access**	**61**
Information Infrastructure	67
Hardware, Software, and Support	55
■ **Network Policy**	**45**
Business and Economic Environment	46
ICT Policy	44
■ **Networked Society**	**50**
Networked Learning	50
ICT Opportunities	56
Social Capital	43
■ **Networked Economy**	**48**
e-Commerce	61
e-Government	47
General Infrastructure	37

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Mridul Chowdhury, *Harvard University*
with **Kazuki Seki's Telecom Research Group,** *IDC Japan*
Richard Brewer, *IDC Japan*

> " The Japanese love of small hand-held gadgets, as opposed to relatively large and immobile PCs, has been a particularly important contributing factor to the rapidly growing popularity of the mobile Internet."
>
> ***—Japanese telecommunications analyst***

> " One problem in Japan is adapting the Japanese language to the standard keyboard. Other technologies need to be developed for data entry."
>
> ***—President of a Japanese IT company***

Japan proved itself to be a champion of the Industrial Age; however, it has yet to demonstrate similar leadership in the Information Age, largely because of the current PC-centric nature of its Networked Readiness. Japan's global leadership in mobile Internet can potentially give the nation a substantial first-mover advantage if and when mobile commerce applications and business models reach a greater level of maturity. Currently, with a Networked Readiness ranking of twenty-one, Japan substantially lags behind most other industrialized countries in overall adoption and sophisticated use of ICT. The e-Japan Priority Policy Program is a comprehensive national strategy that identifies challenges in the IT and telecommunications sectors and sketches a holistic approach to overcoming them.

Several factors contribute to the slow growth of ICTs in Japan. Despite a relatively high teledensity, Japan has one of the lowest rates of Internet penetration among the major industrial nations, and even among many of its East Asian neighbors. High telecommunications fees resulting from restricted competition in the telephony sector is a significant deterrent to Internet use. The absence of an independent telecom regulator and political strife among different governmental departments regarding regulation have resulted in many cumbersome restrictions and bureaucratic procedures that prevent vibrant competition among telecommunications providers (Ranking in Effect of Telecommunications Competition: 32).

There are some infrastructure bottlenecks to Internet penetration as well. There is currently relatively limited use of high-speed network infrastructure for Internet access in Japan (Ranking in Availability of Broadband: 58), but it is increasing rapidly. Due to heavy investment in ISDN in the early 1990s, there is alleged reluctance among officials of NTT, the nation's main telecommunications operator, to encourage the growth of DSL, an alternative but much faster technology.[1] NTT is trying to promote fiber-to-the-home (FTTH) service, which is faster, though more expensive, than DSL.

As a consequence of the hindrances to using the fixed infrastructure, coupled with high mobile penetration and the well-documented Japanese proclivity for small gadgets, the mobile telephone has become a key form of Internet access in Japan. NTT's I-mode holds the majority share of the market. With an innovative pricing model based on packets of data transferred, the I-mode has become an extremely popular medium for online news, trading, games, and e-mail.

However, a limited level of Internet access through PCs has inhibited the use of Internet for more sophisticated purposes in business and government than the mobile Internet allows. B2C e-commerce is limited by a small credit card user base (Ranking in Internet-based Payment Systems: 30). However, *konbini*, the Japanese convenience store, has become a popular center for cash payments for online consumer transactions.[2] The largest B2C e-commerce segments are in the auto, real estate, PC, and travel industries. The growth of B2B e-commerce also lags behind most industrialized countries. The most intensive B2B e-commerce activity is taking place in the auto and electronics industries. Japan is also lagging behind in e-government (Ranking in e-Government micro-index: 31). Services to citizens are generally limited to interchange of administrative information, and services to businesses include online applications for certain procedures and clearances.

High Japanese income per capita and openness to new technologies should be significant factors in building an e-Japan. Under a program called Digitization of Education, the government is investing heavily in providing Internet access to schools, which already have about 100 percent PC penetration.[3] Internet kiosks are also being installed in public institutions.

Japan

Key Facts

Population	127,000,000
Rural population (% of total population) 1999	21.34 %
GDP per capita (PPP)	US$25,796
Global Competitiveness Index Ranking, 2001–2002	21
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	9
Main telephone lines per 100 inhabitants	58.47
Telephone faults per 100 main telephone lines	1.70
Internet hosts per 10,000 inhabitants	365.66
Personal computers per 100 inhabitants	31.52
Piracy rate	37.00 %
Percent of PCs connected to Internet	11.60 %
Internet users per host	8.33
Internet users per 100 inhabitants	30.44
Cell phone subscribers per 100 inhabitants	52.61
Average monthly cost for 20 hours of Internet access	US$15.26

	RANK
Networked Readiness Index	**21**
Network Use component index	**23**
Enabling Factors component index	**20**
■ **Network Access**	**18**
Information Infrastructure	17
Hardware, Software, and Support	19
■ **Network Policy**	**25**
Business and Economic Environment	20
ICT Policy	29
■ **Networked Society**	**17**
Networked Learning	32
ICT Opportunities	6
Social Capital	13
■ **Networked Economy**	**22**
e-Commerce	22
e-Government	31
General Infrastructure	14

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Ugonwa Nwoye, *Harvard University*
Karim Kawar, *Idealsoft and int@j*

> “Jordan is a country where IT leadership and initiative from the very top has made a significant difference.”
>
> ***—Business analyst, Jordan***

> “Most human resources available are young graduates. What we need is people with advanced international leadership skills, who can lead organizations and transform them into world-class companies, able to compete internationally.”
>
> ***—Jordanian IT executive***

Jordan’s national Networked Readiness strategy, the REACH Initiative, has tried to marshal the intellectual capital of Jordan’s private sector and the cooperative will of key members of the government to identify underlying regulatory and infrastructure problems facing the ICT sector (Ranking in ICT as Government Priority: 6). REACH aims by 2004 to attract US$150 million in cumulative foreign direct investment; achieve US$550 million in annual exports; and create 30,000 jobs, all in the ICT sector.[1] Jordan ranks forty-ninth overall in Networked Readiness.

While the past decade has seen notable improvements in Jordan’s Networked Readiness, many challenges remain. In addition to problems of enabling infrastructure and appropriate policy, there are difficult legacies such as inertia, awareness, income disparity, and entrenched attitudes toward telecommunications and competition.

The Telecommunications Law of 1995 opened all nonfixed-line services to the private sector (Ranking in Effect of Telecommunications Competition: 35). Jordan’s ICT infrastructure has since developed rapidly to include mobile networks, two payphone networks, a paging service, a new, digital ATM backbone and several data service companies, offering either Internet access or private communication networks.[2] The law also created the Telecommunications Regulatory Commission (TRC).

Although Jordan Telecommunications (JT) was partially privatized in 2000, it will continue to be the monopoly provider and operator of basic telephone services until the end of 2004.

Jordan’s fixed network has been largely converted to digital switching and transmission, and expanded to reach a teledensity of 9 percent in 2000, nearly double the penetration of the mid-1990s, but still below such Middle Eastern and North African countries as Lebanon and Tunisia.

An estimated fourteen out of 100 people in Jordan currently own mobile phones—the national mobile GSM network is operated as a duopoly by Fastlink and MobileCom (a subsidiary of JT).

The Internet is becoming popular in Jordan. However, personal computers are not generally affordable because of low average incomes, which remains a great impediment to the spread of Internet use, especially in homes. The nine ISPs and 170 Internet cafés serve an estimated 127,000 users who use the Internet for e-mail and chat services, the daily news, job vacancy advertisements, and other tasks.[3] Authorities have been more tolerant toward online news and content than toward traditional media. Although voice over Internet is illegal, Internet telephony and callback services are popular, due to the high cost of international calls.

E-commerce activity is minimal in Jordan (Ranking in e-Commerce micro-index: 51); only a handful of local companies are capable of processing online payments. Although Jordan’s national banks issue credit cards, they are reluctant to launch electronic banking services in general, primarily because of the absence of regulatory guidelines, but also because of the cost of implementing the required technology to support secure transactions in the local currency.

Jordan’s labor pool is well educated, and ICT education is a top national priority—the curriculum has been revised at all levels to reflect a new and compulsory ICT focus (Ranking in Quality of IT Education: 37).

Many believe that the entire ICT sector would benefit from a greater government commitment to the role of independent regulation. The King’s personal involvement in Jordan’s planning for Networked Readiness is generally regarded as a very positive factor (Ranking in Effectiveness of Government ICT Programs: 9).

Jordan

Key Facts

Population	6,670,300
Rural population (% of total population) 1999	26.36 %
GDP per capita (PPP)	US$4,079
Global Competitiveness Index Ranking, 2001–2002	45
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	61
Main telephone lines per 100 inhabitants	9.29
Telephone faults per 100 main telephone lines	42.00
Internet hosts per 10,000 inhabitants	1.36
Personal computers per 100 inhabitants	1.35
Piracy rate	71.00 %
Percent of PCs connected to Internet	0.68 %
Internet users per host	140.37
Internet users per 100 inhabitants	1.91
Cell phone subscribers per 100 inhabitants	5.83
Average monthly cost for 20 hours of Internet access	US$19.09

	RANK
Networked Readiness Index	**49**
Network Use component index	**58**
Enabling Factors component index	**42**
Network Access	**51**
Information Infrastructure	46
Hardware, Software, and Support	56
Network Policy	**30**
Business and Economic Environment	30
ICT Policy	30
Networked Society	**54**
Networked Learning	46
ICT Opportunities	61
Social Capital	54
Networked Economy	**44**
e-Commerce	51
e-Government	43
General Infrastructure	39

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Mridul Chowdhury, *Harvard University*
with **Sunshik Min,** *YBM/Si-sa*
Sang Hyun Lee, *KCC Information and Communication*

> " Thanks to the well-developed broadband infrastructure, the online game business has been extremely successful in Korea."
>
> ***—Executive of IT company, Korea***

> " The use of the Internet is more in the area of entertainment and personal communications rather than company work. Employers are concerned about how to keep employees from using office time and network for private businesses such as online stock trading."
>
> ***—President of Korean IT company***

Korea's information technology and telecommunications sectors have contributed greatly to the country's recovery from the Asian financial crisis. With booming demand for telecommunications equipment and services, a growing domestic software market, and policies promoting intense competition, Korea has recovered more quickly than many other Asian countries. To continue this path of national growth, the government has formulated the Cyber Korea Initiative, a comprehensive plan to promote Korea as the "information hub" of Asia, with a high-quality information infrastructure, a skilled ICT labor force, and an ICT-savvy society, business, and government. Korea ranks twentieth overall in Readiness for the Networked World.

Korea has one of the most developed telecommunications infrastructures in Asia (Ranking in Information Infrastructure micro-index: 18). In early 2001, the government completed construction of a high-speed fiber-optic backbone linking 144 major cities nationwide. The existence of an independent telecommunications regulator paved the way for intense competition, leading to low telecommunications costs, high teledensity, and high mobile penetration.

Even more dramatic is Korea's growth in sophisticated Internet access. Korea has one of the highest rates of broadband penetration in the world (Ranking in Availability of Broadband: 3). Factors that have contributed to the growth of broadband include fierce competition between DSL and cable Internet providers, relatively low service charges, and a thriving demand for broadband. Wireless Internet access via hand-held mobile devices has also attracted a significant number of subscribers, and more than 200 wireless Internet content providers operate in Korea.

The Korean advantage in high-speed Internet access has yet to translate into correspondingly extensive use of ICT in business (Ranking in e-Commerce micro-index: 15). B2B e-commerce marketplaces have developed in a few industries, and e-commerce is only beginning to become popular in Korean companies. The government is trying to create change, establishing The Korean Institute for Electronic Commerce to support the growth of e-commerce through private-public cooperation and formulating Digital Government, an e-government strategy to be implemented by 2003 (Ranking in e-Government micro-index: 18).

The Internet is finding enthusiastic acceptance among the Korean people. A majority of stock trading takes place online, and Internet banking has become a part of everyday life. The government plans to network 3,622 postal offices as Internet outposts for commercial and financial transactions.[1] Deployment of PCs and Internet to schools has also taken place at an impressive rate (Ranking in Internet Access in Schools: 8)

Korea has developed a sizeable software industry in response to the growing domestic demand for software. The nation is one of the major targets in Asia for multinational ICT companies to locate subsidiaries. The industry is taking active steps to reach beyond its borders and become a global software player. While it has many factors in its favor, such as high-quality ICT infrastructure, relatively low piracy rate, and heavy presence of ICT multinationals, Korea faces formidable challenges, such as a lack of an ICT-skilled workforce and insufficient competence in English.

Korea

Key Facts

Population	47,300,000
Rural population (% of total population) 1999	18.84 %
GDP per capita (PPP)	US$17,311
Global Competitiveness Index Ranking, 2001–2002	23
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	25
Main telephone lines per 100 inhabitants	46.36
Telephone faults per 100 main telephone lines	1.05
Internet hosts per 10,000 inhabitants	84.10
Personal computers per 100 inhabitants	19.03
Piracy rate	56.00 %
Percent of PCs connected to Internet	4.42 %
Internet users per host	47.86
Internet users per 100 inhabitants	40.25
Cell phone subscribers per 100 inhabitants	56.69
Average monthly cost for 20 hours of Internet access	US$12.12

	RANK
Networked Readiness Index	**20**
Network Use component index	**15**
Enabling Factors component index	**25**
Network Access	**26**
Information Infrastructure	18
Hardware, Software, and Support	33
Network Policy	**27**
Business and Economic Environment	35
ICT Policy	18
Networked Society	**30**
Networked Learning	25
ICT Opportunities	36
Social Capital	29
Networked Economy	**21**
e-Commerce	15
e-Government	18
General Infrastructure	31

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Alzhan Braliev, *Harvard University*
with **Ina Gudele,** *Latvian Internet Association*

> “ There are insufficient investments in the national ICT industry and an underdeveloped domestic market for software solutions.”
>
> ***— Director, Latvian IT company***

> “ The present state policy in the field of ICT is directed to implementation of activities according to *Acquis Communautaire* [the entire body of European laws] as well as to providing complete access to [the] Internet.”
>
> ***—Latvian governmental official***

Latvia was one of the most advanced regions in the former Soviet Union in terms of telecommunications development. Today the nation is preparing for the second round of European Union (EU) accession. Latvia ranks thirty-ninth overall in Readiness for the Networked World (significantly below Estonia, but above neighboring Lithuania).

Latvia faces challenges such as frequent changes in the government, a weak judiciary system, corruption, and bureaucracy. Moreover, a dearth of telecommunications laws and Lattelkom’s monopoly over fixed-line services have impeded Latvian progress toward Networked Readiness (Ranking in Effect of Telecommunications Competition: 59). Motivated by WTO standards and the potential of EU membership, the Latvian government is trying to reduce the duration of Lattelkom’s monopoly by ten years, to end in 2003.

The brain drain in Latvia is slowing as salaries increase, but current local demand for ICT professionals exceeds the national supply. With the goal of preparing students, teachers, administrators, and institutions at all levels, the government and the University of Latvia launched the Latvian Education Information System (LIIS) in 1997. LIIS established education, management, and information services as its priorities. Latvia’s ICT education budget increased by 20 percent in 2000.[1] By the end of 2000, all schools offered computer classes and almost all had Internet access (more than half used it), and more than 50 percent of the country’s teachers were trained[2] (Ranking in Internet Access in Schools: 30).

ICT is the fastest-growing sector in the country and is among the three top national economic priorities (Ranking in ICT as Government Priority: 36), alongside timber and light industry. Hardware and services have traditionally been stronger, but the total number of software development companies, some ISO-certified, has grown to more than 100, employing over 4,000 people.[3]

A Latvian fiber-optic cable network has been under construction and adds to an existing connection with Sweden. The Latvian Ministry of Transportation is exploring ways to reach distant regions in Latvia to make them ICT-accessible.

While some estimate that Lattelkom’s monopoly has tripled fixed-line communications costs, competition in the mobile wireless section has been vibrant and has led to low costs and good service. Conversely, nearly half of all fixed lines remain analog, and DSL broadband is only available in the largest cities.[4] Internet services are competitive, with four dominant ISPs and more than thirty others operating nationwide. Call charges commonly comprise two-thirds of dial-up Internet access costs;[5] dial-up operators will face fierce competition from new providers of cable broadband. More information has become available via Internet in the Latvian language, which has increased significantly the incentives for people to go online.

Internet penetration is much higher among private companies than in the public sector. B2C e-commerce is still in its initial stage due to security concerns, lack of credit cards, and high shipping costs (Ranking in e-Commerce micro-index: 43). The major banks offer electronic transactions and are beginning to support mobile e-commerce. Online payment mechanisms are also available.

The government has adopted a National Program on IT, as well as a conceptual outline for e-Latvia, a program that details the guidelines for national ICT development and prepares the country for launching e-government systems.[6] Currently, the ICT sector is unregulated, with ISP regulations and e-commerce laws under exploration. E-document and e-Signature Acts are scheduled for consideration in late 2001 (Ranking in Legal Framework for IT Business: 51).

Latvia

Key Facts

Population	2,379,900
Rural population (% of total population) 1999	31.00 %
GDP per capita (PPP)	US$6,838
Global Competitiveness Index Ranking, 2001–2002	47
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	39
Main telephone lines per 100 inhabitants	31.19
Telephone faults per 100 main telephone lines	47.17
Internet hosts per 10,000 inhabitants	83.72
Personal computers per 100 inhabitants	8.40
Piracy rate	NA
Percent of PCs connected to Internet	9.44 %
Internet users per host	7.53
Internet users per 100 inhabitants	6.30
Cell phone subscribers per 100 inhabitants	16.86
Average monthly cost for 20 hours of Internet access	US$19.97

	RANK
Networked Readiness Index	**39**
Network Use component index	**38**
Enabling Factors component index	**37**
■ **Network Access**	**43**
Information Infrastructure	43
Hardware, Software, and Support	42
■ **Network Policy**	**44**
Business and Economic Environment	38
ICT Policy	50
■ **Networked Society**	**37**
Networked Learning	34
ICT Opportunities	51
Social Capital	26
■ **Networked Economy**	**40**
e-Commerce	43
e-Government	38
General Infrastructure	40

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Alzhan Braliev, *Harvard University*
with **Dziugas Junkys,** *Info-Balt Association*

> “ Lack of investments and low Internet penetration are some of the obstacles in Lithuania.”
>
> ***—Technical manager, Lithuanian IT company***
>
> “ Flat rates introduced for dial-up and broadband access reduced average Internet usage costs and proved to be a positive factor for Lithuanian Internet market development.”
>
> ***—IT consultant in Lithuania***

Lithuania’s overall ranking of forty-two in the Networked Readiness Index places it between Turkey and Thailand. The country shows strengths in areas such as online government services (Ranking in Online Government Services: 23) and overall social capital (Ranking in Social Capital micro-index: 27), but fares less well in measures of e-commerce (Ranking in e-Commerce micro-index: 58) and ICT policy (Ranking in ICT Policy micro-index: 67).

Lithuania gained independence from the Soviet Union in 1991, and has since focused on developing a market economy and integrating into the European Union. Though Lithuania is being considered for the second round of accession, it still has to overcome many challenges before it complies with EU regulations. There has been significant progress in the legal and judiciary system; however, unemployment, corruption, and bureaucracy still present major obstacles. Successful development of the national ICT sector depends directly on large investments, which, in turn, depend on political and economic progress. Once these improvements are in place, Lithuania’s strategic geographic location and well developed infrastructure could make the country more enticing for multinational companies and foreign investors.

ICT is the fastest-growing sector in Lithuania. In the former Soviet Union, Lithuania was a leading manufacturer of electronics. This technological heritage provides the country with a favorable infrastructure for hardware development, the dominant part of the national ICT market.[1] Software development, adaptation, and service comprise another significant share of the Lithuanian ICT market, despite high rates of software piracy. Lietuvos Telcomas (LT*)*, the formerly state-owned telecommunications monopoly, was privatized in 1998, but retains fixed-line exclusivity until the 2003 (Ranking in Effect of Telecommunications Competition: 64). Rapid improvement in the ICT market is expected to result from full liberalization of the Lithuanian telecommunications market.

Lithuania has the lowest percentage of Internet users in the Baltic States. The government has initiated several programs to address the need for ICT literacy across the population (Ranking in Quality of IT Education: 60). In May 2000, the Department of Information and Informatics created a strategy to develop Lithuania’s Information Society and identified guidelines for the next several years.[2] Additionally, the Ministry of Education (ME) has made access to information technologies a priority for education. The resulting educational initiative is expected to link all secondary schools with higher institutions and the ME, and will allow research and development to be more integrated.[3] Distance learning has also gained importance as part of the solution for improving ICT literacy in rural regions. A significant proportion of the Lithuanian population lives in rural areas, but extending access to more distant regions in the country will be difficult. LT has established agreements with some ICT companies to address this problem with wireless infrastructure.

For some Lithuanians, a fixed-line telephone is still a luxury. Mobile telephony has experienced constant growth, with GSM networks covering most of the country, and WAP technology is under development. E-commerce in Lithuania is in its initial stage; however, some banks and ICT companies are starting e-commerce and online services. Security remains one of the main concerns for online shoppers. The Lithuanian Parliament, Seimas, approved corrections to the Law on Legal Protection and Personal Data and adopted the Law on Electronic Signature, but these laws have not yet been implemented.

Lithuania

Key Facts

Population	3,698,500
Rural population (% of total population) 1999	31.66 %
GDP per capita (PPP)	US$6,999
Global Competitiveness Index Ranking, 2001–2002	43
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	37
Main telephone lines per 100 inhabitants	32.11
Telephone faults per 100 main telephone lines	18.95
Internet hosts per 10,000 inhabitants	48.14
Personal computers per 100 inhabitants	5.95
Piracy rate	NA
Percent of PCs connected to Internet	6.45 %
Internet users per host	7.26
Internet users per 100 inhabitants	2.78
Cell phone subscribers per 100 inhabitants	14.16
Average monthly cost for 20 hours of Internet access	NA

	RANK
Networked Readiness Index	**42**
Network Use component index	**46**
Enabling Factors component index	**43**
■ **Network Access**	**35**
Information Infrastructure	49
Hardware, Software, and Support	21
■ **Network Policy**	**58**
Business and Economic Environment	49
ICT Policy	67
■ **Networked Society**	**49**
Networked Learning	62
ICT Opportunities	59
Social Capital	27
■ **Networked Economy**	**43**
e-Commerce	58
e-Government	40
General Infrastructure	32

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Indran Ratnathicam, *Harvard University*

> “ A lack of IT skills in domestic customers limits growth. People tend to go with the well-known multinational products. The irony is that the domestic products are often accepted overseas.”
>
> ***—CEO, Malaysian software company***

> “ The government must educate Malaysian society, reaching out to people from all walks of life, on the importance of technology, especially the Internet.”
>
> ***—Malaysian marketing executive***

Malaysia ranks thirty-sixth in Readiness for the Networked World, though its vision may surpass that mark by several degrees. The Malaysian government is placing its hopes for continued growth on a strategy of government-led policies and initiatives aimed at attracting high-end foreign investment and a transition to a knowledge economy (Ranking in ICT as Government Priority: 11). The plan, outlined as early as 1996, permeates all aspects of the Malaysian economy and society, including initiatives in telemedicine, e-government, education, and industry. Malaysia's Vision 2020 is one of the most aggressive and comprehensive ICT plans in the world, and faces one of the greatest challenges: using ICTs to address the economic development hurdles of a highly rural developing country.

The best-known element of the Malaysian ICT strategy has been the Multimedia Super Corridor (MSC), an ultra high-technology business city built outside Kuala Lumpur and now home to more than 540 companies.[1] First conceptualized in 1996 with the intention of attracting foreign ICT and service companies and stimulating internal growth in the ICT and media industries, MSC included such concessions as a ten-year tax holiday, expedited work visas for skilled immigrant workers, and duty-free import of ICT equipment. Though the MSC Founder Members include CEOs from such global high-technology giants as Microsoft, Sun, and Oracle, the MSC has yet to attract large facilities from any large multinationals, nor has it fostered many internationally successful local ICT start-ups (Ranking in Effectiveness of Government ICT Programs: 30).

In e-government, plans are underway to use ICT-based initiatives in procurement, an electronic labor exchange, and internal process improvements (Ranking in e-Government micro-index: 45). In addition, the capitol and major administrative buildings will be moved to Puterajaya in the MSC to symbolize the national need for ICT progress and to take advantage of superior information infrastructure. In one of the first pilot projects, Government Multipurpose Smart Cards are being administered in Kuala Lumpur and the MSC for identity and social services cards, giving users access to driver's licenses, passports, e-cash facilities, medical information, and key public information.

Due to operational struggles and the Asian financial crisis, the Smart Schools project is behind schedule on its pilot for connecting ninety schools, likely delaying completion of a full 8,000-school rollout (Ranking in Internet Access in Schools: 42).[2] Additionally, the education system faces challenges to its administration of an ICT education. It is estimated that more than 1,000 schools in rural areas lack electricity. Illiteracy rates are at about 14 percent.[3, 4] Small-scale projects, such as Internet-equipped buses that visit rural schools, have shown success in exposing residents and students to ICT, but they do not provide long-term training and are limited in scale.[5]

Access to telephony and the Internet remains limited among the general population, especially outside Kuala Lumpur. The telecommunications industry was officially deregulated in 1996, but Telekom Malaysia continues to dominate, especially in fixed-line telephony (Ranking in Effect of Telecommunications Competition: 38). Although local telecommunications operators offer Internet access for less than their own cost, Internet penetration is still lower than in some neighboring countries. The Government of Malaysia has responded with programs such as the National Internet Literacy Campaign (NILC), which establishes local telecenters in urban and rural areas, charging area residents a nominal fee for a week of training on the use of PCs and the Internet.

Malaysia

Key Facts

Population	23,300,000
Rural population (% of total population) 1999	43.34 %
GDP per capita (PPP)	US$8,924
Global Competitiveness Index Ranking, 2001–2002	30
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	43
Main telephone lines per 100 inhabitants	19.92
Telephone faults per 100 main telephone lines	46.00
Internet hosts per 10,000 inhabitants	29.33
Personal computers per 100 inhabitants	10.31
Piracy rate	66.00 %
Percent of PCs connected to Internet	2.84 %
Internet users per host	54.21
Internet users per 100 inhabitants	15.90
Cell phone subscribers per 100 inhabitants	21.31
Average monthly cost for 20 hours of Internet access	US$16.00

	RANK
Networked Readiness Index	**36**
Network Use component index	**35**
Enabling Factors component index	**38**
■ **Network Access**	**42**
Information Infrastructure	35
Hardware, Software, and Support	49
■ **Network Policy**	**34**
Business and Economic Environment	36
ICT Policy	31
■ **Networked Society**	**45**
Networked Learning	44
ICT Opportunities	39
Social Capital	52
■ **Networked Economy**	**38**
e-Commerce	42
e-Government	45
General Infrastructure	28

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Indran Ratnathicam, *Harvard University*
with **David Kissoondoyal,** *Mauritius Internet Society*

> “ Being a hardware or software engineer in Mauritius is tantamount to being a computer technician.”
>
> ***—Mauritian IT manager***

> “ The younger generation, aged 12 to 20, is making the most use of computers and [the] Internet. This bodes well for the future.”
>
> ***—Mauritian IT executive***

The growth and stability of the Mauritian economy has been a sustained success story in Africa over the past two decades. Having progressed so far in such a short period of time, the newly elected government pledged in September 2000 to diversify the economy further, moving away from cyclical, lower-wage jobs in agriculture and manufacturing to service industries with better international potential. A large part of this effort has been tied to information and communication technologies. Mauritius is ranked fifty-first overall in Readiness for the Networked World.

The new government has rejuvenated the Ministry of IT and Telecommunications, with a directive to help move Mauritius into the Networked World (Ranking in ICT as Government Priority: 11) and make the nation into a regional technology and commerce hub, a “Singapore of Africa.”[1]

As of May 2001, Mauritius was one of only two countries in Africa that maintained a legal monopoly telecommunications market (Ranking in Effect of Telecommunications Competition: 75). The ISP sector has been liberalized by law, but has yet to see competition in practice. Several potential ISPs have received licenses to operate, and their operation would diversify and improve the quality of offerings to consumers and businesses. However, they are being hamstrung instead by high prices for leased lines and service from Mauritius Telecom, the incumbent and owner of the fixed-line infrastructure. An independent regulator exists as a department of the Ministry for IT and Telecommunications, and has imposed price controls on the leased-line infrastructure, hoping to enable ISPs to begin service soon (Ranking in Effect of ISP Competition: 74).

Building on the success of the Export Processing Zones for manufactured goods, an ICT-Free Zone (ITFZ) is being established to attract foreign multinationals in technology and banking. The ITFZ features first-class facilities, with high-speed network connectivity and direct international backbone connections as well as tax and legal incentives for business.

Training programs, both at the university level and in continuing education for adults, have been identified as necessary to enable Mauritians to compete for the new opportunities that will be attracted to the island (Ranking in Quality of IT Education: 64). Current school systems lack an ICT infrastructure and face challenges in retaining students through high school. To this end, the government has established a fund of US$54 million aimed at ICT skills development, from primary through continuing adult education.[2] Additional funds and cooperation are expected from the private sector.

As Mauritius develops its workforce to fill the growing need for ICT workers, the government is trying to accommodate the needs of companies that need staff immediately. A Green Visa concept for ICT professionals has been somewhat successful in helping companies attract ICT workers from other countries (Ranking in IT Brain Drain: 47).

There are signs that the government’s efforts may be rewarded (Ranking in Effectiveness of Government ICT Programs: 20). IBM has established a regional headquarters in Port Louis, citing the quality of the Mauritian workforce and its bilingual ability as reasons for other companies to follow suit.[3] By autumn of 2001, it was estimated that more than 250 ICT-related companies had emerged in this small, island nation.[4] Many in the Mauritian ICT industry hope that such signs of activity will induce further foreign direct investment, since, in spite of its economic success, Mauritius has had difficulties attracting high levels of foreign direct investment (Ranking in Business and Economic Environment micro-index: 43).

Mauritius

Key Facts

Population	1,185,900
Rural population (% of total population) 1999	58.86 %
GDP per capita (PPP)	US$9,512
Global Competitiveness Index Ranking, 2001–2002	32
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	46
Main telephone lines per 100 inhabitants	23.68
Telephone faults per 100 main telephone lines	45.77
Internet hosts per 10,000 inhabitants	27.62
Personal computers per 100 inhabitants	9.28
Piracy rate	66.00 %
Percent of PCs connected to Internet	0.75 %
Internet users per host	26.56
Internet users per 100 inhabitants	7.34
Cell phone subscribers per 100 inhabitants	10.49
Average monthly cost for 20 hours of Internet access	US$15.45

	RANK
Networked Readiness Index	**51**
Network Use component index	**51**
Enabling Factors component index	**54**
Network Access	**54**
Information Infrastructure	58
Hardware, Software, and Support	50
Network Policy	**53**
Business and Economic Environment	43
ICT Policy	63
Networked Society	**47**
Networked Learning	51
ICT Opportunities	44
Social Capital	45
Networked Economy	**55**
e-Commerce	71
e-Government	61
General Infrastructure	34

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Karen Coppock, *Harvard University*
Alberto Emilio Loyo, *Escuadra Consultores*
with **Romúlo Sánchez,** *ITESM*

> "The cost of [the] Internet is high and the lack of adequate international bandwidth makes the Internet really slow and unstable...Subsidization for international bandwidth will definitely help promote IT business and is good for subscribers as well."
>
> ***—Internet executive, Mexico***

> "The IT industry is a great opportunity for doing business in Mexico, [it is] growing extremely quickly [and is] empowered by a government that has made its bet for this sector [being] a key industry for the future."
>
> ***—Mexican legal consultant***

High levels of poverty, particularly in rural and peri-urban areas, remain a major obstacle to Mexican Networked Readiness, in which the country ranks forty-fourth. President Fox's solution is e-Mexico, an initiative designed to bring all of Mexico into the information age. e-Mexico is a comprehensive ICT program including projects in education, health, e-commerce, and e-government. The success of this program will depend on Fox's ability to coalesce political support, dedicate adequate funding, and achieve cooperation among the numerous government agencies involved in its implementation.

Mexico's teledensity compares unfavorably with other countries of similar development and is characterized by significant regional disparity, with the capital city having ten times the teledensity of most rural areas.[1] Mexico's progress in Internet access is a bit more promising. Mexico was the first Latin American country to connect to the Internet, and from 1998 to 2000, the number of Mexican Internet users increased by more than 200 percent.[2] This boom in use could be attributed in part to increasing competition, which has led to a decrease in Internet access fees and creative pricing strategies, including bundling desktop computers with Internet access.

Mexico is an innovator in the use of ICT in education in Latin America (Ranking in Internet Access in Schools: 40); decades ago the government launched its *Telesecundaria* program, which transmits secondary school education via videotapes and satellite television broadcasts. Another cutting-edge initiative is *Red Escolar Linux*. Calculating that it could save millions in software licensing fees by using the Linux operating system, the Mexican government decided to standardize the use of Linux in its educational institutions. Mexican universities have long made extensive use of ICTs, and several offer a wide range of degrees and continuing education courses via distance education. Mexico's most recent initiative, *e-Educación*, will focus on using ICTs to provide primary and secondary school education to the millions of Mexicans who have not had an opportunity to finish their studies.

Large corporations are the primary users and providers of ICTs in Mexico (Ranking in e-Commerce micro-index: 41). These companies are beginning to become active in B2B e-commerce, often with a regional focus. Small and medium enterprises, however, are not exploiting ICTs in their businesses because they are generally unaware of the potential effect of these technologies on their productivity, do not have the financial resources to acquire them, and find very few offerings tailored to their needs. B2C e-commerce has also been slow to start in Mexico and is hindered by a lack of faith in online transactions and a low credit card penetration rate. The Mexican government is embracing ICTs in operations such as e-Gobierno, a program to provide Internet access and interconnection for all of Mexico's 2,400 municipalities, and CompraNet, an online government procurement system (Ranking in e-Government micro-index: 31).

Mexico opened its telecommunications market to competition in 1996, yet Telmex, its previous monopoly provider, still dominates almost all market segments (Ranking in Effect of Telecommunications Competition: 55). Mexico has adjusted its existing legal framework to facilitate e-commerce, including recognition in April 2000 of Internet purchase orders as binding contracts. Yet, many observers feel that digital signatures and increased protection of intellectual property should be addressed to further stimulate e-commerce and software production in Mexico (Ranking in Legal Framework for e-Commerce: 60).

Mexico

Key Facts

Population	98,900,000
Rural population (% of total population) 1999	25.80 %
GDP per capita (PPP)	US$8,914
Global Competitiveness Index Ranking, 2001–2002	42
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	40
Main telephone lines per 100 inhabitants	12.47
Telephone faults per 100 main telephone lines	2.22
Internet hosts per 10,000 inhabitants	56.55
Personal computers per 100 inhabitants	5.06
Piracy rate	56.00 %
Percent of PCs connected to Internet	11.18 %
Internet users per host	4.85
Internet users per 100 inhabitants	2.74
Cell phone subscribers per 100 inhabitants	14.23
Average monthly cost for 20 hours of Internet access	US$24.14

	RANK
Networked Readiness Index	**44**
Network Use component index	**43**
Enabling Factors component index	**46**
■ **Network Access**	**42**
Information Infrastructure	39
Hardware, Software, and Support	44
■ **Network Policy**	**56**
Business and Economic Environment	59
ICT Policy	52
■ **Networked Society**	**48**
Networked Learning	47
ICT Opportunities	43
Social Capital	53
■ **Networked Economy**	**42**
e-Commerce	41
e-Government	31
General Infrastructure	53

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Tariq Mohammed, *Harvard University*
with **Dr. Matthijs Leendertse,** *Van Dusseldorp & Partners*

> “ Holland is well poised to become the leading European e-commerce nation given the Dutch propensity to be effective traders.”
>
> ***—Dutch IT analyst***
>
> “ Despite the hype, online procurement is limited to only a handful of multinational companies.”
>
> ***—IT executive, Netherlands***

The Netherlands has shown itself to be a global leader in adopting and using ICTs, as its sixth ranking in the Networked Readiness Index indicates. Both the private and public sectors have played an active role in cultivating the nation’s strengths, such as capitalizing on its highly skilled, multilingual workforce.

Since 1994, the Dutch government has taken steps to support ICT development, culminating in The Netherlands Goes Digital, a national e-commerce initiative launched in 2000 that broadly focuses on infrastructure, know-how and innovation, access and skills, regulatory aspects, and the use of ICTs in the public sector. The private sector has effectively built out an advanced telecommunications infrastructure (Ranking in Information Infrastructure micro-index: 7), and a subsector of ICT start-up incubation has been nurtured successfully (Ranking in VC Willingness to Invest in e-Commerce: 7). Even small and medium enterprises (SMEs) have adopted the Internet rapidly.

The Netherlands has a liberalized telecommunications environment in both fixed-line and mobile telephony, but the telecommunications sector is dominated by KPN Telecom, the former state-run incumbent telecommunications company (Ranking in Effect of Telecommunications Competition: 18). Dutch mobile penetration rates are close to those of the Nordic countries. In July 2000, the Dutch mobile telephony market was among the first in Europe to issue third-generation (UMTS) licenses. With more than 100 ISPs, a high cable television density, the development of Kenniswijk (government-backed Smart City Project), and two key European Internet exchanges, the Netherlands is a leader in information infrastructure. Moreover, the Dutch government is committed to continuing improvements in overall connectivity, particularly in educational institutions.

In 1999, the government set forth policies to bolster Networked Learning, one of which aims to connect all schools, libraries, and museums to a national Intranet, Kennisnet (Knowledge Network) by the end of 2001 (Ranking in Internet Access in Schools: 16). Several Dutch schools have been identified for best practices under the ICT School Portraits program for innovative use of multimedia, teacher training, and curriculum development.[1]

The Netherlands has a competitive e-commerce landscape in which the B2B e-commerce sector is well poised for growth (Ranking in e-Commerce micro-index: 7). Signaling this trend, several major non-ICT multinationals are shifting to online procurement. B2C e-commerce is mostly conducted over Dutch websites, with music, books, and software being the most popular online purchases.[2] Women and the elderly are the fastest-growing segments of online users.[3] Low credit card penetration, security issues, and logistical constraints have been barriers to greater e-commerce adoption, although most online retailers in the Netherlands simply send a bill and even advertise that credit cards are not necessary. In general, however, Dutch online banking, virtual marketplaces, and e-government services are some of the most sophisticated in Europe.

Efforts to create a Dutch Digital Delta are well underway, with the government taking the lead on developing virtual desks, portals, and Intranets for public and private use. For example, the Overheidsloket 2000 (Government Desk 2000 Initiative) provides citizens with information on housing, health, and employment, among others. The government’s goal is to be able to deliver almost 25 percent of its services online by 2002[4] (Ranking in Online Government Services: 16).

Netherlands

Key Facts

Population	16,000,000
Rural population (% of total population) 1999	10.68 %
GDP per capita (PPP)	US$25,598
Global Competitiveness Index Ranking, 2001–2002	8
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	8
Main telephone lines per 100 inhabitants	61.91
Telephone faults per 100 main telephone lines	0.50
Internet hosts per 10,000 inhabitants	1017.49
Personal computers per 100 inhabitants	39.48
Piracy rate	40.00 %
Percent of PCs connected to Internet	25.77 %
Internet users per host	4.48
Internet users per 100 inhabitants	45.62
Cell phone subscribers per 100 inhabitants	67.11
Average monthly cost for 20 hours of Internet access	US$15.41

	RANK
Networked Readiness Index	**6**
Network Use component index	**6**
Enabling Factors component index	**4**
■ **Network Access**	**9**
Information Infrastructure	7
Hardware, Software, and Support	10
■ **Network Policy**	**9**
Business and Economic Environment	8
ICT Policy	10
■ **Networked Society**	**5**
Networked Learning	6
ICT Opportunities	3
Social Capital	7
■ **Networked Economy**	**8**
e-Commerce	7
e-Government	13
General Infrastructure	5

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Indran Ratnathicam, *Harvard University*
with **Jim O'Neil,** *Information Technology Association of New Zealand (ITANZ)*

> "While very IT literate and innovative, New Zealand's IT industry has yet to attract outside investment due to its small domestic market."
>
> ***—New Zealand IT executive***

> "New Zealand business and government don't really support local IT businesses. There appears to be a predominate attitude that 'foreign' is 'better'."
>
> ***—IT executive, New Zealand***

New Zealand's overall Networked Readiness ranking of eleven is particularly reflective of the country's relative strength in Network Use (in which it ranks ninth overall) vis-à-vis its network Enabling Factors (in which the nation ranks twenty-first). Government ICT initiatives, the entrepreneurial nature of New Zealanders, profitable business opportunities for businesses, and a slowly liberalizing telecommunications industry have produced a varied and often inconsistent Networked Readiness landscape in New Zealand.

New Zealand was the first OECD country to legally introduce full competition to all sections of its telecommunications industry. Since 1989, no licenses have been required for market entry, and there has been no independent regulator. Due to the small size of the market and the lack of regulation, Telecom NZ, the privatized version of the state telecommunications business, had, until 1999, retained a monopolistic hold on its fixed network, especially in the local loop (Ranking in Effect of Telecommunications Competition: 25). Perceived inconsistencies in the incentive scheme and slow progress in Telecom NZ's network development led to an official inquiry by the government in 2000, which recommended establishment of an independent telecommunications authority.

A small but vibrant software industry has emerged in New Zealand, and has become competitive both locally and in exports to foreign markets such as Australia, Southeast Asia, and the U.S. Export sales in 2000 reached US$160 million, small by global standards, but a promising sign of the industry's potential.[1] The software industry is primarily homegrown (Ranking in Software Products Fitting Local Needs: 14), and is a product of New Zealand's culture of self-reliance, entrepreneurship, and high-quality education. Few major ICT multinationals have export facilities in New Zealand, and a small venture capital community has emerged to fund high-potential businesses. Local entrepreneurs have used the country's geography to create a competitive advantage in security software, because the local time zone allows them to detect and address problems first in the global business day.[2]

Overall, however, non-ICT companies have been slower to adopt the Internet for business practices. At mid-year 2000, it was reported that just one-third of New Zealand businesses had a domain name, and only one-tenth have linked e-commerce to existing business systems[3] (Ranking in e-Commerce micro-index: 27). Though B2B e-commerce marketplaces were established rapidly in 2000, primarily in the dominant agriculture and construction industries, companies are only beginning to equip their systems to use these marketplaces effectively.[4] It is hoped by those in the industry that uptake of ICT and e-commerce will receive a boost from the Electronic Transactions Bill currently under debate.

Until 2001, New Zealand's university system encouraged broad and diverse undergraduate education, with little opportunity for the kind of specialization characteristic of many other countries' university ICT programs (Ranking in Quality of IT Education: 25). The university system is undergoing reforms, led by the IT Ministry and the Ministry of Education, meant to improve the offering of software- and engineering-related degrees. Additionally, high costs of tertiary education have contributed to a brain drain. Many ICT graduates are attracted to higher-paying markets in other countries to repay their educational debts.

New Zealand

Key Facts

Population	3,830,800
Rural population (% of total population) 1999	24.86 %
GDP per capita (PPP)	US$20,010
Global Competitiveness Index Ranking, 2001–2002	10
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	18
Main telephone lines per 100 inhabitants	49.98
Telephone faults per 100 main telephone lines	14.00
Internet hosts per 10,000 inhabitants	900.87
Personal computers per 100 inhabitants	36.02
Piracy rate	28.00 %
Percent of PCs connected to Internet	25.01 %
Internet users per host	4.32
Internet users per 100 inhabitants	38.90
Cell phone subscribers per 100 inhabitants	56.33
Average monthly cost for 20 hours of Internet access	US$10.94

	RANK
Networked Readiness Index	**11**
Network Use component index	**9**
Enabling Factors component index	**21**
Network Access	**17**
Information Infrastructure	19
Hardware, Software, and Support	14
Network Policy	**17**
Business and Economic Environment	19
ICT Policy	14
Networked Society	**26**
Networked Learning	20
ICT Opportunities	47
Social Capital	12
Networked Economy	**23**
e-Commerce	27
e-Government	20
General Infrastructure	22

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Tariq Mohammed, *Harvard University*
Carlos Osorio, *Harvard University*

> “ It would be ideal if the authorities work hand-in-hand with the private sector to implement an IT development plan…”
>
> ***—CIO of Nicaraguan IT company***

> “ Promises of greater access to IT [are being used] in generating support for political campaigns—[this] demonstrates that IT is in the mind of the politicians.”
>
> ***—Nicaraguan IT executive***

Natural disasters, political turmoil, and economic woes have all had negative impacts not only on overall economic development in Nicaragua, but also on the nation’s Networked Readiness. The Nicaraguan economy is largely dependent on global commodity markets. The nation faces major development challenges, including widespread poverty, poor infrastructure, and decaying health and educational systems. Nicaragua ranks sixty-ninth overall in Readiness for the Networked World.

As a Highly Indebted Poor Country, nearly 30 percent of Nicaraguans live in poverty,[1] which, when added to high access costs and predominantly urban telephony coverage, makes Internet access impossible for most of the population.

There have been a number of problems in reforming the telecommunications regulatory environment in Nicaragua (Ranking in ICT Policy micro-index: 73). Consecutive attempts to privatize Empresa Nicaraguense de Telecomunicaciones (ENITEL), the state-owned telecommunications company, in 1996, 1999, and 2000, were unsuccessful. Partial privatization occurred in August 2001 when a consortium led by Swedish operator Telia bought a 40 percent stake. This was accompanied by legal controversy that ignited political opposition.

In 1998, Hurricane Mitch caused an estimated US$12 million in damage to the country’s already poor telecommunications infrastructure[2] (Ranking in Information Infrastructure micro-index: 69). Network access is very limited nationally. Teledensity in Nicaragua is the lowest in Central America, another factor that has hampered growth of the Internet. There are eighteen operational ISPs with approximately 25,000 subscribers.

The mobile telephony market is expected to grow with the issuing of a Personal Communication System (PCS) license to Grupo Azteca, a Mexican telecommunications company with rights to national coverage. The two existing mobile providers are limited to providing services on one of the coasts—Bell South (with a 55 percent digital network) serves the Pacific coast, and Teleglobo (analog cellular) serves the Caribbean coast.

There are very few computers, let alone Internet connections, in Nicaraguan primary and secondary schools (Ranking in Internet Access in Schools: 69). At the tertiary level, Nicaragua is participating in the RedHUCyT project, which aims to create a hemisphere-wide interuniversity scientific and technological network. The project is helping to develop the first Nicaraguan Academic Network.

According to Nicaragua’s Network Information Center, there were only 1,756 first- and second-level Nicaraguan Internet domains as of September 2001 (sixty-nine from government organizations, some of which do not work), an indication of the modest development of locally relevant Web content and services.[3] The most common Nicaraguan websites cover news or advertise goods and services.

A small number of firms have adopted B2C e-commerce, but it is still in its infancy due to low Internet penetration, unreliability of the postal system, and lack of access to credit cards. Nonetheless, in B2B e-commerce, one Nicaraguan bank has begun to offer online payment capability to employees and suppliers.

Internet access became relevant enough to be an issue during the presidential campaign leading up to the November 2001 election. Nonetheless, illiteracy, poverty, poor infrastructure, and, in general, building enabling factors for Networked Readiness (Ranking in Enabling Factors component index: 73) will continue to be major long-term challenges.

Nicaragua

Key Facts

Population	5,074,000
Rural population (% of total population) 1999	44.22 %
GDP per capita (PPP)	US$2,396
Global Competitiveness Index Ranking, 2001–2002	73
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	67
Main telephone lines per 100 inhabitants	3.04
Telephone faults per 100 main telephone lines	79.30
Internet hosts per 10,000 inhabitants	2.76
Personal computers per 100 inhabitants	0.79
Piracy rate	78.00 %
Percent of PCs connected to Internet	2.62 %
Internet users per host	19.10
Internet users per 100 inhabitants	0.41
Cell phone subscribers per 100 inhabitants	0.89
Average monthly cost for 20 hours of Internet access	NA

	RANK
Networked Readiness Index	**69**
Network Use component index	**65**
Enabling Factors component index	**73**
Network Access	**69**
Information Infrastructure	69
Hardware, Software, and Support	69
Network Policy	**72**
Business and Economic Environment	71
ICT Policy	73
Networked Society	**68**
Networked Learning	67
ICT Opportunities	66
Social Capital	70
Networked Economy	**69**
e-Commerce	68
e-Government	64
General Infrastructure	75

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Tariq Mohammed, *Harvard University*
Dr. Kolawole Olayiwola, *Development Policy Centre, Ibadan*

> “ Nigerians are beginning to realize that the nation cannot continue to rely on its natural resource base for much longer…we want to be a major software exporter to sustain our development.”
>
> ***—IT leader, Nigeria***

> “ Information technology as an industry is steadily growing. However, with a boost from government in the form of strong policy support, [it] will definitely assist in making Nigeria a prominent player in the IT industry in Africa.”
>
> ***—Director of Nigerian IT company***

As Nigeria grapples with major challenges of poverty alleviation and evolving democracy while balancing ethnic tensions, the nation is also struggling to participate in the Networked World. Nigeria’s inadequate telecommunications infrastructure, unreliable power supply, and poor governance help to explain only some of the underlying factors that lead to the nation’s overall seventy-fifth ranking in the Networked Readiness Index.

Nevertheless, the long-anticipated issuance of mobile telephony licenses has created a new sense of hope that progress can be made in improving the telecommunications sector. The Nigerian government is trying hard to build on its demonstrated willingness for private-sector-led development to roll out a much-needed national information infrastructure (Ranking in Information Infrastructure micro-index: 75). The Computerize Nigeria Project, a private-public partnership between the government and a local ICT hardware manufacturer, is expected to produce the first set of Made in Nigeria computers for local consumption.[1]

In April 2001, the government announced an ambitious national information technology strategy that aims “to make Nigeria an IT-capable country in Africa and a key player in the information society by the year 2005.”[2] This strategy is being debated in the senate, but some observers argue that it is not well integrated with national policies on science and technology, industry and commerce, communications, education, and investment.

After years of unreliable service and high charges, NITEL, the state-owned monopoly in fixed-line operations, is on course to be partially privatized (Ranking in Effect of Telecommunications Competition: 73). In the meantime, the majority of Nigerians are unable to afford a telephone, let alone access the Internet. Schools, hospitals, and businesses all lack connectivity. Faced with the burden of vandals and thieves digging up copper wire, some Nigerian telecommunications engineers may welcome the potential of wireless telephony as Nigeria’s cellular market begins to unfold.[3]

The banking and energy sectors are the major corporate users of ICT, with foreign multinationals leading the way. Online banking has been introduced to cater to both resident Nigerians and expatriates, but the domestic economy is predominantly cash-based. However, several B2B and B2C e-commerce initiatives were launched recently through a consortium of banks and individual players, offering a variety of electronic payment systems via Smart Pay technology.[4] Few foreign-based Nigerian professionals return to their country; much of Nigeria-based ICT talent pursues opportunities in the United States and other developed economies (Ranking in IT Brain Drain: 59).

In an attempt to improve the skills of ICT workers, a national computer literacy program was launched in the late 1990s; however, critics argue that it is too basic and does not encourage Nigerian ICT users to be producers of knowledge-based services (Ranking in Quality of IT Education: 69). Annual imports of computers, software, and peripherals were US$450 million at the end of 2000.[5] Efforts to raise awareness and provide ICT training in the national university system are underway. The Nigerian Universities Network (NUNet) aims to use satellite technology to connect higher education institutions to the international backbone, but only a handful of universities are benefiting due to the licensing restrictions on VSAT[6] (Ranking in Internet Access in Schools: 73). There is an innovative project underway to use solar power for computer labs in secondary schools in Lagos, to compensate for shortcomings in the standard electricity supply.[7]

Nigeria

Key Facts

Population	114,000,000
Rural population (% of total population) 1999	56.90 %
GDP per capita (PPP)	US$871
Global Competitiveness Index Ranking, 2001–2002	74
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	74
Main telephone lines per 100 inhabitants	0.43
Telephone faults per 100 main telephone lines	327.00
Internet hosts per 10,000 inhabitants	0.06
Personal computers per 100 inhabitants	0.61
Piracy rate	67.00 %
Percent of PCs connected to Internet	0.01 %
Internet users per host	1,298.70
Internet users per 100 inhabitants	0.09
Cell phone subscribers per 100 inhabitants	0.02
Average monthly cost for 20 hours of Internet access	US$40.71

	RANK
Networked Readiness Index	**75**
Network Use component index	**75**
Enabling Factors component index	**74**
Network Access	**67**
Information Infrastructure	75
Hardware, Software, and Support	59
Network Policy	**74**
Business and Economic Environment	73
ICT Policy	74
Networked Society	**67**
Networked Learning	63
ICT Opportunities	65
Social Capital	72
Networked Economy	**65**
e-Commerce	59
e-Government	63
General Infrastructure	74

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Indran Ratnathicam, *Harvard University*

> "It is difficult to find qualified people because the supply is too low. Expanding school capacity and upgrading the knowledge base will help our industry greatly."
>
> ***—CEO of technology company, Norway***

> "The next step for Norwegian IT is to improve the collaboration between companies and create clusters that can gain greater international recognition."
>
> ***—IT product manager, Norway***

Along with its Nordic peers, Norway forms part of the most Networked Ready region in the world; the nation ranks fifth overall in this year's Index. Though Norway shares many characteristics with other Scandinavian countries, such as its well developed communications infrastructure, the nation has striking differences as well. For example, the growing information technology industry plays a less significant role in Norway's diverse economy than it does in those of its neighbors.

The telecommunications industry has been deregulated since 1998, a condition of joining the European Economic Area. Internet and mobile penetration in Norway are among the highest in the world, the result of the nation's technology-friendly culture and publicly and privately funded modern infrastructure. Despite slow initial development of broadband, recent estimates suggest that at least one-third of all Norwegians will have broadband access by the end of 2005[1] (Ranking in Availability of Broadband: 26). Meanwhile, the government aims to connect all local authority administrations, hospitals, schools, and libraries by the end of 2002.

In June 2000, the Norwegian government launched a national ICT program, dubbed eNorge, designed to promote ICT and Internet use (Ranking in ICT as Government Priority: 30). In the promotion of a Networked Society, eNorge looks to support Norwegian cultural content and services. For example, eNorge has backed projects that incorporate the Sami language and its unique characters into software as well as others that develop digital teaching aids. In addition, eNorge has supported public access by working with local schools to make their ICT facilities open to the public during evening hours.

Commercial use of ICTs is beginning to catch up with the sophistication of the network. The majority of Norwegian businesses boast websites, but companies have been less enthusiastic about moving their transactions online. In Norway's large oil and oilfield services industry, the dominant companies have also been world leaders in introducing e-marketplaces. However, across the multibillion-dollar industry, more than 60 percent of all companies, mostly medium and small enterprises, had yet to integrate their sales and purchasing into an e-marketplace by the first half of 2001.[2] Concerns about security and lack of an ICT strategy are often cited as obstacles to ICT use, which prompted incorporation within eNorge of a program to implement national security and commerce standards. Additionally, the government is planning a public procurement portal for 2003 that should encourage vendors to go online. The domestic ICT industry is growing quickly, but Norway maintains a significant deficit of ICT hardware and services in its trade balance.

Norway is having trouble meeting the demand for ICT-skilled workers. Fewer university students are studying ICT-related courses, and the universities are facing challenges attracting qualified instructors—the student to teacher ratio is far higher in Norway than in neighboring Sweden[3] (Ranking in Quality of IT Education: 17).

Norway's National Center for Telemedicine is at the forefront of telemedicine research globally, with ties to universities throughout the northern hemisphere. Using rural Norway as a local proving ground, the Center has pioneered new models of centralized specialization and remote diagnosis with high-resolution digital imaging and collaborative online tools.

Norway

Key Facts

Population	4,485,000
Rural population (% of total population) 1999	14.30 %
GDP per capita (PPP)	US$29,500
Global Competitiveness Index Ranking, 2001–2002	6
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	1
Main telephone lines per 100 inhabitants	72.90
Telephone faults per 100 main telephone lines	39.50
Internet hosts per 10,000 inhabitants	1009.31
Personal computers per 100 inhabitants	49.05
Piracy rate	35.00 %
Percent of PCs connected to Internet	20.58 %
Internet users per host	4.86
Internet users per 100 inhabitants	49.05
Cell phone subscribers per 100 inhabitants	70.25
Average monthly cost for 20 hours of Internet access	US$10.81

	RANK
Networked Readiness Index	**5**
Network Use component index	**4**
Enabling Factors component index	**7**
Network Access	**7**
Information Infrastructure	5
Hardware, Software, and Support	9
Network Policy	**13**
Business and Economic Environment	14
ICT Policy	11
Networked Society	**6**
Networked Learning	12
ICT Opportunities	5
Social Capital	2
Networked Economy	**9**
e-Commerce	14
e-Government	12
General Infrastructure	2

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Mark Lopes, *Harvard University*
with **Luis Cisneros,** *SENACYT*
Manuel Ossa, *SENACYT*

> “ E-commerce could be bigger than the Panama canal.”
>
> ***—Senior e-commerce executive, Panama***

> “ Panama needs to increase investment in science and technology to raise the qualifications of the workforce.”
>
> ***—IT executive, Panama***

Panama is trying to position itself as the Connectivity Hub of the Americas, by expanding on its forty-eighth position overall in the Networked Readiness Index. With several fiber-optic backbones passing alongside the Panama Canal, access to first-mile broadband is widely available, and prices have dropped considerably in the last few months of 2001. Most Internet and telephony access, however, is centered in Panama City, and little effort is being made to deliver last-mile connectivity throughout the country. While Panama has more than twenty-five ISPs offering a variety of connection options, services tend to be focused in the capital.

Rural connectivity is the focus of some government programs; efforts are being made to spread the use of ICT to all sectors of the population through community telecenters. The Infoplazas program is one such initiative. To date, twenty-six telecenters have been installed in rural and semiurban locations, with an additional thirty planned for 2002[1] (Ranking in Public Access to the Internet: 37). A recent census found that only 8.6 percent of the 700,000 homes in Panama, 80 percent of which are in the Province of Panama, have a computer.[2] Many believe that telecenters could be crucial in providing greater access to rural areas.

As a result of the nation’s history as a competitive banking and financial services center devoted to attracting foreign business, many Panamanians have identified the need to adopt and use ICT more quickly than their neighbors. Although most small businesses do not have access to the Internet, many have realized its importance. With the nation’s zero-tax jurisdiction, no double tax treaties for commercial activities, and no VAT on goods or services exported, proponents feel that Panama could be an attractive environment for e-commerce.[3]

The Government of Panama has taken steps to enable e-commerce by creating Technology and Telecommunications Zones (TTZs). The City of Knowledge is the largest of those zones. Technopark, a technology park built on the former U.S. Army base at Fort Clayton outside Panama City, offers companies fiscal benefits, immigration advantages, and an established infrastructure. Since opening in January 2000, it has succeeded in attracting more than twenty-five multinational companies.[4]

An e-commerce law was signed in July 2001 that grants electronic documents and signatures the same validity as written documents (Ranking in Legal Framework for IT Business: 48), the first such law in Central America. Since the law’s passage, several call and data center operations, as well as web-hosting and e-commerce firms, have been launched.

In May 1997, Panama sold 49 percent of INTEL, the state-owned telecommunications company, to Cable and Wireless (C&W). Panama now has a monopoly on local and international wireline services until January 2003, when the entire telecommunications sector will be opened up to full competition (Ranking in Effect of Telecommunications Competition: 50). The current monopoly is curtailing investment from the private sector and limiting the diffusion of telecommunications services to noneconomically viable rural areas, so increased competition should hasten Panama’s movement into the Networked World. Currently, other services are provided by private companies on a competitive basis, including cellular, paging, satellite, and value-added services.

Panama

Key Facts

Population	2,856,000
Rural population (% of total population) 1999	43.96 %
GDP per capita (PPP)	US$6,169
Global Competitiveness Index Ranking, 2001–2002	53
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	41
Main telephone lines per 100 inhabitants	16.42
Telephone faults per 100 main telephone lines	52.00
Internet hosts per 10,000 inhabitants	52.82
Personal computers per 100 inhabitants	3.15
Piracy rate	64.00 %
Percent of PCs connected to Internet	1.37 %
Internet users per host	36.44
Internet users per 100 inhabitants	1.60
Cell phone subscribers per 100 inhabitants	8.27
Average monthly cost for 20 hours of Internet access	US$24.00

	RANK
Networked Readiness Index	**48**
Network Use component index	**55**
Enabling Factors component index	**48**
Network Access	**48**
Information Infrastructure	50
Hardware, Software, and Support	45
Network Policy	**50**
Business and Economic Environment	50
ICT Policy	49
Networked Society	**48**
Networked Learning	60
ICT Opportunities	40
Social Capital	44
Networked Economy	**52**
e-Commerce	48
e-Government	53
General Infrastructure	54

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Karen Coppock, *Harvard University*
Mark Lopes, *Harvard University*
with **Juan L. Balsevich P.,** *Planet Internet ISP*
Luis Guerrero, *Upgrade Magazine*

> “ The Internet has made us feel less landlocked.”
>
> ***—Senior Paraguayan telecommunications executive***

> “ Until the telecom is privatized, connection fees will remain prohibitively high for most households.”
>
> ***—Internet content provider executive, Paraguay***

Paraguay is in the midst of a political and economic crisis. The country’s international image has deteriorated as a result of overall instability, deep-seated government corruption, and the flow of pirated goods. Paraguay ranks sixty-third overall in Readiness for the Networked World.

Several government institutions, including the monopoly telecommunications provider Antelco, are slated for privatization with the hope that increased competition and efficiency will lead to an improvement in basic services and economic activity (Ranking in Effect of Telecommunications Competition: 62). In 1995, the Paraguayan government passed legislation to privatize Antelco and create a telecommunications regulatory authority. The government authorized the transaction in late 2000, and five companies are bidding for the contract. The process has been delayed numerous times, but is slated to take place in the first quarter of 2002.

Some hopes surround the Mercosur Agreement, which theoretically will convey benefits to all member countries, yet many feel that Paraguay must resolve its internal problems before it will be in a position to take advantage of any potential international economic opportunities.

Telephone and Internet connection and use charges remain very high in Paraguay, and services are generally poor. Delays in obtaining a new residential fixed line can be as long as one year. Not surprisingly, Paraguay has the lowest teledensity in South America and extremely low Internet penetration rates (Ranking in Network Access component index: 72). The rapid expansion of mobile telephony, which has more customers than fixed telephony, demonstrates the pent-up demand for telecommunications services. Most Internet connections are through dial-up accounts; however, because of poor telephone services, use of microwave connections, available near larger cities, is gaining in popularity, even though monthly fees start at US$99.

While Paraguay’s educational system was reformed recently, it continues to lack the necessary financial resources to give the reforms momentum. Education officials are focusing on providing support to recent reforms and giving schools a basic infrastructure and administrative framework with which to incorporate ICTs into the curriculum. Paraguay is one of the original four World Links countries in Latin America. The World Links program, which focuses on establishing Internet connectivity, teacher training, and curriculum design, is being developed within the framework of the National Policy on New Technologies in Education. The national telecommunications commission (CONATEL) has provided an Internet connection, a computer, or both to more than 300 schools, sixty of which receive direct support from World Links.[1] Although many World Links centers are located in urban areas where Internet connections and reliable electricity are available, there is a strong effort to connect rural areas as well (Ranking in Internet Access in Schools: 63). While the program has succeeded in providing connectivity and initial training, the typical challenges of local support and education remain significant obstacles to taking advantage of the donated equipment. Although overall computer use is low and Internet diffusion is still in its initial stages, many rural and urban families are investing enthusiastically in private computer education for their children. This has spurred growth of private education facilities throughout the country.

Paraguay

Key Facts

Population	5,496,000
Rural population (% of total population) 1999	44.72 %
GDP per capita (PPP)	US$4,396
Global Competitiveness Index Ranking, 2001–2002	72
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	54
Main telephone lines per 100 inhabitants	5.00
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	2.36
Personal computers per 100 inhabitants	1.09
Piracy rate	76.00 %
Percent of PCs connected to Internet	2.77 %
Internet users per host	12.05
Internet users per 100 inhabitants	0.37
Cell phone subscribers per 100 inhabitants	19.55
Average monthly cost for 20 hours of Internet access	US$22.25

	RANK
Networked Readiness Index	**63**
Network Use component index	**47**
Enabling Factors component index	**68**
Network Access	**72**
Information Infrastructure	70
Hardware, Software, and Support	73
Network Policy	**69**
Business and Economic Environment	70
ICT Policy	68
Networked Society	**61**
Networked Learning	66
ICT Opportunities	62
Social Capital	56
Networked Economy	**63**
e-Commerce	63
e-Government	70
General Infrastructure	56

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Colin Maclay, *Harvard University*
Juan Carlos Lujan Zavala, *Pontificia Universidad Católica del Perú*

> “ We have to build an e-government model because the Peruvian government is the biggest buyer in my economy, so if it starts buying over the Internet, all the providers would go to the Internet.”
>
> ***—Peruvian IT manager***

> “ One of the main problems is coordination between [the] private and public sector[s] regarding IT business.”
>
> ***—Peruvian IT manager***

After a controversial, decade-long civilian government that generated economic growth and modernization, along with political corruption, there is notable new enthusiasm in Peru. There have been important macroeconomic improvements and significant telecommunications investments, but Peru faces substantial economic, social, and technological barriers to joining the Networked World. The nation is ranked fifty-second overall in the Networked Readiness Index.

Peru’s information infrastructure has improved significantly (between 1993 and 1999, the number of fixed lines and network digitalization nearly tripled, and there is a new undersea cable)[1] since privatizing the state provider. Though all markets are officially competitive, Telefónica remains dominant in telephony, Internet provision, and government influence (Ranking in Effect of Telecommunications Competition: 45). There is significant competition in some markets in Lima, Peru’s capital and largest metropolitan area.

The limited competition that existed until 1999 led to some of the region’s highest telephony prices, a lower teledensity than its poorer neighbor, Ecuador, and little growth in lines since 1997. In 1999, telephone access was uneven; Lima had more than 15 percent teledensity, while Arequipa and Tacna (the next most populous departments) had about 8 percent, and seventeen of the remaining twenty-one departments had fewer than 4.2 lines per 100 people.[2]

Recognizing the importance and difficulty of public ICT access, in 1994, the Red Científica Peruana (RCP) began to introduce *cabinas públicas*, or public cabins. RCP’s awareness campaigns and support for entrepreneurs ignited a trend that resulted in establishment of an estimated 1,500 public-access points around Lima and the nation. Public Internet service costs about 40 percent of home telephone access (not including the cost to purchase a computer or use an ISP)[3] (Ranking in Public Access to the Internet: 13). The public-access points also offer VoIP, with international calls often costing less than 20 percent of the official rate.

In October 2001, the government launched the ambitious Plan Huascarán as part of an effort to rebuild the public education system that prepares 85 percent of all Peruvians, and to promote democratic participation and a self-sufficient population. While the details are unclear, the plan is to network approximately 5,000 state grade schools nationwide. Many observers fear that the emphasis is on technology rather than education. EDURED, an earlier Education Ministry program, connected nearly 271 schools for collaborative learning projects through technology, but suffered from the lack of a connectivity budget[4] (Ranking in Internet Access in Schools: 46).

The new government is interested in ICTs, particularly for their democratization potential, but many involved in ICT decry the lack of leadership or clear strategy for creating a networked nation (Ranking in ICT as Government Priority: 56). Several studies and plans have been undertaken recently by multisectoral groups, suggesting popular support and resources for decision making. Previous governments have been proactive in creating online content (including a national Web portal, online customs payments, and national current accounts database), and created the FITEL fund to subsidize rural telephony and Internet access. The National Institute of Statistics and Informatics (INEI), regulator OSIPTEL, and, in particular, the Peruvian e-Commerce Institute (IPCE) have gathered more extensive Networked World insights than most developing nations, but the government has little capacity to use them.

Instability and limited access to capital have slowed the growth of new technology businesses, but an IPCE survey claims that there are thirty-five e-commerce servers in Lima, and about 4 percent of Lima households have purchased goods online.[5]

Peru

Key Facts

Population	25,700,000
Rural population (% of total population) 1999	27.58 %
GDP per capita (PPP)	US$4,797
Global Competitiveness Index Ranking, 2001–2002	55
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	52
Main telephone lines per 100 inhabitants	6.37
Telephone faults per 100 main telephone lines	17.11
Internet hosts per 10,000 inhabitants	4.17
Personal computers per 100 inhabitants	3.51
Piracy rate	61.00 %
Percent of PCs connected to Internet	1.03 %
Internet users per host	43.34
Internet users per 100 inhabitants	1.59
Cell phone subscribers per 100 inhabitants	4.01
Average monthly cost for 20 hours of Internet access	NA

	RANK
Networked Readiness Index	**52**
Network Use component index	**44**
Enabling Factors component index	**62**
■ **Network Access**	**48**
Information Infrastructure	47
Hardware, Software, and Support	48
■ **Network Policy**	**61**
Business and Economic Environment	60
ICT Policy	62
■ **Networked Society**	**58**
Networked Learning	55
ICT Opportunities	64
Social Capital	55
■ **Networked Economy**	**59**
e-Commerce	62
e-Government	50
General Infrastructure	65

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Mridul Chowdhury, *Harvard University*
with **Roberto DC Yap,** *IntelTech Resources, Inc.*

> “ One whole chapter of the *Medium-Term Philippine Development Plan 2001 to 2004* is devoted to how information and communications technology can be the main instrument to combat poverty and bridge the digital divide in the country.”
>
> ***—Government official, Philippines***

> “ The government has a tendency to encourage/woo multinationals and foreign IT companies at the cost of ignoring local IT companies.”
>
> ***—IT company executive, Philippines***

Enthusiasm within the Philippines for the economic potential of ICTs became evident in 1994 with the nation’s formulation of the National Information Technology Plan. The plan laid the foundation for an overall strategy to spur national competitiveness through adoption and use of ICTs. Over the past few years, the Philippines has become a major East Asian hub for multinational ICT companies and a primary hardware exporter. The Filipinos have become global leaders in the use of Short Messaging Service (SMS). The Government of the Philippines has taken some aggressive initial steps in the right direction, and has shown its commitment to ICTs by efficiently passing important ICT laws and creating several ICT parks. Nonetheless, substantial challenges remain to achieve more sustained ICT development. The Philippines ranks fifty-eighth overall in Readiness for the Networked World.

One of the most pressing barriers lies in the telecommunications sector. Although the Philippine government was quite advanced in liberalizing its telecommunications market as early as 1995, these efforts have not translated to low prices. Significant investment in telecommunications infrastructure during the 1990s was not accompanied by efficient allocation of resources. There has also been a lack of leadership in telecommunications regulation (Ranking in Effect of Telecommunications Competition: 36). In the Philippines, more than 50 percent of the installed fixed lines remain unused.[1] At the same time, there has been dramatic growth in mobile telephony. The number of cellular telephone subscribers now far exceeds the number of fixed-line subscribers.

Use of the Internet has grown rapidly in the Philippines. Internet cafés have become very popular in the cities. In addition to online banking and stock trading, the Internet has had an impact on political participation in the Philippines, through increasing online political discussions and petitions. However, low levels of PC penetration, low incomes, a precarious economic situation, and relatively high Internet fees have stifled diffusion of the Internet to a wider portion of the population.

Built on the strength of the national ICT skill base, low labor costs, competence in English, and very favorable support from the government, a sizeable ICT industry has been created in the Philippines. Software, semiconductors, and microelectronics represent a major portion of the Philippines’s total export revenues.[2] However, challenges to the software industry include a high level of brain drain of the ICT labor force (Ranking in IT Brain Drain: 67), the expensive and inefficient electricity supply, lack of financing options, and a high software piracy rate.

E-commerce is beginning to develop in the Philippines (Ranking in e-Commerce micro-index: 37). B2B e-commerce marketplaces have emerged in the agricultural and other sectors, and there is a growing demand for e-commerce solutions, driven mainly by foreign multinational companies. Many B2C e-commerce sites that provide online shopping and tourism services are becoming popular, although online payment is not yet common.

One strength of the Philippines is its highly educated population (Ranking in Social Capital micro-index: 48); the country’s literacy rate exceeds 94 percent.[3] Recognizing the importance of education, the government’s national ICT strategy has placed heavy emphasis on enhancing the education system with ICTs and creating an ICT-skilled workforce (Ranking in Quality of IT Education: 31).

Philippines

Key Facts

Population	76,500,000
Rural population (% of total population) 1999	42.32 %
GDP per capita (PPP)	US$3,956
Global Competitiveness Index Ranking, 2001–2002	48
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	51
Main telephone lines per 100 inhabitants	3.92
Telephone faults per 100 main telephone lines	5.20
Internet hosts per 10,000 inhabitants	2.54
Personal computers per 100 inhabitants	1.93
Piracy rate	61.00 %
Percent of PCs connected to Internet	1.31 %
Internet users per host	102.84
Internet users per 100 inhabitants	2.61
Cell phone subscribers per 100 inhabitants	8.23
Average monthly cost for 20 hours of Internet access	US$16.45

	RANK
Networked Readiness Index	**58**
Network Use component index	**63**
Enabling Factors component index	**53**
Network Access	**49**
Information Infrastructure	52
Hardware, Software, and Support	46
Network Policy	**47**
Business and Economic Environment	47
ICT Policy	47
Networked Society	**52**
Networked Learning	36
ICT Opportunities	71
Social Capital	48
Networked Economy	**55**
e-Commerce	37
e-Government	57
General Infrastructure	71

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Indran Ratnathicam, *Harvard University*

> “ Those able to connect to the Internet have already done so. Many people are still unaware of the possibilities of the Internet.”
>
> ***—Polish IT consultant***

> “ We’ve got IT companies here, and that’s a good start.”
>
> ***—Financial analyst, Poland***

Poland’s overall ranking of thirty-five in Readiness for the Networked World is an indicator of the nation’s position as one of the leaders of Central and Eastern Europe. Accession to the European Union (EU) has made the telecommunications sector the most active part of Poland’s Networked World landscape.

As one of the requirements to join the EU, the process to fully liberalize Telekomikacja Polska (TPSA), the dominant telecommunications company, has begun. TPSA continues to control 90 percent of the local dialing market and has a monopoly on international long-distance through 2002 (Ranking in Effect of Telecommunications Competition: 57). Competition in local markets exists, but only one additional competitor per city/region has been licensed, and little change in pricing or market share is evident. Local calling prices are prohibitively high for many Poles, and teledensity is expected to grow slowly until new entrants are able to gain strength and achieve fiscal stability. In the meantime, mobile telephones are being adopted quickly as an alternative communications device in Poland. TPSA is also being privatized; the government sold 10 percent of TPSA’s shares on the Warsaw Exchange in 1998 and 35 percent of the company to France Telecom in 2001.

The Internet is starting to become a meaningful sector for the telecommunications industry. Online traffic is growing rapidly. Falling prices of Internet access, along with higher-quality networks and better service quality, have driven greater Internet use. TPSA was the first ISP in Poland. It offered the Internet free to its customers in hope of increasing phone use; however, service was so unreliable that fee-based dial-up providers emerged. Two of these new providers, Wirtualna Polska and onet.pl, have become the most dominant ISPs in Poland (Ranking in Effect of ISP Competition: 47).

The Internet’s economic impact and adoption by businesses are also just becoming visible. While most foreign direct investment has focused on Poland’s recently privatized heavy industry and agricultural sector, ICT infrastructure is now recognized as an undeveloped opportunity. Almost 300 Polish firms were engaged in e-commerce at the beginning of 2000[1] (Ranking in e-Commerce micro-index: 30). Vertically integrated industries are beginning to adopt e-commerce, and as supply chains diversify with liberalization and accession to the EU, it is estimated that B2B e-commerce in Poland could grow to more than US$7 billion in 2005.[2]

Poland’s gray market legacy as a former member of the Soviet bloc has led to thriving ICT-related business subsectors. The “entrepreneurs” who once pieced together smuggled components into computers sold in Poland, Czechoslovakia, and the USSR are now the leaders in the Polish PC industry.[3] Several other ICT companies floated on the public markets with initial but short-lived success also have elicited interest in the industry as an area for growth.

Knowledgeable observers point out that if Poland is to produce the ICT workforce necessary even in an economy based on manufacturing and agriculture, the nation’s greatest need for improvement lies in its schools. At the beginning of 2000, 16 percent of Polish primary or secondary schools had Internet connectivity (Ranking in Internet Access in Schools: 33), and no Polish universities taught modern Internet skills.[4] A government program has been established to bring all schools online by 2001.[5]

Poland

Key Facts

Population	38,800,000
Rural population (% of total population) 1999	34.78 %
GDP per capita (PPP)	US$8,971
Global Competitiveness Index Ranking, 2001–2002	41
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	32
Main telephone lines per 100 inhabitants	28.23
Telephone faults per 100 main telephone lines	26.00
Internet hosts per 10,000 inhabitants	87.66
Personal computers per 100 inhabitants	6.89
Piracy rate	54.00 %
Percent of PCs connected to Internet	12.73 %
Internet users per host	8.24
Internet users per 100 inhabitants	7.22
Cell phone subscribers per 100 inhabitants	17.40
Average monthly cost for 20 hours of Internet access	US$26.48

	RANK
Networked Readiness Index	**35**
Network Use component index	**36**
Enabling Factors component index	**33**
■ **Network Access**	**48**
Information Infrastructure	56
Hardware, Software, and Support	39
■ **Network Policy**	**42**
Business and Economic Environment	27
ICT Policy	56
■ **Networked Society**	**32**
Networked Learning	38
ICT Opportunities	33
Social Capital	24
■ **Networked Economy**	**35**
e-Commerce	30
e-Government	34
General Infrastructure	41

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Tariq Mohammed, *Harvard University*
with **Dr. Ana Maria Ramalho Correia,** *Universidade Nova de Lisboa-UNL*

> “ The fact that a global software company has selected Portugal as a test bed for launching an advanced ICT service gives us much confidence in being able to attract more foreign investment.”
>
> ***—IT manager, Portugal***

> “ The shortfall of Portuguese entering into higher education (in comparison to EU standards) has negatively affected the supply of IT workers within the economy.”
>
> ***—Portuguese IT executive***

Concerted efforts have led to significant advancements in Portugal’s Networked Readiness, although the country’s overall Readiness ranking of twenty-seven reflects long-term deficits in many of Portugal’s social and economic indicators. Since 1995, the Portuguese government has assertively pushed an integrated Networked Readiness agenda in such diverse areas as telecommunications reform, learning, business, and government. The private sector has also forged ahead, competing aggressively in Internet services and mobile telephony, among other areas.

Portugal’s telecommunications environment was harmonized with EU guidelines when basic telecommunications services were liberalized in January 2000. Portugal Telecom (PT), the fully privatized former state monopoly, plays a major role in the Internet, cable, and mobile telephony markets and controls virtually all local fixed lines—and more than 90 percent of all traffic (Ranking in Effect of Telecommunications Competition: 18). Mobile telephony penetration grew 95 percent between 1995 and 1999[1] and 40 percent in the last year, exceeding rates for Spain, Germany, and France.[2] Due to equipment problems, launching of third-generation cellular telephony (UMTS) has been delayed until December 2002. The ISP market is dominated by a few of the country’s approximately fifteen ISPs, but stiff competition has lowered prices and led to free Internet access (not including telephone charges) for an estimated two-thirds of all users (Ranking in Effect of ISP Competition: 29).

The .pt Web domain has grown consistently, and Portuguese ranks among the top five languages on the World Wide Web (although most websites in the Portuguese language are directed at Brazil). While Internet use remains relatively limited within Portugal, the nation’s penetration rate surpasses higher-income countries such as France, Italy, and Spain. Low PC penetration and high local call costs are impediments, but tax incentives for hardware and software purchases, a flat rate for Internet calls, and a public Internet access program are expected to help extend Internet use. Most Internet users are male students under age thirty.[3]

Portugal has made great strides in Networked Learning, and is only one of three EU nations to have connected all of its secondary schools to the Internet. In addition, by the end of 2001, every primary school is expected to be connected to the Internet. Challenging work still remains for government programs tasked with integrating ICT and education. NONIO focuses on improved teaching via ICTs, while Profmail provides e-mail service to teachers. The Science, Technology and Society Network (RCTS) connects universities, research institutes, nongovernmental organizations, museums, schools, and, most recently, all public libraries in Portugal (Ranking in Public Access to the Internet: 27).

E-commerce has grown, but remains in an incipient state, partially due to security fears (Ranking in e-Commerce micro-index: 34). Estimates suggest that about 10 percent of Portuguese Internet users bought goods online in 1999, which increased to almost 18 percent in 2001.[4] The banking and retail sectors have made progress toward online activities and are integrating debit cards and ATMs. Many have high hopes for mobile commerce; one group sold more than 25,000 theater tickets via WAP phones in a little over a year.[5]

The Portuguese government hopes to set the tone for adoption of ICTs at large by placing its own activities online and winning over technology skeptics (Ranking in Online Government Services: 21). Public Financing of the Digital Economy 2000–2006 calls for improving e-government services, and while there are still few interfaces, the work is underway.

Portugal

Key Facts

Population	10,000,000
Rural population (% of total population) 1999	37.20 %
GDP per capita (PPP)	US$16,882
Global Competitiveness Index Ranking, 2001–2002	25
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	26
Main telephone lines per 100 inhabitants	43.04
Telephone faults per 100 main telephone lines	11.20
Internet hosts per 10,000 inhabitants	62.02
Personal computers per 100 inhabitants	10.48
Piracy rate	42.00 %
Percent of PCs connected to Internet	5.92 %
Internet users per host	35.90
Internet users per 100 inhabitants	22.27
Cell phone subscribers per 100 inhabitants	66.51
Average monthly cost for 20 hours of Internet access	US$14.84

	RANK
Networked Readiness Index	**27**
Network Use component index	**25**
Enabling Factors component index	**28**
Network Access	**28**
Information Infrastructure	25
Hardware, Software, and Support	30
Network Policy	**24**
Business and Economic Environment	23
ICT Policy	25
Networked Society	**33**
Networked Learning	29
ICT Opportunities	28
Social Capital	41
Networked Economy	**28**
e-Commerce	34
e-Government	26
General Infrastructure	24

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Dr. Varujan Pambuccian, *Romanian Parliamentary IT&C Committee*
Cassandra Bischoff, *Harvard University*

> “We do have the ICT resources in place—great people and ideas—we just need to enhance and protect them by enacting and enforcing good laws and regulations.”
>
> ***—Romanian IT executive***

> “I think that ICT in rural areas is a problem. We can’t expect people in the villages to understand they need Internet when they don’t even have a phone line in their home.”
>
> ***—IT policymaker, Romania***

Historically, Romania has shown regional leadership in information technology: the first computer was designed and manufactured in Romania in 1957, launching the nation’s indigenous IT industry, and the country was a significant exporter of hardware and software in Eastern Europe during the 1990s. Nonetheless, Romania ranks only sixty-fifth overall in Readiness for the Networked World.

A series of government reforms were enacted in 2000 that should be harbingers of future development of the ICT sector. The establishment of a new Ministry of Information and Communications Technology, as well as new parliamentary mechanisms to ease adoption of ICT legislation, signaled a greater commitment by the government to ICTs as a national priority. A mechanism of tax incentives was set up for the ICT industry, and progress was made on adopting e-commerce and e-signature legislation. Private-sector perceptions of the government’s commitment, however, remain very poor (Ranking in ICT as Government Priority: 75).

E-commerce and e-government are basically nonexistent in Romania. The low purchasing power of the Romanian population, extremely limited PC ownership, high Internet access costs, and difficult national economic situation all remain obstacles. Nonetheless, there has been rapid recent growth in the number of Internet hosts and mobile telephony subscribers.

Romanian Networked Readiness is held back by an inability to set the stage for sound regulatory reform (Ranking in Effect of Telecommunications Competition: 60). Chronic inconsistency and unpredictability in policymaking and unevenly enforced tax laws have had a negative impact on foreign investment, because foreign investors have been reluctant to bring their resources to an unstable business environment. A lack of enforcement of intellectual property rights and a soft approach toward piracy and the black market have counterbalanced positive opportunities such as the decline in computer prices and the growing demand for ICT applications in schools.

Romania’s largest challenge may be the underdevelopment of its rural areas. The lack of technology in rural areas (in 1999, only about 5 percent of the rural population had access to telephones[1]) has paralleled significant economic and social discrepancies. To overcome these deficits, the Romanian government started a US$500 million, 3-year program in 2001 to create ICT community centers and to supply schools with computers, software, and educational content (Ranking in Internet Access in Schools: 74).

Economic considerations have compelled a large number of ICT specialists to leave the country to seek better-paid jobs in Western Europe and the U.S. (Ranking in IT Brain Drain: 75). However, during the last ten years, the brain drain has decreased from its estimated high of 40 percent,[2] reviving optimism in the power of the ICT market to absorb human resources.

Many consider Romania’s greatest opportunity to be liberalization of telephony in 2003, which is expected to give a great boost to the telecommunications sector. Two new licenses for national fixed-telephony operators will be issued at the end of 2003. There are three national GSM operators, and a CDMA operator started service at the end of 2001. Alternative network telephony and Internet access solutions are also anticipated.

Romania

Key Facts

Population	22,300,000
Rural population (% of total population) 1999	44.06 %
GDP per capita (PPP)	US$6,309
Global Competitiveness Index Ranking, 2001–2002	56
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	44
Main telephone lines per 100 inhabitants	17.46
Telephone faults per 100 main telephone lines	49.08
Internet hosts per 10,000 inhabitants	18.60
Personal computers per 100 inhabitants	2.69
Piracy rate	77.00 %
Percent of PCs connected to Internet	6.05 %
Internet users per host	19.27
Internet users per 100 inhabitants	3.58
Cell phone subscribers per 100 inhabitants	11.19
Average monthly cost for 20 hours of Internet access	US$16.62

	RANK
Networked Readiness Index	**65**
Network Use component index	**57**
Enabling Factors component index	**65**
Network Access	**65**
Information Infrastructure	60
Hardware, Software, and Support	70
Network Policy	**61**
Business and Economic Environment	53
ICT Policy	69
Networked Society	**60**
Networked Learning	75
ICT Opportunities	73
Social Capital	31
Networked Economy	**65**
e-Commerce	75
e-Government	75
General Infrastructure	45

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Alzhan Braliev, *Harvard University*
with **Konstantin Korischenko*,** *Troika Dialog*

> " E-commerce and B2B virtually don't exist in Russia."
>
> ***—Russian telecommunication analyst***

> " Exceptional human capital and [high] literacy rates can facilitate fast ICT sector development in Russia. The government wants every school in Russia to be connected to the Internet by 2005."
>
> ***—Russian governmental official***

Economic downturns, political turmoil, and a lack of sufficient foreign investment dominated Russia's attention in the 1990s, leaving little room for ICT development, as reflected in the nation's sixty-first rank in overall Readiness for the Networked World. The country's vast territories, along with such constraints as poor-quality telephone lines (Ranking in Information Infrastructure micro-index: 66), especially in rural areas, and an inefficient legislative base, also make the process of national ICT development complex and challenging. Nonetheless, Russia's high literacy rate and strong academic and scientific base (Ranking in Social Capital micro-index: 38), in conjunction with sufficient foreign investment, could contribute to one of the most promising areas for long-term economic activity in Russia—the evolution of the IT and telecommunications sectors.[1]

Despite the ongoing financial crisis, the telecommunications sector is one of the leading areas of growth in Russia. Internet-related companies have also been growing rapidly within the last couple of years (Ranking in Prevalence of Local Internet Start-ups: 34). However, due to the excessive cost of high-speed Internet services, broadband is limited primarily to ISPs and large corporations that can afford it (Ranking in Availability of Broadband: 68). The recent introduction of digital networks in large cities has added some new means for Internet access, though most areas are still using mostly outdated analog cables. This constraint, alongside a lack of PCs among the populace, adds to the overall low Internet penetration.

Rostelecom, the public telecommunications provider, still monopolizes international and long-distance switching and transmission (Ranking in Effect of Telecommunications Competition: 53). The popularity and development of mobile services have increased rapidly due to the poor quality and long waiting periods for obtaining a fixed line.[2] The hardware industry is well developed in Russia, and local companies meet the majority of market demand. Despite the high level of software piracy, the software industry is developing, but it is mainly targeted at banking and accounting services (Ranking in Software Products Fitting Local Needs: 41). Low purchasing power among consumers is one major impediment to development of this sector.

The education sector also has a low level of ICT penetration, especially in rural areas (Ranking in Internet Access in Schools: 65). Universities and colleges are better equipped with PCs than secondary schools, though they, too, face challenges such as obsolete computers and ICT illiteracy among both teachers and students. Resource allocation varies greatly by region, with huge discrepancies in Network Access between schools in Moscow and those in rural regions. Distance education has been getting more attention and has created high hopes for reaching more rural areas.[3]

Where available, the Internet is used widely by NGOs, academics, and businesses. E-government is in its initial stages and is hindered by the absence of appropriate laws (Ranking in e-Government micro-index: 60). Electronic Russia 2002–2010, a US$2.6 billion program, was approved by the Russian government and is intended to promote e-commerce and Internet use in the country.[4] In B2B e-commerce, some see great potential for greater ICT application in fuel and energy, metallurgy, banking, consumer goods production, and trade[5] (Ranking in e-Commerce micro-index: 57). By providing security and consumer protection for online transactions, the recently approved e-commerce law and electronic digital signature law could facilitate further e-commerce development in Russia.

Russian Federation

Key Facts

Population	147,000,000
Rural population (% of total population) 1999	22.66 %
GDP per capita (PPP)	US$8,213
Global Competitiveness Index Ranking, 2001–2002	63
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	42
Main telephone lines per 100 inhabitants	21.82
Telephone faults per 100 main telephone lines	35.21
Internet hosts per 10,000 inhabitants	22.22
Personal computers per 100 inhabitants	4.29
Piracy rate	88.00 %
Percent of PCs connected to Internet	5.18 %
Internet users per host	9.49
Internet users per 100 inhabitants	2.11
Cell phone subscribers per 100 inhabitants	2.22
Average monthly cost for 20 hours of Internet access	US$14.83

	RANK
Networked Readiness Index	**61**
Network Use component index	**59**
Enabling Factors component index	**63**
Network Access	**64**
Information Infrastructure	66
Hardware, Software, and Support	62
Network Policy	**60**
Business and Economic Environment	61
ICT Policy	59
Networked Society	**52**
Networked Learning	71
ICT Opportunities	48
Social Capital	38
Networked Economy	**55**
e-Commerce	57
e-Government	60
General Infrastructure	47

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Mridul Chowdhury, *Harvard University*
with **Chang Huong Tan,** *iGINE Pte. Ltd.*
Sandra Lee, *Cargo Web International Ltd.*
Daniel Mankani, *Redpacket.com Pte. Ltd.*

> " Due to the small domestic market, local IT companies in Singapore have to become regional or global players to be competitive in this business."
>
> ***—Executive, Singaporean IT company***

> " One of the most pervasive problems for the private sector to do business in Singapore is facing unfair competition from state-owned companies."
>
> ***—IT company executive, Singapore***

Singapore has been the most successful country in Asia in promoting Networked Readiness, as evidenced by its eighth ranking in the overall global Networked Readiness Index. The city-state has been able to exploit its small and literate population, innovative private sector, and efficient government to make ICT a key stimulus to economic growth. Favorable laws, a stable political environment, and strategic geographical location have made Singapore a haven for hundreds of foreign ICT companies. Since the early 1990s, the government has made aggressive efforts to ensure that the benefits of Networked Readiness reach every citizen and every business institution in Singapore. Infocomm 21, a five-year national ICT plan, was put together with the belief that the national ICT strategy must be industry-led, and that the government role should be primarily that of catalyst.

To lay a strong foundation for an information-driven economy, the Singaporean government has invested heavily in the country's infrastructure since the mid-1970s. Fixed-line telephone access currently reaches more than 99 percent of households, and over 50 percent of households have access to the Internet[1] (Ranking in Information Infrastructure micro-index: 15). The government has built a nationwide broadband infrastructure called SingaporeONE (Ranking in Availability of Broadband: 4). To facilitate further development of the telecommunications sector, the government has fully liberalized the telecommunications market (Ranking in Effect of Telecommunications Competition: 11).

Singapore's advanced information infrastructure has been a key contributor to the nation's Readiness for e-commerce. The e-commerce market in Singapore is one of the most well developed in Asia (Ranking in e-Commerce micro-index: 13). However, many critics argue that B2B e-commerce revenue in Singapore mostly benefits the numerous large, foreign multinational corporations based in the country, and that smaller domestic firms are still reluctant to use the Internet for sophisticated business purposes. The government has targeted programs to help these SMEs adopt e-commerce. The growth of B2C e-commerce has been quite conservative compared with the country's information infrastructure and income per capita. Another primary challenge to the Singaporean economy that has affected the growth of e-commerce in Singapore is the nation's small domestic market: the nation depends heavily on export revenues and foreign investment and, consequently, is very sensitive to global economic conditions.

Singaporean innovation in online services is best exemplified by its e-government initiatives. It is one of the few countries in the world where e-government services not only have provided more efficient access to the government but also have contributed significantly to realigning the way the government operates. The eCitizen initiative has received accolades from around the world as one of the best public-service delivery platforms in the world (Ranking in e-Government micro-index: 1).

The Singaporean government has also been progressive in using IT to create one of the most ICT-savvy societies in the world. Recognizing the inadequate supply of an ICT-skilled workforce, the education system has been largely revamped to generate innovative teaching and learning processes using ICT under a program called Masterplan for IT in Education (Ranking in Networked Learning micro-index: 4). To enhance people's quick access to online services, SingaporeONE is being made available at public places, schools, and libraries.

Singapore

Key Facts

Population	4,017,700
Rural population (% of total population) 1999	0.00 %
GDP per capita (PPP)	US$23,000
Global Competitiveness Index Ranking, 2001–2002	4
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	24
Main telephone lines per 100 inhabitants	48.44
Telephone faults per 100 main telephone lines	4.32
Internet hosts per 10,000 inhabitants	437.56
Personal computers per 100 inhabitants	48.31
Piracy rate	50.00 %
Percent of PCs connected to Internet	9.06 %
Internet users per host	10.52
Internet users per 100 inhabitants	46.05
Cell phone subscribers per 100 inhabitants	68.38
Average monthly cost for 20 hours of Internet access	US$18.75

	RANK
Networked Readiness Index	**8**
Network Use component index	**8**
Enabling Factors component index	**11**
Network Access	**16**
Information Infrastructure	15
Hardware, Software, and Support	16
Network Policy	**3**
Business and Economic Environment	1
ICT Policy	4
Networked Society	**16**
Networked Learning	4
ICT Opportunities	8
Social Capital	37
Networked Economy	**8**
e-Commerce	13
e-Government	1
General Infrastructure	9

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Alzhan Braliev, *Harvard University*
Joshua Budd, *IDC CEMA*

> “ There is an imbalance between the well-qualified people working in [the] IT field and insufficient investments in [the] ICT industry.”
>
> ***—Professor of computer science, Slovak Republic***

> “ The Internet has become an effective medium for communication resulting in a greater participation amongst different members of Slovak society.”
>
> ***—IT consultant, Slovak Republic***

The legacy of lack of investment and a disproportionate allocation of resources in the former Czechoslovakia have impeded the Slovak Republic’s Networked Readiness. After years of political isolation, the Slovak Republic has made significant progress since the election of a new government in 1998: the country ranks thirty-third overall in the Networked Readiness Index. The current government is introducing reforms that have spurred economic development and stabilized democratic institutions. The government’s top priorities for economic policy are privatization of banks and energy utilities, initiatives to address the country’s ongoing high unemployment rate, and development of the national ICT and telecommunications infrastructure.

In the early 1990s, the Slovak Republic’s telecommunications infrastructure was obsolete by Western European standards. By the end of the 1990s, however, new digital networks had supplemented the country’s older analog network infrastructure (Ranking in Information Infrastructure micro-index: 34). The incentive for the Slovak Republic to comply with EU standards and technological advancement should spur faster ICT development, and, coupled with Slovak Telecom’s (ST) loss of its monopoly over basic voice services in 2003, growth in this sector is expected (Ranking in Effect of Telecommunications Competition: 32). Since the new telecommunications law went into effect, the Slovak Republic has a new regulatory structure that largely complies with EU standards. The Telecommunications Office has become a mostly independent regulatory authority, taking over duties such as licensing from the Ministry of Transport, Post, and Telecommunications and tariff regulation from the Ministry of Finance.

Dial-up service is the most common means used by people in the Slovak Republic to access the Internet. Dial-up users must pay time-metered rates to ST in addition to ISP usage fees, but ST offers a less costly dial-up tariff specific to Internet calls. Internet service providers must obtain a license to operate in the country. Seventy-four licenses have been issued, and approximately thirty ISPs are connected to the Slovak Republic’s Internet exchange, SIX.[1] There is currently one ISP in the Slovak Republic providing free dial-up Internet access, although users must still pay a metered-call charge to ST.

The number of people using the Internet in the Slovak Republic is growing slowly, because PC penetration is low and Internet access is expensive (Ranking in Public Access to the Internet: 43). Internet penetration in the education sector is still low. In an effort to alleviate this problem, the government has launched the Infovek Slovakia Program, which will provide an Internet connection and PCs to approximately 3,000 schools over the next five years.[2] E-commerce and e-government are still underdeveloped. Although many government organizations and agencies have Web pages, they are primarily static and used for information purposes, rather than to carry out transactions online (Ranking in Online Government Services: 43). The new Law on Telecommunications adopted in May 2000 and the new Freedom of Information Act of 2001 show the government’s commitment not only to Networked Readiness, but also to greater overall transparency[3] (Ranking in ICT as Government Priority: 45).

Slovak Republic

Key Facts

Population	5,405,000
Rural population (% of total population) 1999	42.68 %
GDP per capita (PPP)	US$11,035
Global Competitiveness Index Ranking, 2001–2002	40
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	30
Main telephone lines per 100 inhabitants	31.41
Telephone faults per 100 main telephone lines	27.91
Internet hosts per 10,000 inhabitants	70.16
Personal computers per 100 inhabitants	10.92
Piracy rate	45.00 %
Percent of PCs connected to Internet	5.05 %
Internet users per host	17.14
Internet users per 100 inhabitants	12.03
Cell phone subscribers per 100 inhabitants	23.93
Average monthly cost for 20 hours of Internet access	US$9.30

	RANK
Networked Readiness Index	**33**
Network Use component index	**33**
Enabling Factors component index	**31**
■ **Network Access**	**33**
Information Infrastructure	34
Hardware, Software, and Support	32
■ **Network Policy**	**32**
Business and Economic Environment	32
ICT Policy	32
■ **Networked Society**	**25**
Networked Learning	29
ICT Opportunities	42
Social Capital	4
■ **Networked Economy**	**39**
e-Commerce	44
e-Government	34
General Infrastructure	38

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Alzhan Braliev, *Harvard University*
with **Joze Gricar,** *University of Maribor*

> "Environmental problems that are primarily the results of heavy industrial practices could be partially solved with development of [the] ICT sector and transition of Slovenia to a knowledge-based society."
>
> ***-Professor of computer science, Slovenia***

> "The taxes are too high and compensations are too low for IT companies in Slovenia."
>
> ***-President, Slovenian IT company***

Slovenia has made progress toward reaching European Union (EU) standards and has shown a commitment to transform itself into an information-based economy. This progress makes Slovenia a top candidate for the first round of EU accession. Slovenia ranks twenty-ninth overall in Readiness for the Networked World, with the Czech Republic and Hungary its closest peers. Slovenia has one of the best infrastructures among the former Yugoslavian states (Ranking in Information Infrastructure micro-index: 36) and is a regional leader in Internet connectivity and ICT education. One of the major challenges Slovenia faces in its transition is extending affordable network access to its entire population.

Slovenia's national telecommunications infrastructure is somewhat comparable to that of Western Europe. Analog networks were fully replaced by digital switches and fiber-optic cables by the end of 2000. Slovenia has high levels of mobile penetration and teledensity, and many observers feel that Slovenia also holds great promise for wireless Internet access.

Liberalization of the ISP market in January 2001 led to healthy competition, and there are now more than forty ISPs. Slovenia exceeds the average PC penetration for European countries. Relatively low telephone call costs have allowed the Internet to spread quickly. There is a gradual move toward integrating ICT into all sectors of the national economy. Slovenian academic institutions have used network technologies to interconnect with each other and other universities across Europe, and a number of multinational ICT companies have founded operations in the country (Ranking in Business and Economic Environment micro-index: 26).

Higher education is one of the Slovenian government's top priorities (Ranking in Social Capital micro-index: 19), and the government has publicly committed to invest in youth for the digital age. All schools have PC labs with Internet access, and Informatics is a required course in the national curriculum[1] (Ranking in Internet Access in Schools: 20). Though there is still a lack of ICT specialists in the country and insufficient educational material on the Web, distance learning programs are beginning to address this problem and may contribute to expediting national development in Slovenia. The University of Maribor recently started the Development of the Technology-Supported Distance Education Initiative, and some municipalities have started projects to install infomats in remote locations.

The Ministry of Information Society recently submitted requests to the European Commission to implement the following programs: Interchange of Data between Administrations, European Digital Content for Global Network, and Promoting Safer Use of the Internet. B2C and B2B e-commerce are growing as more companies and people go online (Ranking in e-Commerce micro-index: 38), and e-government has increased public services via electronic access (Ranking in e-Government micro-index: 38). The new e-Business and e-Signature Act (June 2000) allows the government and citizens to use electronic means for official interactions. In addition, in May 2001, a telecommunications act was enacted that is in line with EU standards and will regulate competition in the Slovenian telecommunications market.[2]

Slovenia

Key Facts

Population	1,986,000
Rural population (% of total population) 1999	49.66 %
GDP per capita (PPP)	US$17,127
Global Competitiveness Index Ranking, 2001–2002	31
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	26
Main telephone lines per 100 inhabitants	37.79
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	110.11
Personal computers per 100 inhabitants	25.18
Piracy rate	61.00 %
Percent of PCs connected to Internet	4.71 %
Internet users per host	10.61
Internet users per 100 inhabitants	12.57
Cell phone subscribers per 100 inhabitants	54.66
Average monthly cost for 20 hours of Internet access	US$17.51

	RANK
Networked Readiness Index	**29**
Network Use component index	**29**
Enabling Factors component index	**32**
■ **Network Access**	**37**
Information Infrastructure	36
Hardware, Software, and Support	38
■ **Network Policy**	**39**
Business and Economic Environment	26
ICT Policy	51
■ **Networked Society**	**27**
Networked Learning	27
ICT Opportunities	34
Social Capital	19
■ **Networked Economy**	**34**
e-Commerce	38
e-Government	38
General Infrastructure	26

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Tariq Mohammed, *Harvard University*
Dr. Jonathan Miller, *Miller, Esselaar and Associates*

> “ Education is one of the biggest problems, as well as the access to PCs and the Internet…it is still seen as a rich man’s toy.”
>
> ***—Manager, South African IT company***

> “ There is strategic political will, grounded by a private-public consensus, to exploit an already strong technical infrastructure and human resource base.”
>
> ***—South African IT policy analyst***

In association with the transition to a multiracial democracy in the mid 1990s, South Africa’s political and business leadership targeted ICTs as an enabler of development, thus embarking on a combined process of accelerated private-sector development and public-sector vision. By the end of 2000, the South African ICT market was valued at US$4.1 billion,[1] establishing the country’s position as the ICT leader on the continent. The nation’s fortieth overall ranking in Readiness for the Networked World puts it in the company of countries such as Brazil, Latvia, and Turkey.

South Africa faces several challenges in attracting foreign direct investment: political turmoil close to the country’s borders, HIV/AIDS, crime, and lingering foreign exchange controls (Ranking in Business and Economic Environment micro-index: 48). Nonetheless, strong political will has led to several major national initiatives working to transform South Africa into a knowledge-based economy that are expected to result in an integrated national ICT policy during 2002 (Ranking in ICT as a Government Priority: 41).

South Africa has an advanced telecommunications infrastructure and boasts the highest teledensity in Africa (Ranking in Information Infrastructure micro-index: 44). Rural areas lack connectivity, although they are starting to benefit from hundreds of telecenters around the country. There are currently two GSM operators with plans for the entry of a third operator by the end of 2001. Mobile connections significantly outnumber fixed lines. Meanwhile, Internet access is growing, but users are mostly wealthy whites.

According to the Schools Register of Needs Survey conducted early in 2000, of 27,148 schools, 58 percent had electricity, 55 percent had telephones, 30 percent had computers, and 16 percent had access to the Internet.[2] A proposed 50 percent subsidy for schools’ Internet access costs, called e-rate, is imminent and is expected to help increase Internet connectivity in public schools (Ranking in Internet Access in Schools: 46). In addition, NGOs, especially SchoolNet SA, working with provincial government authorities, have linked upwards of 3,000 schools to the Internet.[3] University students in forty-eight institutions enjoy well developed telecommunications networks through the Tertiary Education Network (TENET), which obtains international and national connectivity via Telkom, the national telecommunications operator.

For a middle-income, developing country with unreliable mail and an expensive courier service, it is noteworthy that 33 percent of South Africa’s online population has used the Internet to purchase goods.[4] As for locally relevant content, at least twenty-seven newspapers have an online presence; they also serve the South African expatriate community.

The diffusion of ICT into major industries can be seen primarily in retailing and financial services; it has yet to be embraced fully by the mining and manufacturing sectors. Supporting the diffusion process and fostering growth of a skilled ICT labor pool are the aims of the National Skills Development Act, which is helping quality assurance in the burgeoning ICT training sector through the Sector Education and Training Authority for Information Systems. This is especially relevant since, like many developing countries, South Africa suffers a brain drain whereby several hundred ICT-skilled professionals leave the country every year (Ranking in IT Brain Drain: 40).

Deregulation of fixed-line telephony will result in a second national operator competing with monopoly fixed-line provider Telkom by 2002. Critics fear this will simply lead to a duopoly (Ranking in Effect of Telecommunications Competition: 65). Leading observers note that the key elements needed to further Networked Readiness will continue to be telecommunications reform, affordable prices, and promotion of computer literacy.

South Africa

Key Facts

Population	43,700,000
Rural population (% of total population) 1999	49.82 %
GDP per capita (PPP)	US$9,189
Global Competitiveness Index Ranking, 2001–2002	34
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	62
Main telephone lines per 100 inhabitants	11.35
Telephone faults per 100 main telephone lines	43.00
Internet hosts per 10,000 inhabitants	42.95
Personal computers per 100 inhabitants	6.18
Piracy rate	45.00 %
Percent of PCs connected to Internet	6.95 %
Internet users per host	12.79
Internet users per 100 inhabitants	5.49
Cell phone subscribers per 100 inhabitants	19.70
Average monthly cost for 20 hours of Internet access	US$12.54

	RANK
Networked Readiness Index	**40**
Network Use component index	**41**
Enabling Factors component index	**41**
Network Access	**36**
Information Infrastructure	44
Hardware, Software, and Support	28
Network Policy	**47**
Business and Economic Environment	48
ICT Policy	46
Networked Society	**47**
Networked Learning	42
ICT Opportunities	50
Social Capital	50
Networked Economy	**36**
e-Commerce	28
e-Government	37
General Infrastructure	43

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Tariq Mohammed, *Harvard University*

> “ It is hard to find lecturers [in the IT field] with the right qualifications, which translates into problems for training more students to satisfy the demand.”
>
> ***—Dean of computer studies at a Spanish university***

> “ While Internet use in large companies and urban areas is about equal to that in the most advanced countries, small companies and rural zones are significantly behind.”
>
> ***—Spanish IT professional***

Spain is marked by dynamism in parts of its ICT sectors, but progress has been slowed by delayed benefits of fixed-line telecommunications liberalization. The country ranks twenty-sixth overall in Readiness for the Networked World.

Both national and local government initiatives are focusing on ICTs for economic growth (Ranking in ICT as Government Priority: 6). For example, the city of Barcelona is trying to use tax incentives to attract companies to set up R&D facilities in an upcoming technology zone.[1] Meanwhile, European Union-funded initiatives in marketing rural tourism through ICTs have proven noteworthy in establishing business and social networks.[2]

In December 1999, the Spanish government launched a four-year national initiative, INFO XXI; La Sociedad de la Información Para Todos (The Information Society for All), which attempts to deliver information services to businesses and citizens (Ranking in Online Government Services: 19). An Action Plan for 2001–2003 calls for support from local government and the private sector on issues of the Internet in education, public access, digital literacy, small and medium enterprises (SMEs), and e-commerce.

In early 2001, the local loop former state provider (over 90 percent of which is owned by Telefónica) was unbundled to create competition among other operators; however, success has been limited because of economic difficulties, technical challenges, and high interconnection fees charged by Telefónica (Ranking in Effect of Telecommunications Competition: 29). Broadband is in its infancy (Ranking in Availability of Broadband: 22). Attempts to roll out cable networks, although increasingly more numerous, have been slowed by bureaucratic red tape, and DSL has only a limited number of subscribers to date, partly due to the high rates Telefónica charges alternative DSL operators. Mobile wireless is growing rapidly. Spain already boasts 2.5G (GPRS) cellular telephony, and has created an innovative third-generation (UMTS) cellular licensing process driven by effectiveness and reach rather than revenue generation.

Internet penetration is a mere 13 percent, due in part to the combination of high access cost and an average of fourteen PCs per 100 inhabitants, less than half the EU average. When adjusted for purchasing power, Spain has among the highest Internet access costs in the EU, even though many ISPs offer free Internet service and draw their income from call charges and portal advertising instead. Despite Spain’s advantage in PCs and income per capita, neighboring Portugal’s rate of Internet penetration is more than 50 percent higher.

E-commerce is new, with estimates of 2000 B2C e-commerce at US$120 million,[3] and B2B e-commerce in 2002 at almost US$ 400 million[4] (Ranking in e-Commerce micro-index: 26). Spain’s numerous SMEs have been slower to adapt to the Internet, with estimates that fewer than one-third have a Web presence, and only about 10 percent of those offer online services.[5] In general, the Web has been viewed more as a marketing tool than one for service delivery.

Educational institutions have relatively good ICT infrastructure. Under the New Information and Communication Technologies Program (PNTIC), 80 percent of secondary schools have computer equipment, with an average of twenty-four students per computer[6] (Ranking in Internet Access in Schools: 30).

Through a consultative process, the Spanish government has drafted the Information Society and Electronic Commerce Law to enforce competition in the Internet sector and prohibit restrictions against other European Union ISPs.

Spain

Key Facts

Population	40,600,000
Rural population (% of total population) 1999	22.62 %
GDP per capita (PPP)	US$19,202
Global Competitiveness Index Ranking, 2001–2002	22
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	20
Main telephone lines per 100 inhabitants	42.12
Telephone faults per 100 main telephone lines	1.50
Internet hosts per 10,000 inhabitants	112.19
Personal computers per 100 inhabitants	14.29
Piracy rate	51.00 %
Percent of PCs connected to Internet	7.85 %
Internet users per host	11.83
Internet users per 100 inhabitants	13.27
Cell phone subscribers per 100 inhabitants	60.92
Average monthly cost for 20 hours of Internet access	US$19.81

	RANK
Networked Readiness Index	**26**
Network Use component index	**26**
Enabling Factors component index	**23**
Network Access	**23**
Information Infrastructure	22
Hardware, Software, and Support	23
Network Policy	**22**
Business and Economic Environment	24
ICT Policy	20
Networked Society	**24**
Networked Learning	24
ICT Opportunities	19
Social Capital	30
Networked Economy	**22**
e-Commerce	26
e-Government	21
General Infrastructure	18

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Professor V. K. Samaranayake, *Harvard University and University of Colombo, Sri Lanka*
with **Indran Ratnathicam,** *Harvard University*

> “Some people are beginning to create an IT culture, but that’s not enough. We need to educate everyone on the island about IT.”
>
> ***—Sri Lankan Internet executive***

> “With the highest literacy rate in South Asia, a large English-speaking population, and low labor costs, Sri Lanka is bound to be a significant IT player in South Asia.”
>
> ***—IT leader, Sri Lanka***

Sri Lanka is going through a period of political instability, coupled with the war situation in the North where the Tamil Tigers are fighting the government for a separate state. The nation ranks sixty-second overall in the Networked World Readiness Index. Under the best of circumstances, Sri Lanka would still be hard-pressed to overcome the difficulties of connecting and empowering its largely rural population and advancing the competitiveness of its mostly low-end manufacturing and agricultural economy. However, progress has occurred in spite of these challenges, and an end to the violence and unrest could signal rapid growth as Sri Lanka continues to train and leverage its adaptable, well-educated workforce (Ranking in Social Capital micro-index: 49).

The liberalization of the economy in the mid-1970s infused dated, but much needed, technology into all sectors of the economy. Subsequent establishment of the Council for Information Technology (CINTEC) in 1985, creation of the Ministry of Information Technology in 2000, deregulation of the telecommunications sector, and the *1998 Year of IT* have contributed much toward raising national awareness of Networked Readiness issues. CINTEC, through its committees on the Internet, Law and Computers, and Computer Education, is continuing to develop policy initiatives. Enactment of the Evidence Act of 1995, which allows computer-related evidence in courts of law, is one such example. In terms of economic policy, the state removed customs duty on all ICT products in 1998 and has since provided incentives to both local and foreign ICT enterprises (Ranking in ICT Policy micro-index: 53).

Local businesses have begun to incorporate the Internet in their activities (Ranking in e-Commerce micro-index: 52). Many companies in the Sri Lankan textiles industry have already made use of ICTs for their internal operations, and industry leaders are now using the Internet to connect with global supply networks and exchanges. “Smart buildings” and software parks are under construction, and adequate infrastructure resources are becoming available for many businesses. Several Sri Lankan expatriates have been able to establish ICT companies overseas to outsource their work to their own branches locally. The recent economic downturn in the West has retarded these activities but many business leaders are still confident of a recovery.

The universities of Colombo, Peradeniya, and Moratuwa have seen their strong computer degree courses serve as models for several newer university training programs. The government of Sri Lanka declared 2001 as the year of IT Education and set aside US$20 million to improve computing facilities in universities, and similar funding for computers to schools. However, limited admissions to the state universities providing free education have resulted in many joining training programs of suspect quality (Ranking in Quality of IT Education: 46).

Reaching the 80 percent of Sri Lanka’s population that lives in rural areas is both difficult and crucial. Multipurpose community telecenters (MCTs) are being tested at the district centers of Sri Lanka’s largest NGO, Sarvodaya. If rolled out broadly, these MCTs could use Sarvodaya’s extensive network of 11,400 village centers to provide a variety of ICT services, including the Internet, to the community, while at the same time building up local content (Ranking in Public Access to the Internet: 62).

Sri Lanka

Key Facts

Population	18,900,000
Rural population (% of total population) 1999	76.70 %
GDP per capita (PPP)	US$3,512
Global Competitiveness Index Ranking, 2001–2002	61
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	56
Main telephone lines per 100 inhabitants	4.05
Telephone faults per 100 main telephone lines	15.00
Internet hosts per 10,000 inhabitants	1.14
Personal computers per 100 inhabitants	0.55
Piracy rate	NA
Percent of PCs connected to Internet	1.15 %
Internet users per host	56.38
Internet users per 100 inhabitants	0.64
Cell phone subscribers per 100 inhabitants	2.38
Average monthly cost for 20 hours of Internet access	US$8.15

	RANK
Networked Readiness Index	**62**
Network Use component index	**67**
Enabling Factors component index	**59**
■ **Network Access**	**54**
Information Infrastructure	54
Hardware, Software, and Support	53
■ **Network Policy**	**53**
Business and Economic Environment	52
ICT Policy	53
■ **Networked Society**	**58**
Networked Learning	59
ICT Opportunities	67
Social Capital	49
■ **Networked Economy**	**56**
e-Commerce	52
e-Government	65
General Infrastructure	51

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Tariq Mohammed, *Harvard University*
Julie Kennedy, *Harvard University*
with **Lars Ilshammar,** *Örebro University*

> “Labor rules in Sweden do not encourage start-up firms.”
>
> ***—IT executive, Sweden***

> “The pragmatic collaboration between private companies and the government (and state-run companies) has been a decisive factor in their development into global high-tech companies.”
>
> ***—IT leader, Sweden***

Sweden, one of the world’s most vibrant economies, ranks fourth overall in the Networked Readiness Index. Sweden’s sophisticated information infrastructure, spectrum of outreach programs offered by the government (Ranking in ICT as Government Priority: 3), and highly skilled population all contribute to the nation’s success in the Networked World.

Since 1994, the Swedish government has had four independent *IT Kommissionen* (IT Commissions) that have helped to shape national strategies and action plans. An ICT bill sent to parliament, Information Society for All, enumerated in 2000 the state’s commitment to a big push in universal access to various ICT services, broad ICT competence in the Swedish population, and promotion of public confidence in ICTs.[1] The government has also acknowledged the desirability of extending broadband to all of Sweden, including hard-to-reach populations and geographic areas (Ranking in Availability of Broadband: 6).

Swedish telecommunications infrastructure is very highly developed (Ranking in Information Infrastructure micro-index: 2), with high levels of Internet penetration and mobile telephony use (Ranking in Network Use component index: 5). Sweden was one of the first European countries to deregulate its telecommunications market, which is open to foreign and domestic competition. Telia, the majority state-owned telecommunications company, dominates the fixed-line market, though as a signal of changed times, it lost its December 2000 bid for a UMTS third-generation cellular license.

With a history of technology and engineering achievements, Swedish society is very inclined to use ICTs. For example, Short Messaging Service (SMS) use has increased by 254 percent since 1999.[2] Concurrently, small and medium enterprises have been quick to have an online presence (Ranking in Business Websites: 2). PC penetration has been aided by a government tax reduction for companies that supply all personnel, regardless of position, with a personal computer. This “personal computer reform” has primarily helped to extend PC ownership to the lower middle classes and blue-collar workers, with a version of it also extended by the Swedish Trade Union Confederation.[3] This initiative has served both to educate a large percentage of the population in ICT skills and to provide widespread PC access.

Sweden has long been committed to education; this is apparent in its ICT and education initiatives, which take into account training, infrastructure, connectivity, and hardware ratios. Two initiatives of note are the ItiS, which targets 40 percent of Sweden’s teaching body and focuses on broad pedagogical skill training, and Schoolnet, the National Education Agency’s schools network.[4] (Ranking in Quality of ICT Education: 3).

Swedish B2B and B2C e-commerce have grown steadily more successful since the late 1990s, with overall profitability of online retail growing between 2000 and 2001.[5] (Ranking in e-Commerce micro-index: 4). The Swedish ICT sector also benefits from ICT clusters such as Kista, just north of Stockholm, which has been dubbed Wireless Valley.[6] In addition, Swedish multinationals are showing leadership in incorporating high-technology solutions. For example, Volvo has developed an automobile that automatically calls emergency services if it is involved in a crash.[7]

Sweden has shown itself to be a global leader in e-government. Planned or existing e-government initiatives include twenty-four-hour online access to government services, online voting, enhanced websites for different branches and services of the government, and online opportunities for meetings and community interface (Ranking in e-Government micro-index: 4).

Sweden

Key Facts

Population	8,880,532
Rural population (% of total population) 1999	16.74 %
GDP per capita (PPP)	US$23,884
Global Competitiveness Index Ranking, 2001–2002	9
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	2
Main telephone lines per 100 inhabitants	68.20
Telephone faults per 100 main telephone lines	8.40
Internet hosts per 10,000 inhabitants	670.79
Personal computers per 100 inhabitants	50.67
Piracy rate	35.00 %
Percent of PCs connected to Internet	13.24 %
Internet users per host	8.39
Internet users per 100 inhabitants	56.30
Cell phone subscribers per 100 inhabitants	71.36
Average monthly cost for 20 hours of Internet access	US$2.59

	RANK
Networked Readiness Index	**4**
Network Use component index	**5**
Enabling Factors component index	**3**
■ **Network Access**	**2**
Information Infrastructure	2
Hardware, Software, and Support	2
■ **Network Policy**	**7**
Business and Economic Environment	12
ICT Policy	2
■ **Networked Society**	**10**
Networked Learning	2
ICT Opportunities	17
Social Capital	11
■ **Networked Economy**	**5**
e-Commerce	4
e-Government	4
General Infrastructure	8

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Stephanie Hutchison, *Harvard University*
Jill Finger, *International Data Corporation*

> “ Most companies will wait until new technologies have been tested abroad and first proof of benefit can be shown. Thereafter businesses seem quite open for implementing the new technology.”
>
> ***—Swiss e-commerce executive***

> “ Even though Switzerland is not generally associated with IT innovation, we can claim that Geneva is the birthplace of the World Wide Web.”
>
> ***—IT researcher, Switzerland***

Switzerland’s highly educated population and well developed infrastructure are two strengths evident in the nation’s overall Networked Readiness ranking of sixteen.

As early as 1987, the Swiss Confederation, in conjunction with eight Swiss universities, launched the SWITCH Foundation, which promotes the use of modern methods of information transfer, specifically as they relate to facilitation of research and development. This group has established itself as an ICT pioneer within Switzerland, testing new technologies well in advance of mainstream adoption.

In 1998, the Swiss telecommunications market was liberalized, first for data traffic and then for voice. Telecom PTT, the state-owned telecommunications company, was also privatized. While these changes reduced government control over the country’s communications industry, the government continues to control almost 66 percent of Swisscom (formerly Telecom PTT). The government further influences the market through the state regulatory body, OFCOM, which is criticized as being slow-moving and lacking true independence.

Although the fixed-line market has been legally open to competition since 1998, Swisscom’s refusal to unbundle the local loop has dampened the competitive dynamic within the telecommunications environment. Yet, in absolute terms, the government’s reforms have brought prices down for both residential and business communications since liberalization (Ranking in Effect of Telecommunications Competition: 13).

In 1998, the Swiss government also launched the Information Society Coordination Group (ISCG) to monitor and execute national ICT development through training and education (Ranking in Effectiveness of Government ICT Programs: 20). The ISCG is also working to promote e-commerce, e-government, and new forms of online culture. Of particular concern to the government is the growing digital marginalization of groups such as the disabled and elderly populations within Switzerland. Further integration of ICT into the national education system is a priority for the Swiss government, but because of the nation’s decentralized government structure, it has limited control over primary and secondary school curriculum design.

The Swiss population’s approach to technology adoption has been measured and thoughtful, even hesitant. Business and individual users alike have shown skepticism of the Internet’s viability as a sales channel or retail outlet. Recent strides have been made, however, in developing electronic commerce in Switzerland (Ranking in e-Commerce micro-index: 10).

Moreover, the high-technology sector has yet to become a significant influence within the Swiss economy. Swiss banks have been reluctant to fund domestic high-technology ventures that fall outside their risk portfolio. Entrepreneurs must rely on their own funds to start businesses and often have to look to partnerships for growth opportunities (Ranking in Prevalence of Internet Start-ups: 22). The bureaucratic complexities of establishing a new business in Switzerland have also discouraged ICT entrepreneurs from moving forward with business plans.

The ICT sector has not let these roadblocks impede all progress, however, and businesses have sprung up to help entrepreneurs navigate these obstacles. The Swiss university system is playing a role as well, using the classroom as a vehicle to develop concepts and launch new companies (Ranking in Quality of Local IT Education: 13).

Switzerland

Key Facts

Population	7,164,400
Rural population (% of total population) 1999	32.30 %
GDP per capita (PPP)	US$28,518
Global Competitiveness Index Ranking, 2001–2002	15
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	11
Main telephone lines per 100 inhabitants	71.99
Telephone faults per 100 main telephone lines	18.47
Internet hosts per 10,000 inhabitants	366.41
Personal computers per 100 inhabitants	50.25
Piracy rate	34.00 %
Percent of PCs connected to Internet	7.29 %
Internet users per host	9.14
Internet users per 100 inhabitants	33.50
Cell phone subscribers per 100 inhabitants	64.45
Average monthly cost for 20 hours of Internet access	US$16.12

	RANK
Networked Readiness Index	**16**
Network Use component index	**17**
Enabling Factors component index	**12**
■ **Network Access**	**9**
Information Infrastructure	11
Hardware, Software, and Support	7
■ **Network Policy**	**11**
Business and Economic Environment	5
ICT Policy	17
■ **Networked Society**	**10**
Networked Learning	14
ICT Opportunities	12
Social Capital	3
■ **Networked Economy**	**14**
e-Commerce	10
e-Government	22
General Infrastructure	11

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Mridul Chowdhury, *Harvard University*
with **Andrew Sun,** *Data Systems Consulting Co., Ltd.*

> "Small software and networking companies in Taiwan will have to work together if they want to compete with global powerhouses. Too much competition on a local level will not increase national competitiveness of the industry."
>
> ***—IT company executive, Taiwan***

> "General businessmen in Taiwan are not yet willing to pay for intangible goods such as software and intellectual property. This impedes the development of a local software market."
>
> ***—IT company executive, Taiwan***

Taiwan, a small island with a sizeable population, is well respected internationally for its commercial prowess and agility, and is a leader in Networked Readiness in Asia, as reflected by its fifteenth overall ranking in Readiness for the Networked World.

During the 1960s and 1970s, Taiwan's economy was based primarily on labor-intensive industries. As the competitive edge of those industries began to decline with the increasing cost of labor, the Taiwanese government was quick to shift its industrial policy to focus on high-technology products—a policy that successfully transformed Taiwan into one of the largest hardware-exporting nations in the world. This achievement has certainly had a major impact on national priorities in harnessing information technologies for economic growth and competitiveness (Ranking in ICT as Government Priority: 5). The National Infrastructure Initiative outlined by the government captures that sense of optimism in a strategic medium-term plan.

Taiwan's teledensity and mobile penetration are among the highest in Asia. Since 1997, its mobile subscriber growth rate has been one of the fastest in the world, largely attributable to the intense competition in the Taiwanese wireless market. Taiwan's telecommunications sector is changing relatively quickly from being a government-run monopoly to a fully deregulated industry (Ranking in Effect of Telecommunications Competition: 18). With the privatization of Chunghwa Telecom, the state-run operator, still in process, the industry remains in transition but is expected to become more competitive in the coming years.

Taiwan's Internet penetration is high by Asian standards. Broadband facilities are currently limited (Ranking in Availability of Broadband: 38) but their numbers are rising rapidly. Cyber cafés have become a very profitable business in the cities. In remote villages, there are more than 300 Internet access centers. Taiwan has also made major strides in connectivity of schools. By mid-1999, all primary schools and junior high schools in Taiwan had computer classrooms connected to the Taiwan Academic Network and to the Internet via DSL (Ranking in Internet Access in Schools: 10). About a hundred Internet teaching training resource centers provide content and materials for courses in primary and secondary schools.[1]

Taiwan's well developed information infrastructure, high level of ICT penetration, and export-driven economy have made it an attractive location for development of e-commerce, particularly B2B. There are considerable efforts to establish B2B electronic supply chains between major ICT companies and their Taiwanese suppliers and among local ICT companies (Ranking in e-Commerce micro-index: 17). To facilitate e-commerce transactions in foreign trade, the Ministry of Economic Affairs plans to set up a Taiwan Information Marketplace (TIM)—a B2B website on Taiwanese industrial products. B2C e-commerce, however, is quite limited in Taiwan, despite high credit card penetration, primarily because of a lack of trust and consumer protection policies for online transactions.

Taiwan has also been making progress in e-government (Ranking in e-Government micro-index: 7). Some e-government initiatives have been undertaken, such as the Government Service Network, to which about a thousand government agencies have access. The government provides some of its services online, while even more initiatives have been approved by the Taiwanese Cabinet.

Taiwan

Key Facts

Population	22,300,000
Rural population (% of total population) 1999	NA
GDP per capita (PPP)	US$17,223
Global Competitiveness Index Ranking, 2001–2002	7
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	NA
Main telephone lines per 100 inhabitants	56.80
Telephone faults per 100 main telephone lines	2.54
Internet hosts per 10,000 inhabitants	495.98
Personal computers per 100 inhabitants	22.46
Piracy rate	53.00 %
Percent of PCs connected to Internet	21.91 %
Internet users per host	5.71
Internet users per 100 inhabitants	28.13
Cell phone subscribers per 100 inhabitants	80.30
Average monthly cost for 20 hours of Internet access	US$7.83

	RANK
Networked Readiness Index	**15**
Network Use component index	**10**
Enabling Factors component index	**22**
■ **Network Access**	**26**
Information Infrastructure	24
Hardware, Software, and Support	27
■ **Network Policy**	**22**
Business and Economic Environment	21
ICT Policy	23
■ **Networked Society**	**14**
Networked Learning	10
ICT Opportunities	12
Social Capital	21
■ **Networked Economy**	**18**
e-Commerce	17
e-Government	7
General Infrastructure	29

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Mridul Chowdhury, *Harvard University*
with **Manoo O,** *Datamat PLC*
Narong Intanate, *The Value Systems Co., Ltd.*

> “The economic crisis leading to the devaluation of the baht has made imports relatively expensive. Now the Thai companies are forced to rely more on innovation and they realize that IT is key to doing that.”
>
> ***—Thai business analyst***

> “IT solutions often cost more than hiring people to do manual work; therefore, it is only in limited cases that an IT investment is profitable. And the advanced services of the multinational IT companies are too expensive.”
>
> ***—Company executive, Thailand***

The government and ICT sector of Thailand are moving aggressively to claim their nation’s place in the Networked World. Although the Asian financial crisis hurt the nation’s economy badly, Thailand has proved its resilience by gradually reestablishing a competitive edge in global ICT markets. In this effort, the productive and efficient use of ICTs has been made a top national priority (Ranking in ICT as Government Priority: 41). The overarching ICT goals of the government, as embodied in the National IT-2000 Plan, are to build an equitable national infrastructure, improve provision of services through ICT, enhance education with the use of ICT, and forge a globally competitive software industry. Thailand ranks forty-third in the Networked Readiness Index.

Thai information infrastructure build-out was quite rapid until mid-1997, when foreign investors in the telecommunications sector suffered major losses after the *baht* was floated. Many telephone users unsubscribed in the wake of the economic slowdown. Even today, almost 2 million telephone lines remain unused.[1] The booming demand for mobile telephones and the Internet is beginning to revive the telecommunications sector, but regulatory issues still impede ICT growth. The dominance of the two state-run telecommunications providers and the lack of an independent regulator (Ranking in Effect of Telecommunications Competition: 43) keep telecommunications costs in Thailand significantly above those in many neighboring countries. However, hope abounds that the current government, many of whose officials hail from the Networked Economy and have a business stake in the ICT sector, will hasten reforms in the telecommunications industry.

In the recovery from the collapse of the financial sector in 1997, many banks embraced ICT to remain competitive and efficient. Internet banking is becoming increasingly common. Several B2B e-commerce marketplaces have emerged in sectors such as food, oil, textiles and automobiles. The government has been increasing the number of services available online—from issuing ID cards to filing tax returns (Ranking in Online Government Services: 50). But lack of PC penetration, low income levels, and high telecommunications fees, particularly for Internet access, limit Internet access to a small segment of the population located primarily in Bangkok.

Investing in People is one of the top national agendas of the government’s IT-2000 Plan. Several “school informatization” programs have been initiated by many organizations, including the Ministry of Education. The SchoolNet project had connected about 3,838 schools to the Internet as of November 2001[2] (Ranking in Internet Access in Schools: 33). Members of SchoolNet are concentrated in Bangkok and spread sparsely throughout the rest of the country.

In Thailand, a high level of optimism surrounds the software industry, which is widely regarded as a “sunrise” sector and believed to have the potential to bring in large amounts of foreign exchange. Relying on low labor costs and favorable government support, the industry has made some initial strides in software export, but the amount is still small by international standards. Substantial challenges exist, such as lack of copyright enforcement, high costs of Internet access, lack of ICT-skilled workforce (Ranking in IT Brain Drain: 33), and too few financing options.

Thailand

Key Facts

Population	60,600,000
Rural population (% of total population) 1999	78.72 %
GDP per capita (PPP)	US$6,469
Global Competitiveness Index Ranking, 2001–2002	33
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	49
Main telephone lines per 100 inhabitants	8.66
Telephone faults per 100 main telephone lines	17.76
Internet hosts per 10,000 inhabitants	10.47
Personal computers per 100 inhabitants	2.43
Piracy rate	79.00 %
Percent of PCs connected to Internet	4.31 %
Internet users per host	18.91
Internet users per 100 inhabitants	1.98
Cell phone subscribers per 100 inhabitants	5.04
Average monthly cost for 20 hours of Internet access	US$6.52

	RANK
Networked Readiness Index	**43**
Network Use component index	**54**
Enabling Factors component index	**40**
■ **Network Access**	**52**
Information Infrastructure	37
Hardware, Software, and Support	67
■ **Network Policy**	**42**
Business and Economic Environment	39
ICT Policy	45
■ **Networked Society**	**36**
Networked Learning	34
ICT Opportunities	27
Social Capital	46
■ **Networked Economy**	**36**
e-Commerce	40
e-Government	41
General Infrastructure	27

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Mridul Chowdhury, *Harvard University*
with **Therese Baptiste-Cornelis,** *Cornelis & Associates Ltd.*
Kazim H Syne, *RBTT Services Limited*

> "People in Trinidad and Tobago have a propensity to get certificates from short courses. As a result, with the rising hype of IT, many training institutes have grown overnight to provide IT education."
>
> ***—Business analyst, Trinidad and Tobago***

> "Although there has been a lot of talk about IT for the past few years, very little of the government rhetoric has been translated into action so far, and much of the private sector is still ignorant about the benefits of IT."
>
> ***—Executive of Trinidadian IT company***

Trinidad and Tobago's economy has historically been dependent on oil, gas, and chemical exports, which has caused the nation to become increasingly vulnerable to the volatility of global energy prices. As part of an effort to reduce this precariousness and to diversify the economy, the government has placed heavy emphasis on ICT to integrate the nation into the Networked World (Ranking in ICT as Government Priority: 56). The government has two main goals: to help build an export-oriented software sector and to increase efficiency in business and government by adoption of ICTs.[1] Trinidad and Tobago ranks forty-sixth overall in Readiness for the Networked World.

The Ministry of Communication and Information Technology was created in 2001 to support and, in some cases, lead ICT initiatives in Trinidad and Tobago. However, a coordinated effort has yet to emerge to put in place and implement a national ICT strategy among the private sector, the government, and academia (Ranking in Effectiveness of Government ICT Programs: 45).

Teledensity in Trinidad and Tobago has been increasing over the last decade at a slow but steady pace. Mobile telephone penetration increased dramatically between 1999 and 2000, but it remains significantly lower than fixed-line penetration. Significant challenges exist in the telecommunications sector: there is no independent regulator, and Telecommunications Services of Trinidad and Tobago (TSTT), the local telecommunications provider, enjoys a virtual monopoly in the fixed-telephony sector. Liberalization and privatization efforts have become particularly challenging now that Cable and Wireless, a regional operator, holds a significant stake in TSTT. Local and national long-distance telephony costs are relatively high in Trinidad and Tobago (Ranking in Effect of Telecommunications Competition: 71).

Trinidad and Tobago has a small population with a fairly low percentage of Internet users. Cyber cafés are popular means of urban access to the Internet due to low household PC penetration. Internet access in academia is generally limited to universities, private schools, and some semiprivate high schools. Numerous ICT training institutes have popped up in the nation to satisfy the increasing demand for ICT education, although most of them have little quality control (Ranking in Quality of IT Education: 43).

E-commerce in Trinidad and Tobago has yet to take off (Ranking in e-Commerce micro-index: 53). There are several B2C e-commerce websites, but few online transactions are taking place in the country. One potential avenue for extensive B2C e-commerce use may be in tourism, a sector in which the island still lags behind most other Caribbean nations. B2B e-commerce currently is limited to large companies, mostly multinational energy companies. Under a program called Information Technology Policy for the Public Service, some government institutions have been targeted for networking to share information and databases. But citizen-government online interaction has yet to become a reality (Ranking in Online Government Services: 72).

The Trinidadian government is putting particular emphasis on building an export-oriented software and ICT services industry. The government has proposed development of a science and technology park to attract local and multinational ICT companies, and ICT training programs are being developed in universities and vocational centers. Some potentially advantageous factors for developing an ICT services industry include the nation's literate, English-speaking population, its proximity to the U.S., and its position as an "English commercial gateway" to Latin America.

Trinidad and Tobago

Key Facts

Population	1,294,368
Rural population (% of total population) 1999	26.38 %
GDP per capita (PPP)	US$8,771
Global Competitiveness Index Ranking, 2001–2002	38
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	38
Main telephone lines per 100 inhabitants	23.10
Telephone faults per 100 main telephone lines	75.00
Internet hosts per 10,000 inhabitants	50.96
Personal computers per 100 inhabitants	5.41
Piracy rate	NA
Percent of PCs connected to Internet	6.93 %
Internet users per host	6.48
Internet users per 100 inhabitants	3.30
Cell phone subscribers per 100 inhabitants	10.29
Average monthly cost for 20 hours of Internet access	US$15.30

	RANK
Networked Readiness Index	**46**
Network Use component index	**49**
Enabling Factors component index	**47**
■ **Network Access**	**56**
Information Infrastructure	57
Hardware, Software, and Support	54
■ **Network Policy**	**44**
Business and Economic Environment	29
ICT Policy	58
■ **Networked Society**	**43**
Networked Learning	48
ICT Opportunities	46
Social Capital	34
■ **Networked Economy**	**52**
e-Commerce	53
e-Government	69
General Infrastructure	35

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Professor Asuman Dogac, *Middle East Technical University*
Aybar Acar, *Middle East Technical University*
Michael Putnam, *Harvard University*

> "The explosive impact of communications has not only eased people's lives, it has made the country more democratic and pluralistic."
>
> ***—Turkish IT leader***

> "Turkey needs a holistic national policy and strategy for the IT sector—both for public IT use as well as for private development and use. Legal frameworks are needed for a productive environment in Turkey, but are missing or lagging behind significantly."
>
> ***—Consultant, Turkey***

The government of the Republic of Turkey has been moving to integrate the country into Europe since its founding by Mustafa Ataturk in 1923. In line with this long-term national aim, Turkey has been investing aggressively in Networked Readiness in recent years, building bridges between Europe and the East. While diffusion and use of these technologies have been proceeding in Turkey, progress has been hampered by unfavorable economic conditions, the November 2000 banking crisis, and rapidly shifting governments during the past ten years.[1] The nation ranks forty-first in overall Networked Readiness.

The telecommunications sector in Turkey is still dominated by the government monopoly, Turk Telekom (TT), which maintains a large infrastructure but hampers competition and remains slow to adapt (Ranking in Effect of Telecommunications Competition: 52). In May 2001, partly in response to IMF demands and as part of its drive to join the EU, the parliament voted to privatize TT by the end of 2003. In contrast, competition in the mobile telephony and Internet Service Provider (ISP) markets has spurred rapid growth. There are now four competing cellular carriers, and mobile telephone use has jumped from roughly 10 percent of households in 1997 to 50 percent in 2000.[2] There are about thirty ISPs whose subscriber base has increased from 450,000 in 1998 to 1.2 million in 2000[3] (Ranking in Effect of ISP Competition: 26).

However, cost and training remain barriers to Turkey's use of ICTs. One recent survey found that cost is the major obstacle to Internet use in Turkey.[4] Bundling long-term Internet subscription packages with PCs has increased use, but the technology remains too expensive for many.

Banks and financial and brokerage firms have led in use of the Internet for business purposes in Turkey. All of the major banks in Turkey have Web-based applications where customers can carry out transactions online, and use of WAP and telephone services for stock exchange operations is encouraged.

Likewise, several governmental bodies have ICT projects underway. The Ministry of Education has begun deploying computer facilities with broadband connections to 75,000 schools within Turkey—a massive undertaking that many expect will run into funding and infrastructure hurdles. The ministries of Health, Justice, and Revenues are all implementing information systems, and the Ministry of Industry is focusing on improving awareness of e-commerce among small and medium enterprises. As promising as these efforts are, the question of coordination remains; the Prime Minister's National Information System and planned Web portal (http://kamu.net.tr),[5] are charged with integrating government efforts.

In Network Policy, the Turkish government has made clear its dedication to improvement of domestic ICT (Ranking in ICT as Government Priority: 68). Privatization of TT is a critical step. It is a slow process, however, and many have balked at the possibility of foreign corporations gaining a controlling interest. But the direction and spirit of these policies have been unmistakably toward Europe. The eEurope+ initiative and the Turkish National Infrastructure Masterplan have many lofty goals related to Networked Readiness, among them establishing regulatory bodies for telecommunications, encouraging ICT research and development, and creating relevant e-commerce and information policies, while nurturing domestic ICT awareness, training, and industry.

Turkey

Key Facts

Population	65,700,000
Rural population (% of total population) 1999	25.92 %
GDP per capita (PPP)	US$6,870
Global Competitiveness Index Ranking, 2001–2002	54
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	56
Main telephone lines per 100 inhabitants	27.99
Telephone faults per 100 main telephone lines	55.73
Internet hosts per 10,000 inhabitants	10.64
Personal computers per 100 inhabitants	3.81
Piracy rate	63.00 %
Percent of PCs connected to Internet	2.80 %
Internet users per host	28.60
Internet users per 100 inhabitants	3.04
Cell phone subscribers per 100 inhabitants	24.55
Average monthly cost for 20 hours of Internet access	US$11.20

	RANK
Readiness for the Networked World	**41**
Network Use Index	**39**
Network Enabling Factors Index	**44**
Network Access	**45**
Information Infrastructure	33
Hardware, Software, and Support	57
Network Policy	**45**
Business and Economic Environment	41
ICT Policy	48
Networked Society	**45**
Networked Learning	38
ICT Opportunities	35
Social Capital	62
Networked Economy	**44**
e-Commerce	33
e-Government	46
General Infrastructure	52

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Alzhan Braliev, *Harvard University*
with **Yuri Onisimov,** *Ryzhyi Law Firm*

> “Availability of powerful software firms, sufficient number of IT specialists, but lack of investments and starting capital [describe the Ukrainian IT sector].”
>
> ***—Vice president, Ukrainian IT company***

> “The Ukrainian market for Internet services depends more on availability of telecom and computer infrastructure than on demand for ISP services.”
>
> ***—IT consultant, Ukraine***

Like all of the former Soviet republics, Ukraine has faced a wide array of economic and political challenges since gaining its independence in 1991 (Ranking in Business and Economic Environment micro-index: 66). However, talented human capital and a rich industrial legacy have been key to the country’s gradual transition to a market economy and the Networked World. Ukraine has tried to improve its national telecommunications infrastructure as it strives for membership in the European Union. As a result of foreign investment in the private sector, there has been exceptional growth in Internet use in recent years. Ukraine ranks sixty-sixth overall in the Networked Readiness Index.

Ukraine’s fairly low teledensity correlates with its weakly developed telecommunications infrastructure, obsolete analog telephone network, and lack of sufficient investment in the ICT sector. Wireless services have grown quickly because of the high installation costs and long waiting periods for fixed telephone lines. However, the high costs of operation make mobile services affordable to only a small proportion of the population.

There are approximately 270 ISPs in the Ukrainian market. Some ISPs now offer free registration and equipment to attract new clients. A significant decrease in the cost of dial-up Internet services and a rise in the number of free off-peak ISP services have led to a rapid increase in the number of Internet users within the last couple of years, from 100,000 to 700,000.[1]

Although Internet access is still too expensive for the majority of the population, the privatization of Ukrtelecom, the state-owned telecommunications company that controls national telecommunications services over fixed lines, is expected to expedite Internet development in the country (Ranking in Effect of Telecommunications Competition: 61). Liberalization of Ukrtelecom was identified as a main priority by the Ukrainian government in 2000, and the first steps toward privatization have begun through privileged sales of shares to the company’s workers and other local companies.[2] The Internet Association of Ukraine is planning to submit a petition to the Antimonopoly Committee concerning the price policy of Ukrtelecom, which allegedly leverages its monopoly position to steer potential clients to its own Internet provision services.[3]

ICT literacy and ICT education recently have become the center of attention in Ukraine as the public and private sectors have begun to work together on ICT training programs (Ranking in Quality of IT Education: 55). For example, the Ukrainian Distance Learning System,[4] made up of educational and R&D institutions, government agencies, corporations, and nonprofit organizations, is developing innovative applications of ICT in education. The joint stock company UkrSat (Ukrainian Satellite Systems), under its initiative, Young Generation in the 21st Century, provides more than 350 schools nationwide with equipment and Internet access (Ranking in Internet Access in Schools: 65).[5] The Internet Access and Training Program, sponsored by the U.S. government and administered by the International Research and Exchanges Board (IREX), provides free Internet access to Ukrainian alumni of U.S. universities and colleges.

E-commerce is in its initial stages (Ranking in e-Commerce micro-index: 54), and is hampered by the absence of online payment systems, an underdeveloped electronic security system, and a lack of specific Internet regulation. Another major impediment to e-commerce expansion is low PC and Internet penetration in Ukraine. There is also poor protection of intellectual property rights overall in the country.

Ukraine

Key Facts

Population	50,500,000
Rural population (% of total population) 1999	32.12 %
GDP per capita (PPP)	US$3,693
Global Competitiveness Index Ranking, 2001–2002	69
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	53
Main telephone lines per 100 inhabitants	19.88
Telephone faults per 100 main telephone lines	34.47
Internet hosts per 10,000 inhabitants	7.09
Personal computers per 100 inhabitants	1.59
Piracy rate	89.00 %
Percent of PCs connected to Internet	3.62 %
Internet users per host	6.90
Internet users per 100 inhabitants	0.39
Cell phone subscribers per 100 inhabitants	1.62
Average monthly cost for 20 hours of Internet access	US$16.41

	RANK
Networked Readiness Index	**66**
Network Use component index	**66**
Enabling Factors component index	**64**
■ **Network Access**	**67**
Information Infrastructure	68
Hardware, Software, and Support	66
■ **Network Policy**	**66**
Business and Economic Environment	66
ICT Policy	65
■ **Networked Society**	**62**
Networked Learning	67
ICT Opportunities	69
Social Capital	51
■ **Networked Economy**	**49**
e-Commerce	54
e-Government	58
General Infrastructure	36

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Indran Ratnathicam, *Harvard University*

> “ We need more support for start-up companies. Cambridge, U.K. is successful, but does not have the level of entrepreneurial infrastructure as Cambridge, MA.”
>
> ***—Software start-up executive, United Kingdom***

> “ The government is intent on bringing technology to education...‘e-learning’ is becoming the buzzword *du jour.*”
>
> ***—IT journalist, United Kingdom***

The United Kingdom ranks tenth overall in the Networked Readiness Index. Deregulated in 1984, the British telecommunications industry is still dominated by British Telecom (BT) and its extensive fixed-line infrastructure. The Office of Telecommunications, the industry’s governing agency, continues to impose price controls on BT, especially in retail services, and will do so until enough competition is established to affect market pricing. Due to the challenges of creating new wireline infrastructure in the U.K.’s densely populated and highly developed geography, competition is emerging slowly, through mobile wireless, radio fixed access, and cable television. Adding to the high costs of fixed-line service is the Value Added Tax (VAT) on telecommunications, which can increase the price of service by as much as 20 percent. The VAT has hindered dial-up Internet access as well.

The mobile telephone industry is fiercely competitive and highly advanced. Basic connection and average monthly service charges on mobile networks are roughly the same as those for a terrestrial line and are affordable for the average citizen, making mobile penetration rates among the highest in the world. Mobile telephone use has had a visible impact on British society, with nearly ubiquitous use in metropolitan areas and high penetration even in more rural areas. For the month of August 2001, there were more than 1 billion Short Messaging Service (SMS) text messages via mobile devices in the United Kingdom.[1] Text messaging, mobile Internet, and mobile e-commerce are growing more popular in the U.K., and are representative of the sophistication of the mobile market.

In the public sector, a government plan, UKonline.gov, has been initiated to move all government services, communications, and transactions online. This ambitious project had succeeded in establishing sites with information for most frontline government service agencies by mid-year 2001 (Ranking in Online Government Services: 11).

Private-sector ICT growth has been helped greatly by the U.K.’s abundance of private investment capital. The U.K. is the European leader in venture capital (Ranking in VC Willingness to Invest in e-Commerce: 1), much of it invested in leading-edge research around the university clusters of Edinburgh and Cambridge. Additionally, these universities and others supply the local workforce with highly competent ICT workers, who in recent years have been supplemented by outsourced programmers from nations such as China and India. This combination of resources and innovation has helped the U.K. to become a leader in many areas of software, from games to security to enterprise software, especially in Europe. The conservative nature of English investors often results in early acquisition exit strategies that preclude large-scale organic growth for many of these successful start-ups. However, the U.K. has had a few breakout international success stories in the overall ICT industry, such as mobile operators Vodaphone and Orange. In 2001, the volatile global political and economic situation made investors even more cautious and likely signaled the end of the high-growth ICT industry of the late 1990s.

United Kingdom

Key Facts

Population	59,800,000
Rural population (% of total population) 1999	10.56 %
GDP per capita (PPP)	US$23,197
Global Competitiveness Index Ranking, 2001–2002	12
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	13
Main telephone lines per 100 inhabitants	58.23
Telephone faults per 100 main telephone lines	4.10
Internet hosts per 10,000 inhabitants	280.75
Personal computers per 100 inhabitants	33.78
Piracy rate	26.00 %
Percent of PCs connected to Internet	8.31 %
Internet users per host	11.91
Internet users per 100 inhabitants	33.43
Cell phone subscribers per 100 inhabitants	66.95
Average monthly cost for 20 hours of Internet access	US$18.22

	RANK
Networked Readiness Index	**10**
Network Use component index	**14**
Enabling Factors component index	**8**
■ **Network Access**	**7**
Information Infrastructure	10
Hardware, Software, and Support	4
■ **Network Policy**	**6**
Business and Economic Environment	3
ICT Policy	9
■ **Networked Society**	**16**
Networked Learning	8
ICT Opportunities	12
Social Capital	28
■ **Networked Economy**	**9**
e-Commerce	5
e-Government	11
General Infrastructure	12

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Indran Ratnathicam, *Harvard University*
Geoffrey Kirkman, *Harvard University*

> “ The heart of the U.S. IT engine is innovation. People and ideas come here from all over the world to thrive and [they] often produce global ripple effects.”
>
> ***—Technology consultant, United States***

> “ Change and evolution of IT and communications here happens so quickly that it’s often difficult to keep up with both the technology and its social implications.”
>
> ***—E-commerce manager, United States***

The United States is ranked first in overall Readiness for the Networked World. American ICT firms and capital markets have served as the primary drivers of both domestic and international growth in ICT over the last decade. Perceived productivity increases and unprecedented stock market valuations of ICT-related companies in the U.S. between 1995 and 2000 propelled one of the largest periods of investment in American history. B2C e-commerce, offered by thousands of businesses, grew rapidly and is expected to reach more than US$60 billion by the end of 2001.[1] B2B e-commerce is expected to exceed US$3 trillion by the end of 2003[2] (Ranking in e-Commerce micro-index: 1).

The United States shows strengths in Networked Readiness across most significant measures. In both component indexes, Enabling Factors and Network Use, the U.S. ranks second overall, behind Finland and Iceland, respectively. Considering the size and diversity of the U.S. geography and population compared to these smaller, more homogeneous nations, these strengths are particularly striking. ICT networks in the U.S. are abundant, diverse, and of high quality, marked throughout the country by redundancy of coverage and vibrant competition among service providers that extend affordable and dependable services to most citizens. The U.S. is the largest online nation.

The Network Policy environment in the U.S. is unique. While many other countries have enacted digital signature laws, e-commerce legislation, and national ICT strategies, the U.S. government has taken a hands-off approach to the Internet. The only major Internet-specific federal law to be enacted was in essence a tax holiday—a moratorium on Internet taxation between 1998 and 2001. This less-interventionist approach, along with low prices, booming investment, and a large domestic market, allowed the private sector to rapidly build out Internet infrastructure, explore new and innovative business models, and facilitate e-government (Ranking in Legal Framework for e-Commerce: 1).

The U.S. government focused on establishing loose guidelines for state-level policy, as well as general assistance to individual federal agencies. Most frontline federal and state agencies now use the Web to interact with citizens and businesses—the Department of Education, for example, through its Web portal (http://www.students.gov), now provides online services to thousands of U.S. students (Ranking in Online Government Services: 12). Many states are considering “fair” Internet taxation that would mirror existing sales taxes on products sold physically. The Department of Education and state governments have wired nearly all primary and secondary schools (Ranking in Internet Access in Schools: 7).

High performance relative to the other countries on the Index does not imply that the U.S. does not have its own Networked development challenges as well. The Telecommunications Act of 1996 has failed to relieve regional incumbents of their monopolistic levels of market share in the local loop, and did not pave the way for widespread broadband. Additionally, the U.S. has yet to extend ICT services equitably to minority and lower-income groups, resolve many interoperability standards, get broadband to rural areas, find effective ways to integrate ICT into classroom curricula, or reverse its declining pool of ICT-trained college graduates.

The investment exuberance is now over, and recent terrorist attacks on the U.S. have added to a cautious investment atmosphere across industries, and particularly in ICTs. Venture capital and internal investment, once the vanguard of the Internet boom (Ranking in VC Willingness to Invest in e-Commerce: 1), have declined significantly and changed their focus to implementation and applications of existing technologies across society and industries.

United States

Key Facts

Population	275,000,000
Rural population (% of total population) 1999	23.02 %
GDP per capita (PPP)	US$33,886
Global Competitiveness Index Ranking, 2001–2002	2
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	6
Main telephone lines per 100 inhabitants	69.97
Telephone faults per 100 main telephone lines	13.40
Internet hosts per 10,000 inhabitants	2928.32
Personal computers per 100 inhabitants	58.52
Piracy rate	24.00 %
Percent of PCs connected to Internet	50.04 %
Internet users per host	2.04
Internet users per 100 inhabitants	59.75
Cell phone subscribers per 100 inhabitants	39.79
Average monthly cost for 20 hours of Internet access	US$19.58

	RANK
Networked Readiness Index	**1**
Network Use component index	**2**
Enabling Factors component index	**2**
Network Access	**3**
Information Infrastructure	4
Hardware, Software, and Support	1
Network Policy	**5**
Business and Economic Environment	6
ICT Policy	3
Networked Society	**8**
Networked Learning	2
ICT Opportunities	1
Social Capital	20
Networked Economy	**5**
e-Commerce	1
e-Government	9
General Infrastructure	4

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Karen Coppock, *Harvard University*
with **Dr. Stephen Moston**

> “ Competition with the state-owned companies is the most pervasive problem of doing business in IT in Uruguay.”
>
> ***—ISP executive, Uruguay***

> “ I think that this new government must be firmly supported as it has entered with a very positive new IT vision.”
>
> ***—Internet company executive, Uruguay***

Uruguay’s Networked Readiness situation is mixed. The nation’s highly educated population and high-quality telecommunications infrastructure have spurred ICT activity within the country, but the challenges of stemming the brain drain of ICT talent, promoting national innovation, and maintaining competitive network access prices in a noncompetitive environment have held Uruguay back vis-à-vis the advancement of other Latin American countries. Uruguay ranks thirty-seventh overall in the Networked Readiness Index.

In August 2000, the National Committee for the Information Society was formed by the Government of Uruguay to “construct a strategy, a national response in [the] face of the profound and radical changes that these technologies are producing on the economy, commerce, culture, labor, health, education and even in the use of free time in all of the world.”[1] The Committee comprises high-level public- and private-sector representatives, including the President himself (Ranking in ICT as Government Priority: 30).

Uruguay leads the Latin American region in many key indicators (teledensity, computer and Internet penetration rates), in spite of the fact that its relatively closed telecommunications market is still dominated by the state-owned monopoly provider, and its Internet users are subject to both Internet access fees and a combination of metered and flat-rate local phone fees.

Uruguay also leads the region in education, with the highest adult literacy rate in Latin America (Ranking in Social Capital micro-index: 36). Nine years of education are mandatory, and education at all levels is free. The use of ICT in education is quite extensive, with the core being the Uruguayan Academic Network (*Red Académica Uruguaya*). This network has connected institutions from primary school through university levels.

Uruguay’s unemployment has increased steadily since 1998, leading to significant brain drain (Ranking in IT Brain Drain: 57). More than 250,000 Uruguayans left the country between January 1995 and June 2000, and it has been pointed out that **“**these were not tourists eager to travel abroad, but people who emigrated to other countries in search of secure jobs and dignified lives.”[2]

B2C e-commerce by Uruguayan companies has been slow to take off, due in part to the fact that many companies require that customers show and/or enter an ID card number while making a payment, regardless of whether the order was placed online. E-commerce with non-Uruguayan companies came to a dramatic halt when the Uruguayan customs office dropped an informal tax amnesty on international packages received via courier services (Ranking in e-Commerce micro-index: 48).[3]

Although liberalization of the telecommunications industry has begun in Uruguay, Uruguayans voted against privatizing ANTEL, the state-owned telephone company. ANTEL continues to enjoy a monopoly in fixed-line services, with competition now allowed in ISP services and beginning soon in the long-distance market (Ranking in Effect of Telecommunications Competition: 50).

Software development has become a key industry for the government. Numerous incentives have been implemented to encourage development of this industry. Thus far, the results are promising: software exports have grown 1,330 percent in the last five years and are now a US$75 million business.[4] Yet, ironically, software piracy is common in Uruguay, with the International Intellectual Property Alliance putting the country on its “priority watch” list.[5]

Uruguay

Key Facts

Population	3,337,000
Rural population (% of total population) 1999	8.96 %
GDP per capita (PPP)	US$8,904
Global Competitiveness Index Ranking, 2001–2002	46
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	32
Main telephone lines per 100 inhabitants	27.84
Telephone faults per 100 main telephone lines	5.60
Internet hosts per 10,000 inhabitants	162.02
Personal computers per 100 inhabitants	9.89
Piracy rate	66.00 %
Percent of PCs connected to Internet	7.69 %
Internet users per host	6.84
Internet users per 100 inhabitants	11.09
Cell phone subscribers per 100 inhabitants	13.19
Average monthly cost for 20 hours of Internet access	US$13.38

	RANK
Networked Readiness Index	**37**
Network Use component index	**37**
Enabling Factors component index	**39**
■ **Network Access**	**38**
Information Infrastructure	38
Hardware, Software, and Support	37
■ **Network Policy**	**38**
Business and Economic Environment	34
ICT Policy	42
■ **Networked Society**	**47**
Networked Learning	45
ICT Opportunities	60
Social Capital	36
■ **Networked Economy**	**41**
e-Commerce	48
e-Government	42
General Infrastructure	33

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Lino Clemente, *Venezuela Competitiva*
Colin Maclay, *Harvard University*

> “ Venezuelan financial systems are Jurassic.”
>
> ***—IT manager, Venezuela***
>
> “ There is a lack of coordination between the public and private sector to pursue an IT action program in the long run, even though there are plenty of initiatives in both sectors.”
>
> ***—IT manager, Venezuela***

Perceived as one of the most attractive, undeveloped ICT markets in Latin America, Venezuela continues to garner significant interest despite recent social and economic instability. Hard times have resulted in brain drain, decreased investment, and general insecurity. Venezuela is ranked fiftieth overall in the Networked Readiness Index.

During the 1990s, telecommunications grew from 1 percent to 3 percent of GDP and was the economy’s most dynamic sector.[1] The decade included the 1991 privatization of CANTV, the end of its monopoly in November 2000, and the rise of mobile telephony. With the economic slowdown in 2000 and 2001, telecommunications investment as a share of GDP decreased from nearly 6 percent in 1994–1996, to less than 1 percent in 1999–2000, and investments planned for the November 2000 deregulation were delayed.[2]

Access to the international telecommunications backbone is good, but only 69 percent of lines are digital, and infrastructure is concentrated in cities[3] (Ranking in Information Infrastructure micro-index: 40). Wireless teledensity increased tenfold between 1996 and 2000,[4] and is among the highest in Latin America. The rise was largely due to the high cost and poor quality of fixed-line telephony before competition, which led people to substitute mobile for fixed telephony (whose total lines have decreased since 1997). There are more than sixty licensed ISPs, but CANTV Servicios and Telcel control over 90 percent of the Internet market (Ranking in Effect of ISP Competition: 37).

There are stark differences between public and private education, and basic and higher education. Public schools serve most students, and are deficient in programs, functioning, attendance, student retention, and ICT access. Fewer than 30 percent of public elementary schools have telephones (2 percent have PCs), while 80 percent of private schools have them.[5]

The higher education system includes twenty-two schools of computer science, engineering, and systems, with approximately 20,000 students, and there are thirty more technological institutes and universities with more than 30,000 enrolled[6] (Ranking in Quality of IT Education: 52).

More than 60 percent of Internet users are in Caracas.[7] Most users come from the 20 percent of the population that earns in excess of US$370/month, but the 60 percent of the population living in critical and extreme poverty[8] has no meaningful ICT access because of educational deficits, limited resources, and high costs (Ranking in Public Access to the Internet: 54). There are pilot initiatives to promote Internet access in poor and rural areas, but their efficacy is unproven.

In 2000, there were approximately 240 dot-com businesses (Ranking in Dot-com Competition: 59), accounting for an estimated US$213 million in B2B e-commerce (mostly large corporations, including petroleum, electricity, telecommunications) and US$16 million in B2C e-commerce (personal services).[9] Most of the activity is in Caracas, where there is also a budding software industry.

The Venezuelan government is automating its processes and recently created an e-government Web portal, but it has had limited success in putting agencies and services online (Ranking in Online Government Services: 68); notably absent is about US$9 billion in annual procurement. There are no special programs to encourage businesses that use or export ICTs.

The government has promoted ICT use by creating the legal and regulatory environment and formally designating ICT a national development priority (Ranking in ICT as Government Priority: 47). The regulatory framework is designed to promote competition and has attracted foreign investors, but it remains unclear if the policies will be enforced effectively.

Venezuela

Key Facts

Population	24,200,000
Rural population (% of total population) 1999	13.38 %
GDP per capita (PPP)	US$5,677
Global Competitiveness Index Ranking, 2001–2002	62
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	46
Main telephone lines per 100 inhabitants	10.78
Telephone faults per 100 main telephone lines	3.50
Internet hosts per 10,000 inhabitants	6.68
Personal computers per 100 inhabitants	4.55
Piracy rate	58.00 %
Percent of PCs connected to Internet	1.47 %
Internet users per host	58.81
Internet users per 100 inhabitants	3.93
Cell phone subscribers per 100 inhabitants	21.74
Average monthly cost for 20 hours of Internet access	US$25.34

	RANK
Networked Readiness Index	**50**
Network Use component index	**50**
Enabling Factors component index	**55**
■ **Network Access**	**46**
Information Infrastructure	40
Hardware, Software, and Support	51
■ **Network Policy**	**53**
Business and Economic Environment	65
ICT Policy	40
■ **Networked Society**	**55**
Networked Learning	52
ICT Opportunities	54
Social Capital	58
■ **Networked Economy**	**57**
e-Commerce	50
e-Government	59
General Infrastructure	62

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Mridul Chowdhury, *Harvard University*
with **Nguyen Kim Cuong,** *CMCSoft*
Le Hong Boi, *Quantic*
Dr. Tran Luong Son, *VietSoftware*

> “ The fact that access to international websites is restricted could be turned into an advantage if efforts are directed towards the creation of Vietnamese Internet content. A decent content industry could develop in Vietnam.”
>
> ***—Business analyst, Vietnam***

> “ The government blocks many Internet service ports except for the popular ones...This prevents software companies from being able to test or sometimes develop certain software which requires access to service ports, such as those for academic library access.”
>
> ***—IT company executive, Vietnam***

Government suspicion about the negative consequences of the Internet stalled its entry into Vietnam until 1997. Since that time, wealthy and urban parts of Vietnamese society have been quick to embrace ICTs. Despite the economic slowdown caused by the Asian crisis, the ICT and telecommunications sectors in Vietnam have achieved high growth rates over the last few years. The government is torn, however, between a policy of active encouragement of ICT development on the one hand, and strict control over information exchange through the Internet on the other. The nation ranks seventy-fourth in overall Networked Readiness.

The 1990s were a decade of mixed results in the telecommunications sector in Vietnam. Heavy investment in building out the ICT infrastructure led to rapid growth in fixed-line telephone penetration (Ranking in Information Infrastructure micro-index: 73). Nevertheless, Vietnam Post and Telecommunication Corporation (VNPT), the state-run telecommunications monopoly, has maintained control of both fixed-line and mobile telephony. Telephone costs continue to be unaffordable to the majority of Vietnamese (Ranking in Effect of Telecommunications Competition: 67). Growth in the mobile telephony market has been less than many observers expected; unlike the situation in many other countries with similar income, Vietnam’s mobile penetration remains significantly lower than its fixed-line teledensity.

Since the inception of the Internet in Vietnam, its use has grown impressively, but it has been limited primarily to the major cities, particularly Hanoi and Ho Chi Minh City. Offices of foreign firms make up a substantial portion of the client base of Vietnamese ISPs. Telecenters are becoming increasingly popular in the cities as ISPs fees continue to decline (Ranking in Effect of ISP Competition: 72). Some twenty villages have been given free Internet access through post offices and public community centers[1] (Ranking in Public Access to the Internet: 68).

Several factors impede the more rapid diffusion of the Internet in Vietnamese society, however. Internet access to foreign websites is strictly guarded by government-owned Vietnam Data Communications (VDC), which provides the only access to the international Internet gateway. The creation of Web content in Vietnam is also carefully monitored. With limited competition in the ISP sector, ISP fees remain unaffordable for most Vietnamese.

Despite its reservations about content, the government has recently become keen to encourage e-commerce in Vietnam, particularly B2B e-commerce ventures to promote export industries. There is little B2B and almost negligible B2C e-commerce currently (Ranking in e-Commerce micro-index: 73). The financial sector is a leader within the country in the use of ICT, as several major banks have begun to offer some basic Internet banking services.

Vietnam’s national ICT strategy places heavy emphasis on creating an export-oriented software industry. Several ICT parks have been created in urban locations with low-cost, high-speed Internet facilities to attract local and foreign ICT companies. However, substantial challenges remain, including the lack of sufficient competition in the telecommunications sector, a high piracy rate, and an inadequate ICT-skilled labor force. Although the Department of Posts and Telecommunications of Vietnam (DGPT) is a separate regulatory body in name, it has little independence in decision making.

Vietnam

Key Facts

Population	79,800,000
Rural population (% of total population) 1999	80.36 %
GDP per capita (PPP)	US$1,974
Global Competitiveness Index Ranking, 2001–2002	60
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	64
Main telephone lines per 100 inhabitants	3.18
Telephone faults per 100 main telephone lines	NA
Internet hosts per 10,000 inhabitants	0.02
Personal computers per 100 inhabitants	0.88
Piracy rate	97.00 %
Percent of PCs connected to Internet	0.02 %
Internet users per host	793.65
Internet users per 100 inhabitants	0.13
Cell phone subscribers per 100 inhabitants	0.98
Average monthly cost for 20 hours of Internet access	US$13.43

	RANK
Networked Readiness Index	**74**
Network Use component index	**74**
Enabling Factors component index	**72**
■ **Network Access**	**74**
Information Infrastructure	73
Hardware, Software, and Support	75
■ **Network Policy**	**67**
Business and Economic Environment	64
ICT Policy	70
■ **Networked Society**	**63**
Networked Learning	69
ICT Opportunities	54
Social Capital	66
■ **Networked Economy**	**69**
e-Commerce	73
e-Government	65
General Infrastructure	68

.ZW

Tariq Mohammed, *Harvard University*
with **Dr. Fortune S. Mhlanga,** *Scientific and Industrial Research and Development, Zimbabwe*

> “There is tremendous intellectual talent in Zimbabwe which we train and develop to complete outsourced work for international clients.”
>
> ***—Manager, Zimbabwean IT company***

> “Changes in the economic environment and information control policy are the solution to Zimbabwe’s troubles.”
>
> ***—CEO of ISP, Zimbabwe***

In recent years Zimbabwe has been wracked by economic and political turmoil, exacerbated in particular by the land settlement crisis. A significant depreciation of the Zimbabwean dollar, fuel shortages, high inflation, political instability, and the threat of HIV/AIDS are having detrimental effects on Zimbabwe’s overall national development as well as the nation’s Networked Readiness, in which it ranks seventieth.

Concerns from prominent players in the ICT industry highlight the country’s inability to find foreign currency to pay for bandwidth and equipment as well as the growing loss of skilled ICT professionals (Ranking in IT Brain Drain: 62). In the midst of these troubles, and following lengthy legal disputes, a handful of successful ICT companies have emerged in Zimbabwe. These pockets of innovation, although enjoyed only by a small minority, can be found in the wireless and ISP markets.

In 2000, the Supreme Court ruled that Zimbabwe Post and Telecommunications Company’s (PTC) monopoly in the provision of fixed telecommunication services was unlawful. Plans to privatize PTC have been discussed over the last several years, but the government’s announcement in October 2001 that it was reverting to a command-and-control economy may hinder further progress toward privatization. Earlier, the government offered telecommunications licenses for US$320 million (fixed), US$100 million (mobile), and US$4 million (ISP). Some observers regarded the high license fees as a means of protecting PTC’s monopoly.[1] In addition, there is no independent telecommunications regulator to ensure affordable prices and high standards (Ranking in Effect of Telecommunications Competition: 62). Interestingly, PTC is one of the few African national telecommunications operators to offer Voice over Internet Protocol (VoIP).

Roughly 2 percent of the population has access to a landline, while less than 0.4 percent has Internet accounts.[2] Since the late 1990s, the private sector has responded to the demand for ICTs through provision of cellular services. There are three GSM operators, with a total subscriber base of 300,000 or almost 2.5 percent of the population.[3] Several initiatives to deploy telecenters in rural areas are underway (Ranking in Public Access to the Internet: 73).

Zimbabwe’s strongest asset may lie in the nation’s 88 percent literacy rate, the highest on the African continent (Ranking in Social Capital micro-index: 67).[4] Substantial investments in the educational system from 1980 to 2000 increased secondary school attainment appreciably[5] (although overall enrollment has dropped significantly since 1998, following the decision to charge tuition to attend schools). Foreign NGOs are improving Internet connectivity in schools as well as in health centers. For example, Healthnet Zimbabwe enables health professionals to share information on controlling diseases. Another ICT initiative initially supported by UNDP (United Nations Development Programme), and now a nonprofit ISP, is the Zimbabwe Academic and Research Network (ZARNet), which provides connectivity to a host of educational institutions and marginalized communities (Ranking in Internet Access in Schools: 71).

There has been very little incorporation of ICTs into everyday Zimbabwean life. E-commerce and e-government are still virtually nonexistent in the country. While the opposition party received international acclaim and attention for its use of the World Wide Web and e-mail to generate political support during the 2000 elections, it is unclear what domestic impact this campaign had.

Zimbabwe

Key Facts

Population	12,600,000
Rural population (% of total population) 1999	65.40 %
GDP per capita (PPP)	US$2,697
Global Competitiveness Index Ranking, 2001–2002	75
UNDP Human Development Index Ranking, 2001 (adjusted to GITR sample)	72
Main telephone lines per 100 inhabitants	1.91
Telephone faults per 100 main telephone lines	223.00
Internet hosts per 10,000 inhabitants	2.31
Personal computers per 100 inhabitants	1.19
Piracy rate	59.00 %
Percent of PCs connected to Internet	1.38 %
Internet users per host	9.65
Internet users per 100 inhabitants	0.17
Cell phone subscribers per 100 inhabitants	2.44
Average monthly cost for 20 hours of Internet access	US$23.02

	RANK
Networked Readiness Index	**70**
Network Use component index	**68**
Enabling Factors component index	**70**
Network Access	**66**
Information Infrastructure	74
Hardware, Software, and Support	58
Network Policy	**71**
Business and Economic Environment	69
ICT Policy	72
Networked Society	**65**
Networked Learning	58
ICT Opportunities	71
Social Capital	67
Networked Economy	**67**
e-Commerce	67
e-Government	74
General Infrastructure	60

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Country Profile Glossary

ATM	Asynchronous Transfer Mode
ASP	Application Service Provider
B2B	Business to Business (e-commerce)
B2C	Business to Consumer (e-commerce)
DSL/xDSL	Digital Subscriber Line
FDI	Foreign Direct Investment
G2B	Government to Business
G2C	Government to Citizen
GDP	Gross Domestic Product
GPR	General Packet Radio Service
GSM	Global System for Mobile communications
EU	European Union
ICT	Information and Communication Technologies
IMF	International Monetary Fund
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
Kbps	Kilobits per second
NAP	Network Access Point
NGO	Nongovernmental Organization
OECD	Organisation for Economic Co-operation and Development
PC	Personal Computer
PCS	Personal Communication Services
SME	Small and Medium Enterprises
SMS	Short Messaging Service
UMTS	Universal Mobile Telephone System
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VAT	Value-Added Tax
VC	Venture Capital
VoIP	Voice over Internet Protocol
VSAT	Very Small Aperture Terminal
WAP	Wireless Access Protocol
WTO	World Trade Organization

Data Rankings

Data Rankings

Data Rankings

How data pages work

The following pages provide detailed data for all 75 nations included in the *Global Information Technology Report 2001–2002*. The data are organized into eleven sections:

I. Network Use
II. Information Infrastructure
III. Hardware, Software, and Support
IV. Information and Communication Technology Policy
V. Business and Economic Environment
VI. Networked Learning
VII. ICT Opportunities
VIII. Social Capital
IX. e-Commerce
X. e-Government
XI. General Infrastructure

Two types of variables are presented in these tables:

(1) average country responses to questions included in the World Economic Forum's Executive Opinion Survey, conducted in early 2001; and

(2) "hard data" obtained from a variety of sources.

① Survey Data

For each survey variable, the original question is included in the description at the top of the table. In most cases, the questions asked for responses on a scale from 1 to 7, where an answer of 1 corresponds to one end of a spectrum of responses and an answer of 7 corresponds to the other end. Where data come from the Executive Opinion Survey, we report the average response for each country. Variable 4.2, for example, corresponds to a question about respondents' perceptions of the effect of telecommunications competition on price and quality of services, with higher scores corresponding to a higher estimated positive effect of telecommunications competition in generating high quality, low cost services, and vice versa. The score indicated for Finland is 6.8, indicating the arithmetic mean of responses to this question from executives in Finland, and a high average perception of positive effect of telecommunications competition in terms of quality and cost of telecommunications services.

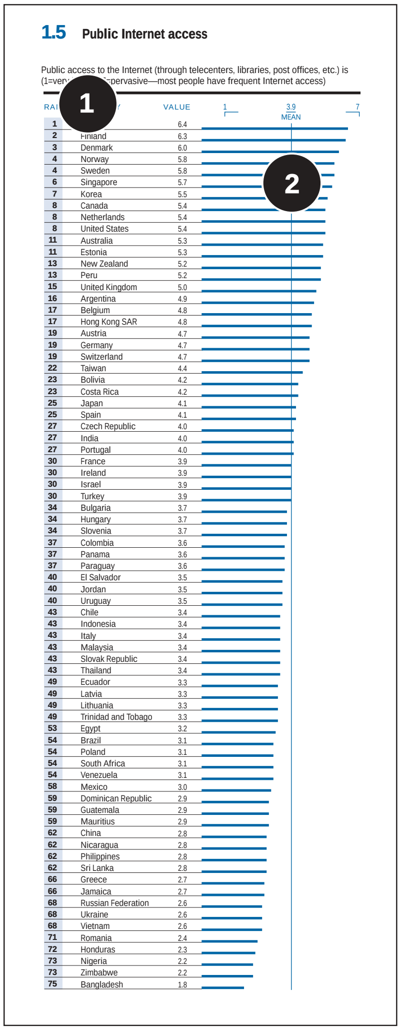
When questions ask for specific data instead of degree of agreement with a statement, we report the median instead of the average response. An example is variable 5.5, which corresponds to the question, "Considering license and permit requirements, what is the typical number of days required to start a new firm in your country?" Average responses for this type of question are biased by outliers—a problem we resolved by using the median measure. Ties are exact in these cases, and shared rankings are indicated accordingly. In question 5.5, for example, the median response was "10 days" for Israel, Netherlands, New Zealand, and Norway. All four countries are thus ranked as tied for fourth place. The survey data that we used to calculate the rankings were rounded to a single decimal place.

Hard Data

For hard data, we report the average value of each variable to one or two decimal points (with the exceptions of the variables in Tables 5.1, 5.2, and 5.3 that are rounded to three decimals). The exact hard data figures were used to determine rankings and for graphs, and while they have been rounded for presentation, only genuinely tied countries are listed as such. In the case of variable 8.2, for example, Germany's value is 9.747, Bulgaria's is 9.740 and Japan's is 9.721, and these economies are ranked thirteenth to fifteenth respectively, even though they are listed with the same rounded value of 9.7.

In many cases, for both the Survey data and hard data, the order of the rankings reflects what is desirable for a country's Networked Readiness, but this is not always the case. There is broad agreement, for instance, that greater availability of online government services (variable 10.2) is good for Networked Readiness; it is not clear, however, that it is always better to have many government websites (variable 10.3), as the number of websites tells us little about their content or usefulness. It should be noted that in cases such as the latter, the data are in a certain order for consistency in presentation, but the order should not be interpreted as a clear indicator of (or priority for) Networked Readiness.

② A solid blue line on the graph indicates the mean country score for each of the 75 countries.



1.5 **Public Internet access**

Public access to the Internet (through telecenters, libraries, post offices, etc.) is (1=very =pervasive—most people have frequent Internet access)

RAI	Y	VALUE
1		6.4
2	Finland	6.3
3	Denmark	6.0
4	Norway	5.8
4	Sweden	5.8
6	Singapore	5.7
7	Korea	5.5
8	Canada	5.4
8	Netherlands	5.4
8	United States	5.4
11	Australia	5.3
11	Estonia	5.3
13	New Zealand	5.2
13	Peru	5.2
15	United Kingdom	5.0
16	Argentina	4.9
17	Belgium	4.8
17	Hong Kong SAR	4.8
19	Austria	4.7
19	Germany	4.7
19	Switzerland	4.7
22	Taiwan	4.4
23	Bolivia	4.2
23	Costa Rica	4.2
25	Japan	4.1
25	Spain	4.1
27	Czech Republic	4.0
27	India	4.0
27	Portugal	4.0
30	France	3.9
30	Ireland	3.9
30	Israel	3.9
30	Turkey	3.9
34	Bulgaria	3.7
34	Hungary	3.7
34	Slovenia	3.7
37	Colombia	3.6
37	Panama	3.6
37	Paraguay	3.6
40	El Salvador	3.5
40	Jordan	3.5
40	Uruguay	3.5
43	Chile	3.4
43	Indonesia	3.4
43	Italy	3.4
43	Malaysia	3.4
43	Slovak Republic	3.4
43	Thailand	3.4
49	Ecuador	3.3
49	Latvia	3.3
49	Lithuania	3.3
49	Trinidad and Tobago	3.3
53	Egypt	3.2
54	Brazil	3.1
54	Poland	3.1
54	South Africa	3.1
54	Venezuela	3.1
58	Mexico	3.0
59	Dominican Republic	2.9
59	Guatemala	2.9
59	Mauritius	2.9
62	China	2.8
62	Nicaragua	2.8
62	Philippines	2.8
62	Sri Lanka	2.8
66	Greece	2.7
66	Jamaica	2.7
68	Russian Federation	2.6
68	Ukraine	2.6
68	Vietnam	2.6
71	Romania	2.4
72	Honduras	2.3
73	Nigeria	2.2
73	Zimbabwe	2.2
75	Bangladesh	1.8

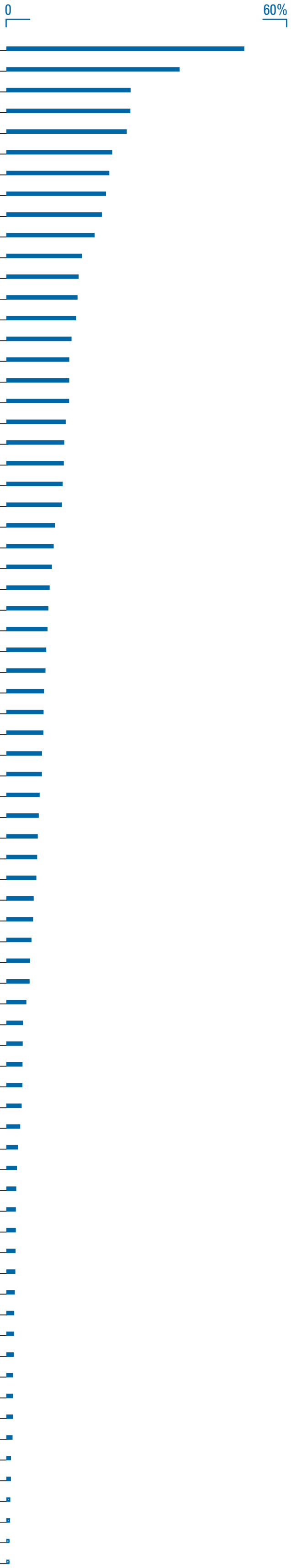
Network Use

Section I

1.1 PC connectivity, 2000

Percentage of computers with Internet connection, 2000

RANK	COUNTRY	VALUE
1	United States	50.04
2	Iceland	36.27
3	Finland	25.82
4	Netherlands	25.77
5	New Zealand	25.01
6	Taiwan	21.91
7	Austria	21.29
8	Norway	20.58
9	Canada	19.70
10	Australia	18.16
11	Estonia	15.44
12	Greece	14.75
13	Denmark	14.52
14	Argentina	14.23
15	Sweden	13.24
16	Italy	12.76
17	Czech Republic	12.75
18	Poland	12.73
19	Hungary	12.00
20	Brazil	11.69
21	Japan	11.60
22	Israel	11.34
23	Mexico	11.18
24	Hong Kong SAR	9.70
25	Latvia	9.44
26	Singapore	9.06
27	Belgium	8.58
28	United Kingdom	8.31
29	Ireland	8.13
30	Spain	7.85
31	Uruguay	7.69
32	Germany	7.38
33	Switzerland	7.29
34	Bulgaria	7.24
35	South Africa	6.95
36	Trinidad and Tobago	6.93
37	Lithuania	6.45
38	France	6.26
39	Romania	6.05
40	Portugal	5.92
41	Chile	5.75
42	Russian Federation	5.18
43	Slovak Republic	5.05
44	Slovenia	4.71
45	Korea	4.42
46	Thailand	4.31
47	Ukraine	3.62
48	Colombia	2.90
49	Malaysia	2.84
50	Turkey	2.80
51	Paraguay	2.77
52	Nicaragua	2.62
53	Bangladesh	2.31
54	Costa Rica	1.87
55	Guatemala	1.61
56	Venezuela	1.47
57	Zimbabwe	1.38
58	Panama	1.37
59	Philippines	1.31
60	Indonesia	1.27
61	Sri Lanka	1.15
62	Peru	1.03
63	El Salvador	0.98
64	Bolivia	0.95
65	India	0.78
66	Ecuador	0.77
67	Mauritius	0.75
68	Jordan	0.68
69	China	0.34
70	Jamaica	0.33
71	Honduras	0.20
72	Egypt	0.16
73	Vietnam	0.02
74	Nigeria	0.01
	Dominican Republic	n.a.

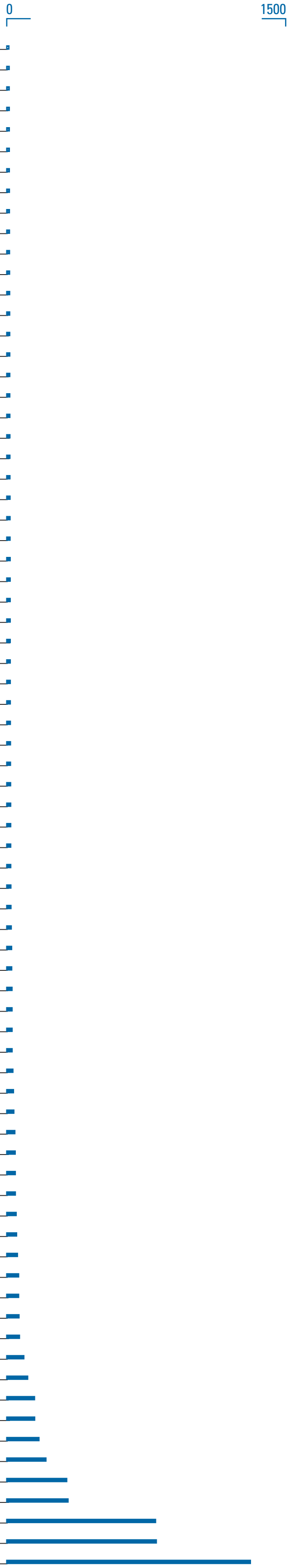


Source: CID at Harvard University analysis of ITU data, August 2001

1.2 Persons sharing a computer connected to the Internet, 2000

Internet users per host, 2000

RANK	COUNTRY	VALUE
1	United States	2.04
2	Finland	3.64
3	Dominican Republic	3.80
4	Iceland	4.21
5	New Zealand	4.32
6	Austria	4.35
7	Netherlands	4.48
8	Mexico	4.85
9	Norway	4.86
10	Australia	5.21
11	Canada	5.37
12	Taiwan	5.71
13	Israel	6.10
14	Czech Republic	6.28
15	Trinidad and Tobago	6.48
16	Uruguay	6.84
17	Hungary	6.85
18	Ukraine	6.90
19	Lithuania	7.26
20	Latvia	7.53
21	France	7.57
22	Denmark	7.73
23	Poland	8.24
24	Japan	8.33
25	Sweden	8.39
26	Estonia	8.96
27	Belgium	8.99
28	Greece	9.04
29	Switzerland	9.14
30	Argentina	9.25
31	Ireland	9.41
32	Russian Federation	9.49
33	Zimbabwe	9.65
34	Hong Kong SAR	9.97
35	Singapore	10.52
36	Slovenia	10.61
37	Brazil	11.23
38	Germany	11.76
39	Spain	11.83
40	United Kingdom	11.91
41	Paraguay	12.05
42	South Africa	12.79
43	Italy	13.16
44	Bulgaria	14.72
45	Bangladesh	16.67
46	Slovak Republic	17.14
47	Colombia	18.75
48	Thailand	18.91
49	Nicaragua	19.10
50	Romania	19.27
51	Chile	23.52
52	Mauritius	26.56
53	Turkey	28.60
54	Costa Rica	33.98
55	Portugal	35.90
56	Panama	36.44
57	Guatemala	36.68
58	El Salvador	41.03
59	Peru	43.34
60	Korea	47.86
61	Malaysia	54.21
62	Indonesia	54.25
63	Sri Lanka	56.38
64	Venezuela	58.81
65	Bolivia	82.28
66	Philippines	102.84
67	India	139.63
68	Jordan	140.37
69	Jamaica	163.49
70	Egypt	200.89
71	Honduras	312.50
72	China	319.64
73	Ecuador	789.47
74	Vietnam	793.65
75	Nigeria	1298.70



Source: CID at Harvard University analysis of ITU data, August 2001

1.3 Internet penetration, 2000

Estimated Internet users per 100 inhabitants, 2000

RANK	COUNTRY	VALUE
1	Iceland	59.79
2	United States	59.75
3	Sweden	56.30
4	Norway	49.05
5	Denmark	48.41
6	Singapore	46.05
7	Netherlands	45.62
8	Australia	43.95
9	Canada	41.30
10	Korea	40.25
11	New Zealand	38.90
12	Finland	37.23
13	Hong Kong SAR	33.59
14	Switzerland	33.50
15	United Kingdom	33.43
16	Japan	30.44
17	Germany	29.21
18	Taiwan	28.13
19	Ireland	27.88
20	Belgium	26.57
21	Austria	25.58
22	Estonia	25.47
23	Italy	23.42
24	Portugal	22.27
25	Israel	17.54
26	Malaysia	15.90
27	France	14.46
28	Spain	13.27
29	Slovenia	12.57
30	Slovak Republic	12.03
31	Chile	11.55
32	Uruguay	11.09
33	Czech Republic	9.76
34	Greece	9.39
35	Mauritius	7.34
36	Poland	7.22
37	Hungary	6.99
38	Argentina	6.75
39	Latvia	6.30
40	Costa Rica	6.21
41	Brazil	5.78
42	South Africa	5.49
43	Venezuela	3.93
44	Romania	3.58
45	Trinidad and Tobago	3.30
46	Turkey	3.04
47	Bulgaria	2.83
48	Lithuania	2.78
49	Mexico	2.74
50	Philippines	2.61
51	Jamaica	2.34
52	Russian Federation	2.11
53	Colombia	2.07
54	Thailand	1.98
55	Jordan	1.91
56	China	1.74
57	Panama	1.60
58	Peru	1.59
59	Ecuador	1.42
60	Bolivia	0.96
61	Egypt	0.71
62	Indonesia	0.68
63	El Salvador	0.65
64	Sri Lanka	0.64
65	Honduras	0.62
66	Guatemala	0.59
67	India	0.49
68	Nicaragua	0.41
69	Ukraine	0.39
70	Paraguay	0.37
71	Dominican Republic	0.30
72	Zimbabwe	0.17
73	Vietnam	0.13
74	Nigeria	0.09
75	Bangladesh	0.04

Source: International Telecommunications Union Database, August 2001

1.4 Cellular telephony penetration, 2000

Number of cellular telephone subscribers per 100 inhabitants, 2000

RANK	COUNTRY	VALUE
1	Taiwan	80.30
2	Hong Kong SAR	80.14
3	Austria	78.55
4	Italy	73.72
5	United Kingdom	72.70
6	Finland	72.64
7	Sweden	71.36
8	Norway	70.25
9	Israel	70.17
10	Singapore	68.38
11	Netherlands	67.11
12	Iceland	66.97
13	Ireland	66.75
14	Portugal	66.51
15	Switzerland	64.45
16	Denmark	60.99
17	Spain	60.92
18	Germany	58.58
19	Korea	56.69
20	New Zealand	56.33
21	Greece	55.90
22	Belgium	54.88
23	Slovenia	54.66
24	Japan	52.61
25	France	49.40
26	Australia	44.63
27	Czech Republic	42.42
28	United States	39.79
29	Estonia	38.70
30	Hungary	29.33
31	Canada	28.45
32	Turkey	24.55
33	Slovak Republic	23.93
34	Chile	22.36
35	Venezuela	21.74
36	Malaysia	21.31
37	Paraguay	19.55
38	South Africa	19.01
39	Poland	17.40
40	Latvia	16.86
41	Argentina	16.33
42	Mauritius	15.08
43	Jamaica	14.24
44	Mexico	14.23
45	Lithuania	14.16
46	Brazil	13.63
47	Uruguay	13.19
48	El Salvador	11.26
49	Romania	11.19
50	Trinidad and Tobago	10.29
51	Bulgaria	8.97
52	Philippines	8.43
53	Panama	8.27
54	Dominican Republic	8.24
55	Bolivia	6.96
56	China	6.58
57	Guatemala	6.11
58	Jordan	5.83
59	Colombia	5.33
60	Costa Rica	5.19
61	Thailand	5.04
62	Peru	4.76
63	Ecuador	3.81
64	Zimbabwe	2.44
65	Honduras	2.39
66	Sri Lanka	2.38
67	Russian Federation	2.22
68	Egypt	2.14
69	Nicaragua	1.77
70	Indonesia	1.73
71	Ukraine	1.62
72	Vietnam	0.98
73	India	0.35
74	Bangladesh	0.14
75	Nigeria	0.02

Source: International Telecommunications Union Database, August 2001

1.5 Public Internet access

Public access to the Internet (through telecenters, libraries, post offices, etc.) is
(1=very limited, 7=pervasive—most people have frequent Internet access)

RANK	COUNTRY	VALUE
1	Iceland	6.4
2	Finland	6.3
3	Denmark	6.0
4	Norway	5.8
4	Sweden	5.8
6	Singapore	5.7
7	Korea	5.5
8	Canada	5.4
8	Netherlands	5.4
8	United States	5.4
11	Australia	5.3
11	Estonia	5.3
13	New Zealand	5.2
13	Peru	5.2
15	United Kingdom	5.0
16	Argentina	4.9
17	Belgium	4.8
17	Hong Kong SAR	4.8
19	Austria	4.7
19	Germany	4.7
19	Switzerland	4.7
22	Taiwan	4.4
23	Bolivia	4.2
23	Costa Rica	4.2
25	Japan	4.1
25	Spain	4.1
27	Czech Republic	4.0
27	India	4.0
27	Portugal	4.0
30	France	3.9
30	Ireland	3.9
30	Israel	3.9
30	Turkey	3.9
34	Bulgaria	3.7
34	Hungary	3.7
34	Slovenia	3.7
37	Colombia	3.6
37	Panama	3.6
37	Paraguay	3.6
40	El Salvador	3.5
40	Jordan	3.5
40	Uruguay	3.5
43	Chile	3.4
43	Indonesia	3.4
43	Italy	3.4
43	Malaysia	3.4
43	Slovak Republic	3.4
43	Thailand	3.4
49	Ecuador	3.3
49	Latvia	3.3
49	Lithuania	3.3
49	Trinidad and Tobago	3.3
53	Egypt	3.2
54	Brazil	3.1
54	Poland	3.1
54	South Africa	3.1
54	Venezuela	3.1
58	Mexico	3.0
59	Dominican Republic	2.9
59	Guatemala	2.9
59	Mauritius	2.9
62	China	2.8
62	Nicaragua	2.8
62	Philippines	2.8
62	Sri Lanka	2.8
66	Greece	2.7
66	Jamaica	2.7
68	Russian Federation	2.6
68	Ukraine	2.6
68	Vietnam	2.6
71	Romania	2.4
72	Honduras	2.3
73	Nigeria	2.2
73	Zimbabwe	2.2
75	Bangladesh	1.8

Section II

Information Infrastructure

2.1 Teledensity, 2000

Main telephone lines per 100 inhabitants, 2000

RANK	COUNTRY	VALUE
1	Denmark	75.25
2	Norway	72.90
3	Switzerland	71.99
4	United States	69.97
5	Sweden	68.20
6	Iceland	67.73
7	Canada	67.65
8	Netherlands	61.91
9	Germany	60.11
10	United Kingdom	58.85
11	Japan	58.47
12	France	58.01
13	Hong Kong SAR	57.76
14	Taiwan	56.80
15	Finland	54.69
16	Greece	53.16
17	Australia	52.40
18	New Zealand	49.98
19	Belgium	49.93
20	Singapore	48.44
21	Israel	48.18
22	Italy	47.38
23	Austria	47.36
24	Korea	46.36
25	Portugal	43.04
26	Ireland	42.62
27	Spain	42.12
28	Czech Republic	37.79
28	Slovenia	37.79
30	Hungary	37.09
31	Estonia	36.32
32	Bulgaria	35.03
33	Lithuania	32.11
34	Slovak Republic	31.41
35	Latvia	31.19
36	Poland	28.23
37	Turkey	27.99
38	Uruguay	27.84
39	Costa Rica	24.94
40	Mauritius	23.53
41	Trinidad and Tobago	23.10
42	Chile	22.12
43	Russian Federation	21.82
44	Argentina	21.31
45	Malaysia	19.92
46	Ukraine	19.88
47	Jamaica	19.86
48	Brazil	18.17
49	Romania	17.46
50	Colombia	16.91
51	Panama	16.42
52	Mexico	12.47
53	South Africa	11.35
54	China	11.11
55	Venezuela	10.78
56	Dominican Republic	10.45
57	Ecuador	10.00
58	Jordan	9.29
59	El Salvador	9.08
60	Thailand	8.66
61	Egypt	8.63
62	Peru	6.37
63	Bolivia	6.05
64	Guatemala	5.70
65	Paraguay	5.00
66	Honduras	4.60
67	Sri Lanka	4.05
68	Philippines	4.00
69	India	3.20
70	Vietnam	3.18
71	Indonesia	3.14
72	Nicaragua	3.02
73	Zimbabwe	1.91
74	Nigeria	0.43
75	Bangladesh	0.34

Source: International Telecommunications Union Database, August 2001

2.2 Years to adoption of cellular telephony

Number of years to adopt cellular telephony since first commercial use in 1980

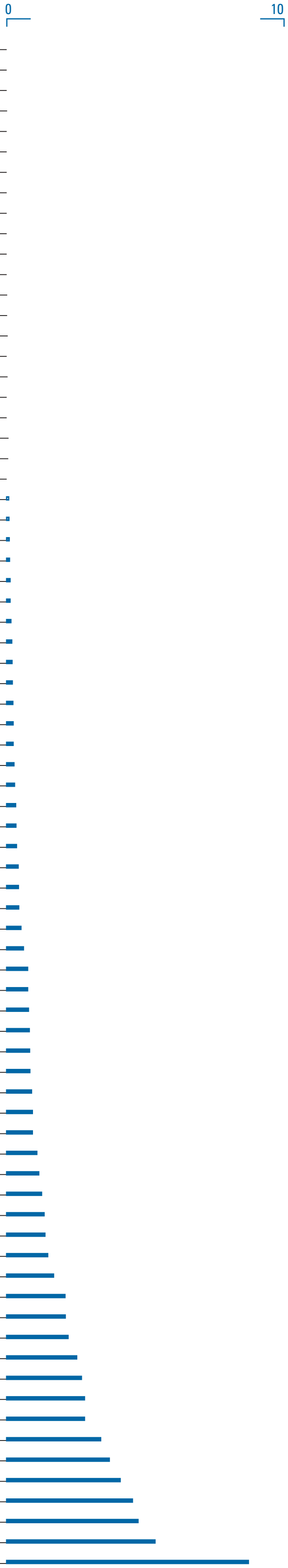
RANK	COUNTRY	VALUE
1	Finland	0
2	Japan	1
2	Norway	1
2	Sweden	1
5	Denmark	2
6	Hong Kong SAR	4
6	Indonesia	4
6	United States	4
9	Austria	5
9	Canada	5
9	Ireland	5
9	Italy	5
9	Netherlands	5
9	United Kingdom	5
15	Belgium	6
15	France	6
15	Germany	6
15	Iceland	6
15	Korea	6
15	Malaysia	6
15	Spain	6
15	Thailand	6
15	Turkey	6
24	Australia	7
24	China	7
24	Egypt	7
24	New Zealand	7
24	Switzerland	7
29	Mexico	8
29	Singapore	8
29	Venezuela	8
32	Argentina	9
32	Chile	9
32	Portugal	9
32	South Africa	9
32	Taiwan	9
37	Brazil	10
37	Dominican Republic	10
37	Guatemala	10
37	Hungary	10
37	Israel	10
37	Jordan	10
37	Mauritius	10
37	Peru	10
37	Sri Lanka	10
46	Bolivia	11
46	Czech Republic	11
46	Estonia	11
46	Jamaica	11
46	Philippines	11
46	Russian Federation	11
46	Slovak Republic	11
46	Slovenia	11
46	Trinidad and Tobago	11
55	Bangladesh	12
55	Bulgaria	12
55	Costa Rica	12
55	Latvia	12
55	Lithuania	12
55	Paraguay	12
55	Poland	12
55	Uruguay	12
55	Vietnam	12
64	El Salvador	13
64	Greece	13
64	Nicaragua	13
64	Nigeria	13
64	Romania	13
64	Ukraine	13
70	Colombia	14
70	Ecuador	14
72	India	15
73	Honduras	16
73	Panama	16
73	Zimbabwe	16

Source: CID at Harvard University analysis of ITU data, August 2001

2.3 Waiting list for telephone lines, 2000

Number of people on waiting list for fixed telephone lines per 100 inhabitants, 2000

RANK	COUNTRY	VALUE
1	Australia	0.00
1	Austria	0.00
1	Canada	0.00
1	Denmark	0.00
1	Finland	0.00
1	France	0.00
1	Germany	0.00
1	Hong Kong SAR	0.00
1	Iceland	0.00
1	Italy	0.00
1	Japan	0.00
1	Korea	0.00
1	Netherlands	0.00
1	New Zealand	0.00
1	Norway	0.00
1	Singapore	0.00
1	Sweden	0.00
1	Switzerland	0.00
1	Taiwan	0.00
1	United Kingdom	0.00
1	United States	0.00
1	Uruguay	0.00
23	Spain	0.01
24	Belgium	0.02
25	Ireland	0.03
26	Nigeria	0.04
27	China	0.06
28	Indonesia	0.06
29	Bolivia	0.09
30	Peru	0.12
31	Bangladesh	0.13
32	Mexico	0.14
33	Argentina	0.16
34	Dominican Republic	0.17
35	Chile	0.17
36	Greece	0.20
37	Vietnam	0.22
38	Portugal	0.26
39	South Africa	0.27
40	Slovenia	0.29
41	Israel	0.35
42	India	0.36
43	Paraguay	0.37
44	Jordan	0.45
45	Ecuador	0.54
46	Malaysia	0.69
47	Thailand	0.69
48	Czech Republic	0.72
49	Hungary	0.75
50	Turkey	0.76
51	Trinidad and Tobago	0.77
52	Latvia	0.83
53	Costa Rica	0.86
54	Zimbabwe	0.86
55	Guatemala	1.02
56	Panama	1.09
57	Sri Lanka	1.19
58	Slovak Republic	1.28
59	Philippines	1.31
60	Brazil	1.41
61	Venezuela	1.62
62	Lithuania	2.03
63	Egypt	2.04
64	Nicaragua	2.14
65	Mauritius	2.45
66	Honduras	2.62
67	Estonia	2.73
68	Colombia	2.73
69	Romania	3.31
70	El Salvador	3.62
71	Bulgaria	4.01
72	Russian Federation	4.45
73	Poland	4.65
74	Ukraine	5.26
75	Jamaica	8.61

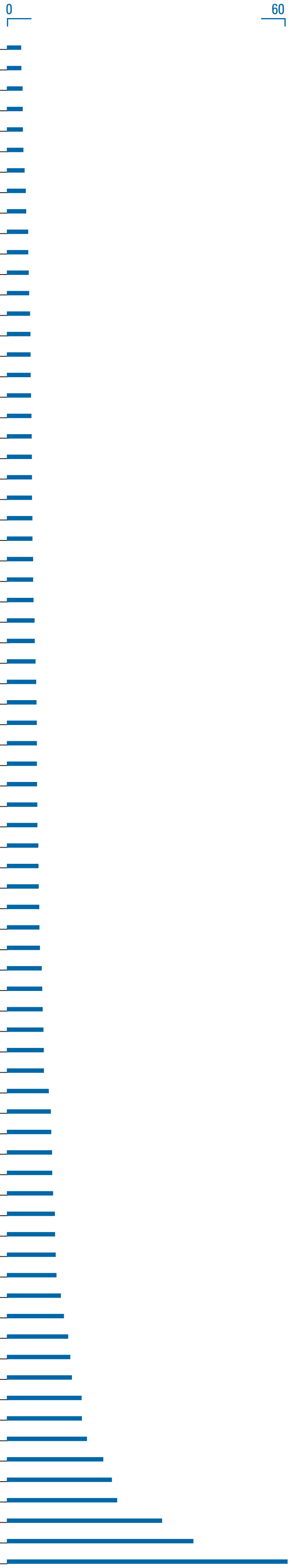


Source: International Telecommunications Union Database, August 2001

2.4 Telecommunications staff, 2000

Telecommunications staff per 1000 main lines, 2000

RANK	COUNTRY	VALUE
1	Japan	2.43
2	Argentina	2.47
3	Spain	2.73
4	Greece	2.76
5	Norway	2.80
6	Italy	2.91
7	Korea	3.17
8	Taiwan	3.43
9	Peru	3.51
10	Turkey	3.94
11	Israel	3.95
12	Canada	4.06
13	Chile	4.15
14	Singapore	4.34
15	Philippines	4.43
16	Slovenia	4.45
17	Belgium	4.47
18	Portugal	4.55
19	Hungary	4.64
20	Costa Rica	4.69
21	Switzerland	4.73
22	Sweden	4.75
23	China	4.76
24	Germany	4.84
25	Netherlands	4.85
26	Dominican Republic	4.99
27	France	5.00
28	Lithuania	5.09
29	Denmark	5.31
30	Malaysia	5.35
31	Ecuador	5.52
32	Indonesia	5.66
33	Jamaica	5.73
34	Estonia	5.79
35	United States	5.81
36	United Kingdom	5.81
37	Latvia	5.84
38	Australia	5.90
39	Uruguay	5.92
40	Czech Republic	6.12
41	Colombia	6.16
42	Austria	6.21
43	Mauritius	6.32
44	Brazil	6.36
45	Thailand	6.47
46	Mexico	6.86
47	Poland	6.96
48	Iceland	7.06
49	Guatemala	7.22
50	New Zealand	7.29
51	Venezuela	7.32
52	Finland	8.37
53	South Africa	8.82
54	Slovak Republic	8.90
55	Trinidad and Tobago	9.07
56	Bulgaria	9.10
57	Hong Kong SAR	9.29
58	Jordan	9.68
59	Bolivia	9.72
60	Romania	9.86
61	Egypt	10.02
62	Ireland	10.97
63	Panama	11.63
64	Ukraine	12.54
65	India	12.99
66	Russian Federation	13.34
67	Nicaragua	15.43
68	Sri Lanka	15.49
69	El Salvador	16.58
70	Honduras	20.09
71	Paraguay	21.94
72	Nigeria	23.07
73	Zimbabwe	32.73
74	Bangladesh	39.47
75	Vietnam	59.72



Source: International Telecommunications Union Database, August 2001

2.5 Telephone faults, 2000

Telephone faults per 100 main telephone lines, 2000

RANK	COUNTRY	VALUE
1	Netherlands	0.50
2	Korea	1.05
3	Spain	1.50
4	Japan	1.70
5	Mexico	2.22
6	Taiwan	2.54
7	Brazil	2.81
8	Venezuela	3.50
9	Belgium	4.00
10	United Kingdom	4.10
11	Bulgaria	4.20
12	Singapore	4.32
13	Philippines	5.20
14	Uruguay	5.60
15	France	5.90
16	Austria	6.27
17	Egypt	6.87
18	Indonesia	7.44
19	Finland	8.40
20	Sweden	8.40
21	Germany	8.70
22	Portugal	11.20
23	Israel	12.00
24	United States	13.40
25	New Zealand	14.00
26	Sri Lanka	15.00
27	Italy	16.20
28	Hungary	16.80
29	Greece	17.00
30	Peru	17.11
31	Argentina	17.29
32	Bangladesh	17.32
33	Thailand	17.76
34	Switzerland	18.47
35	Lithuania	18.95
36	Czech Republic	20.27
37	Hong Kong SAR	21.60
38	Honduras	24.00
39	Poland	26.00
40	Slovak Republic	27.91
41	Estonia	28.60
42	Ukraine	34.47
43	Iceland	35.00
44	Russian Federation	35.21
45	El Salvador	36.70
46	Ireland	38.00
47	Norway	39.50
48	Jordan	42.00
49	Costa Rica	42.10
50	South Africa	43.00
51	Guatemala	45.20
52	Mauritius	45.77
53	Malaysia	46.00
54	Latvia	47.17
55	Ecuador	48.00
56	Romania	49.08
57	Chile	52.00
57	Panama	52.00
59	Turkey	55.73
60	Colombia	59.90
61	Trinidad and Tobago	75.00
62	Jamaica	79.20
63	Nicaragua	79.30
64	Dominican Republic	133.20
65	India	186.00
66	Zimbabwe	223.00
67	Nigeria	327.00
	Australia	n.a.
	Bolivia	n.a.
	Canada	n.a.
	China	n.a.
	Denmark	n.a.
	Paraguay	n.a.
	Slovenia	n.a.
	Vietnam	n.a.

Source: International Telecommunications Union Database, August 2001

2.6 Availability of telephone lines for businesses

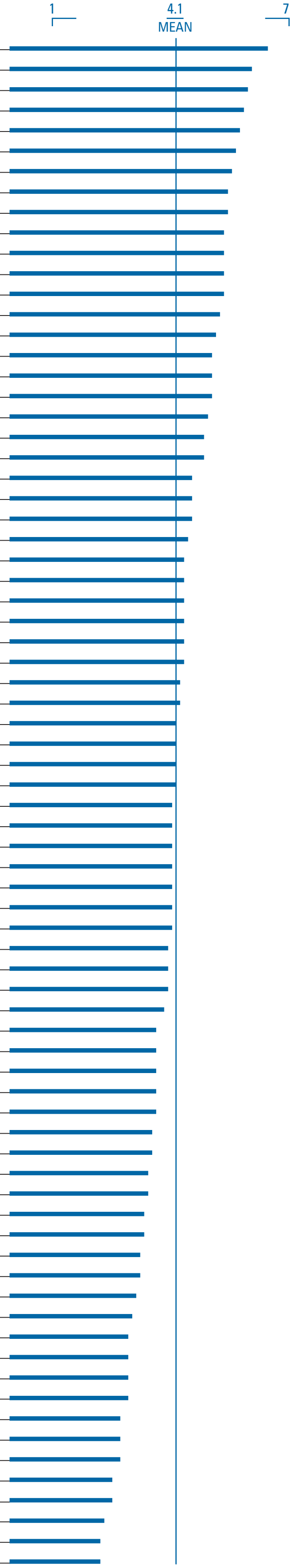
New telephone lines for your business are (1=scarce and difficult to obtain, 7=widely available and highly reliable)

RANK	COUNTRY	VALUE
1	Finland	7.0
2	France	6.9
2	Hong Kong SAR	6.9
2	Iceland	6.9
2	Sweden	6.9
2	Switzerland	6.9
7	Denmark	6.8
7	Germany	6.8
7	Japan	6.8
7	Norway	6.8
7	Singapore	6.8
12	Austria	6.7
12	Chile	6.7
12	Israel	6.7
12	Netherlands	6.7
12	United Kingdom	6.7
17	Argentina	6.6
17	Canada	6.6
17	United States	6.6
17	Uruguay	6.6
21	Australia	6.5
21	New Zealand	6.5
23	Belgium	6.4
23	Hungary	6.4
23	Slovak Republic	6.4
26	El Salvador	6.3
26	Taiwan	6.3
28	Dominican Republic	6.2
28	Italy	6.2
28	Portugal	6.2
31	Korea	6.1
31	Spain	6.1
33	Ireland	6.0
34	Czech Republic	5.9
34	Estonia	5.9
34	Malaysia	5.9
34	Thailand	5.9
38	Greece	5.8
38	Jordan	5.8
40	Slovenia	5.7
41	Brazil	5.6
42	Egypt	5.5
42	Latvia	5.5
42	Lithuania	5.5
42	Mauritius	5.5
42	Panama	5.5
42	Peru	5.5
42	Venezuela	5.5
49	China	5.4
49	Sri Lanka	5.4
51	Jamaica	5.3
51	Mexico	5.3
53	Colombia	5.2
53	South Africa	5.2
53	Turkey	5.2
56	India	5.1
56	Poland	5.1
58	Trinidad and Tobago	5.0
59	Indonesia	4.8
60	Philippines	4.7
61	Bolivia	4.6
61	Bulgaria	4.6
63	Guatemala	4.5
64	Vietnam	4.4
65	Russian Federation	4.1
66	Ukraine	4.0
67	Paraguay	3.6
68	Ecuador	3.2
69	Romania	3.0
70	Costa Rica	2.9
71	Nicaragua	2.4
71	Zimbabwe	2.4
73	Nigeria	2.2
74	Bangladesh	2.1
75	Honduras	1.6

2.7 Perceptions of broadband Internet access

Broadband Internet in your country (e.g. through DSL or Cable modem) is (1=not available, 7=widely used)

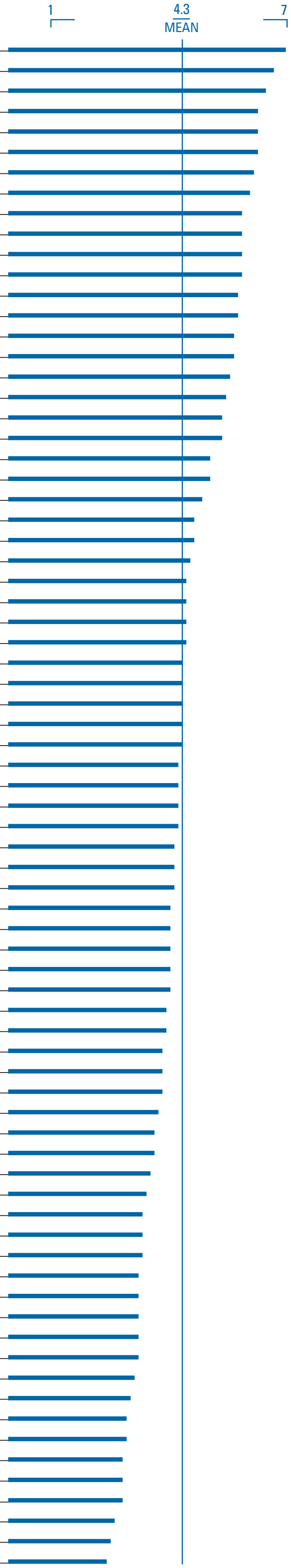
RANK	COUNTRY	VALUE
1	Finland	6.4
2	Canada	6.0
3	Korea	5.9
4	Singapore	5.8
5	United States	5.7
6	Sweden	5.6
7	Belgium	5.5
8	Austria	5.4
8	Germany	5.4
10	Hong Kong SAR	5.3
10	Iceland	5.3
10	Netherlands	5.3
10	United Kingdom	5.3
14	Denmark	5.2
15	Panama	5.1
16	Australia	5.0
16	Estonia	5.0
16	Switzerland	5.0
19	New Zealand	4.9
20	France	4.8
20	Slovak Republic	4.8
22	Chile	4.5
22	El Salvador	4.5
22	Spain	4.5
25	Romania	4.4
26	Argentina	4.3
26	Czech Republic	4.3
26	Italy	4.3
26	Latvia	4.3
26	Norway	4.3
26	Venezuela	4.3
32	Hungary	4.2
32	Mexico	4.2
34	Brazil	4.1
34	Costa Rica	4.1
34	Guatemala	4.1
34	Turkey	4.1
38	Dominican Republic	4.0
38	Nicaragua	4.0
38	Peru	4.0
38	Poland	4.0
38	Portugal	4.0
38	Slovenia	4.0
38	Taiwan	4.0
45	Colombia	3.9
45	Ireland	3.9
45	Thailand	3.9
48	Israel	3.8
49	Ecuador	3.6
49	Jordan	3.6
49	Philippines	3.6
49	South Africa	3.6
49	Ukraine	3.6
54	Greece	3.5
54	Honduras	3.5
56	Indonesia	3.4
56	Malaysia	3.4
58	Egypt	3.3
58	Japan	3.3
60	India	3.2
60	Lithuania	3.2
62	Nigeria	3.1
63	Sri Lanka	3.0
64	Bolivia	2.9
64	Bulgaria	2.9
64	China	2.9
64	Zimbabwe	2.9
68	Russian Federation	2.7
68	Uruguay	2.7
68	Vietnam	2.7
71	Jamaica	2.5
71	Paraguay	2.5
73	Trinidad and Tobago	2.3
74	Bangladesh	2.2
74	Mauritius	2.2



2.8 Price and quality of Internet connection

Leased-line or dial-up access in your country is (1=slow and expensive, 7=as fast and cheap as anywhere in the world)

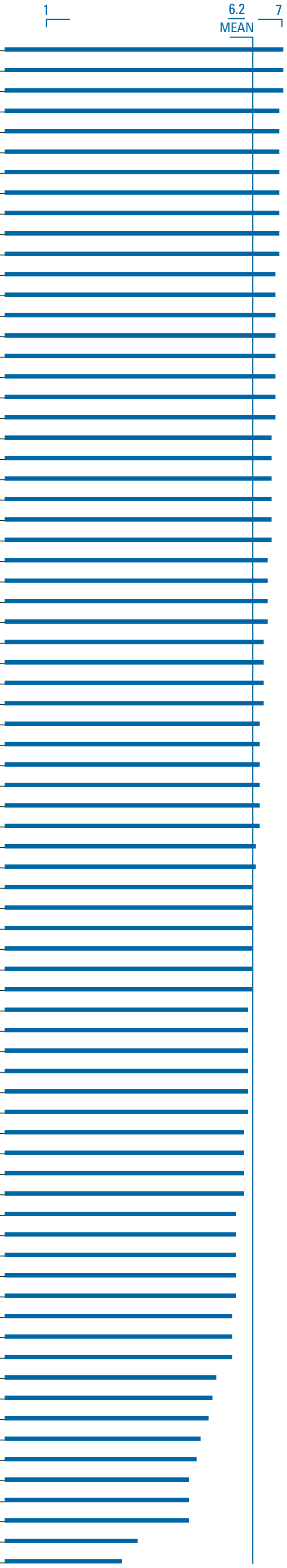
RANK	COUNTRY	VALUE
1	Finland	6.9
2	United States	6.6
3	Sweden	6.4
4	Canada	6.2
4	Iceland	6.2
4	Netherlands	6.2
7	Hong Kong SAR	6.1
8	Norway	6.0
9	Austria	5.8
9	Denmark	5.8
9	Germany	5.8
9	Singapore	5.8
13	Australia	5.7
13	United Kingdom	5.7
15	New Zealand	5.6
15	Switzerland	5.6
17	Israel	5.5
18	France	5.4
19	Belgium	5.3
19	Korea	5.3
21	Chile	5.0
21	Estonia	5.0
23	Portugal	4.8
24	Spain	4.6
24	Taiwan	4.6
26	Italy	4.5
27	El Salvador	4.4
27	Greece	4.4
27	Slovak Republic	4.4
27	Turkey	4.4
31	Dominican Republic	4.3
31	Ireland	4.3
31	Jordan	4.3
31	Panama	4.3
31	Slovenia	4.3
36	Argentina	4.2
36	Egypt	4.2
36	South Africa	4.2
36	Thailand	4.2
40	Czech Republic	4.1
40	Malaysia	4.1
40	Romania	4.1
43	Brazil	4.0
43	Hungary	4.0
43	Japan	4.0
43	Mexico	4.0
43	Venezuela	4.0
48	Trinidad and Tobago	3.9
48	Uruguay	3.9
50	Colombia	3.8
50	Jamaica	3.8
50	Sri Lanka	3.8
53	Indonesia	3.7
54	India	3.6
54	Latvia	3.6
56	Bulgaria	3.5
57	Peru	3.4
58	China	3.3
58	Lithuania	3.3
58	Philippines	3.3
61	Bolivia	3.2
61	Costa Rica	3.2
61	Guatemala	3.2
61	Russian Federation	3.2
61	Ukraine	3.2
66	Paraguay	3.1
67	Zimbabwe	3.0
68	Ecuador	2.9
68	Poland	2.9
70	Honduras	2.8
70	Mauritius	2.8
70	Nicaragua	2.8
73	Bangladesh	2.6
74	Nigeria	2.5
75	Vietnam	2.4



2.9 Availability and cost of mobile telephony

Mobile or cellular telephones for your business are (1=not available, 7= as accessible and affordable as in the world's most technologically advanced countries)

RANK	COUNTRY	VALUE
1	Finland	7.0
1	Iceland	7.0
1	Sweden	7.0
4	Denmark	6.9
4	France	6.9
4	Hong Kong SAR	6.9
4	Netherlands	6.9
4	Norway	6.9
4	Singapore	6.9
4	Switzerland	6.9
4	United Kingdom	6.9
12	Australia	6.8
12	Austria	6.8
12	Chile	6.8
12	El Salvador	6.8
12	Germany	6.8
12	Israel	6.8
12	Italy	6.8
12	Japan	6.8
20	Canada	6.7
20	Czech Republic	6.7
20	New Zealand	6.7
20	Portugal	6.7
20	Spain	6.7
20	United States	6.7
26	Belgium	6.6
26	Estonia	6.6
26	Hungary	6.6
26	Slovenia	6.6
30	Dominican Republic	6.5
30	Korea	6.5
30	Poland	6.5
30	Romania	6.5
34	Argentina	6.4
34	Greece	6.4
34	Jordan	6.4
34	Lithuania	6.4
34	South Africa	6.4
34	Turkey	6.4
40	Uruguay	6.3
40	Venezuela	6.3
42	Bolivia	6.2
42	Ireland	6.2
42	Malaysia	6.2
42	Philippines	6.2
42	Slovak Republic	6.2
42	Taiwan	6.2
48	Brazil	6.1
48	Ecuador	6.1
48	Egypt	6.1
48	Guatemala	6.1
48	Latvia	6.1
48	Mauritius	6.1
54	Jamaica	6.0
54	Panama	6.0
54	Sri Lanka	6.0
54	Thailand	6.0
58	Colombia	5.8
58	Honduras	5.8
58	India	5.8
58	Indonesia	5.8
58	Peru	5.8
63	Mexico	5.7
63	Nicaragua	5.7
63	Trinidad and Tobago	5.7
66	Zimbabwe	5.3
67	Bangladesh	5.2
68	China	5.1
69	Ukraine	4.9
70	Vietnam	4.8
71	Bulgaria	4.6
71	Paraguay	4.6
71	Russian Federation	4.6
74	Costa Rica	3.3
75	Nigeria	2.9



Section III

Hardware,
Software,
and Support

3.1 PC penetration, 2000

Personal computers per 100 inhabitants, 2000

RANK	COUNTRY	VALUE
1	United States	58.52
2	Sweden	50.67
3	Switzerland	50.25
4	Norway	49.05
5	Singapore	48.31
6	Australia	46.46
7	Denmark	43.15
8	Finland	39.61
9	Netherlands	39.48
10	Iceland	39.15
11	Canada	39.02
12	Ireland	36.46
13	New Zealand	36.02
14	Hong Kong SAR	34.72
15	Belgium	34.45
16	United Kingdom	33.78
17	Germany	33.64
18	Japan	31.52
19	France	30.48
20	Austria	27.65
21	Israel	25.36
22	Slovenia	25.18
23	Taiwan	22.46
24	Korea	19.03
25	Spain	14.29
26	Italy	13.94
27	Estonia	13.55
28	Czech Republic	12.20
29	Slovak Republic	10.92
30	Portugal	10.48
31	Malaysia	10.31
32	Costa Rica	9.94
33	Uruguay	9.89
34	Mauritius	9.28
35	Chile	8.55
36	Hungary	8.51
37	Latvia	8.40
38	Greece	7.05
39	Poland	6.89
40	South Africa	6.18
41	Lithuania	5.95
42	Trinidad and Tobago	5.41
43	Argentina	5.13
44	Mexico	5.06
45	Venezuela	4.55
46	Brazil	4.41
47	Russian Federation	4.29
48	Jamaica	4.27
49	Turkey	3.81
50	Peru	3.51
51	Colombia	3.31
52	Panama	3.15
53	Romania	2.69
54	Bulgaria	2.67
55	Thailand	2.43
56	Egypt	2.21
57	Ecuador	1.98
58	Philippines	1.93
59	El Salvador	1.59
60	China	1.59
61	Ukraine	1.59
62	Jordan	1.35
63	Bolivia	1.20
64	Zimbabwe	1.19
65	Paraguay	1.09
66	Indonesia	0.99
67	Guatemala	0.97
68	Honduras	0.93
69	Vietnam	0.88
70	Nicaragua	0.79
71	Nigeria	0.61
72	Sri Lanka	0.55
73	India	0.45
74	Bangladesh	0.09
	Dominican Republic	n.a.

Source: International Telecommunications Union Database, August 2001

3.2 Software piracy, 2000

Percentage of software revenue lost to piracy, 2000

RANK	COUNTRY	VALUE
1	United States	24
2	Denmark	26
2	United Kingdom	26
4	Germany	28
4	New Zealand	28
6	Finland	29
7	Australia	33
7	Belgium	33
9	Switzerland	34
10	Norway	35
10	Sweden	35
12	Austria	37
12	Japan	37
14	Canada	38
15	France	40
15	Netherlands	40
17	Ireland	41
17	Israel	41
19	Portugal	42
20	Czech Republic	43
21	Slovak Republic	45
21	South Africa	45
23	Italy	46
24	Chile	49
25	Singapore	50
26	Hungary	51
26	Spain	51
28	Colombia	53
28	Taiwan	53
30	Poland	54
31	Egypt	56
31	Korea	56
31	Mexico	56
34	Hong Kong SAR	57
35	Argentina	58
35	Brazil	58
35	Venezuela	58
38	Zimbabwe	59
39	Peru	61
39	Philippines	61
39	Slovenia	61
42	India	63
42	Turkey	63
44	Panama	64
45	Ecuador	65
46	Greece	66
46	Malaysia	66
46	Mauritius	66
46	Uruguay	66
50	Nigeria	67
51	Costa Rica	68
51	Dominican Republic	68
51	Honduras	68
54	Jordan	71
55	Paraguay	76
56	Guatemala	77
56	Romania	77
58	Bulgaria	78
58	Nicaragua	78
60	El Salvador	79
60	Thailand	79
62	Bolivia	81
63	Russian Federation	88
64	Indonesia	89
64	Ukraine	89
66	China	94
67	Vietnam	97
	Bangladesh	n.a.
	Estonia	n.a.
	Iceland	n.a.
	Jamaica	n.a.
	Latvia	n.a.
	Lithuania	n.a.
	Sri Lanka	n.a.
	Trinidad and Tobago	n.a.

Source: Business Software Alliance, 2001

3.3 Availability of specialized IT services

Specialized information technologies are (1=not available in the country, 7=available from world-class local institutions)

RANK	COUNTRY	VALUE
1	United States	6.6
2	Finland	6.4
3	Israel	6.2
4	Germany	6.1
4	Sweden	6.1
6	Australia	6.0
6	Switzerland	6.0
6	United Kingdom	6.0
9	Denmark	5.9
9	France	5.9
11	India	5.8
12	Austria	5.7
12	Ireland	5.7
12	Japan	5.7
12	Spain	5.7
16	Brazil	5.6
16	Canada	5.6
16	Netherlands	5.6
19	Czech Republic	5.5
19	Iceland	5.5
19	Slovak Republic	5.5
22	Estonia	5.4
22	South Africa	5.4
24	Belgium	5.3
24	Norway	5.3
24	Taiwan	5.3
27	New Zealand	5.2
27	Singapore	5.2
29	Chile	5.1
29	Costa Rica	5.1
29	Hong Kong SAR	5.1
29	Hungary	5.1
29	Italy	5.1
34	Latvia	5.0
34	Poland	5.0
36	Argentina	4.9
36	Dominican Republic	4.9
36	Uruguay	4.9
39	Panama	4.8
40	Korea	4.7
40	Peru	4.7
40	Portugal	4.7
43	Lithuania	4.6
43	Philippines	4.6
45	Jordan	4.5
45	Mexico	4.5
45	Slovenia	4.5
45	Trinidad and Tobago	4.5
49	Colombia	4.4
49	Russian Federation	4.4
51	Bulgaria	4.3
51	China	4.3
51	El Salvador	4.3
51	Guatemala	4.3
55	Ecuador	4.2
55	Greece	4.2
55	Jamaica	4.2
55	Nigeria	4.2
55	Sri Lanka	4.2
55	Turkey	4.2
55	Ukraine	4.2
62	Egypt	4.1
62	Honduras	4.1
64	Indonesia	4.0
64	Nicaragua	4.0
64	Venezuela	4.0
67	Malaysia	3.9
67	Thailand	3.9
69	Bolivia	3.8
70	Mauritius	3.7
70	Paraguay	3.7
72	Zimbabwe	3.5
73	Vietnam	3.4
74	Romania	2.9
75	Bangladesh	2.8

3.4 Software products fitting local needs

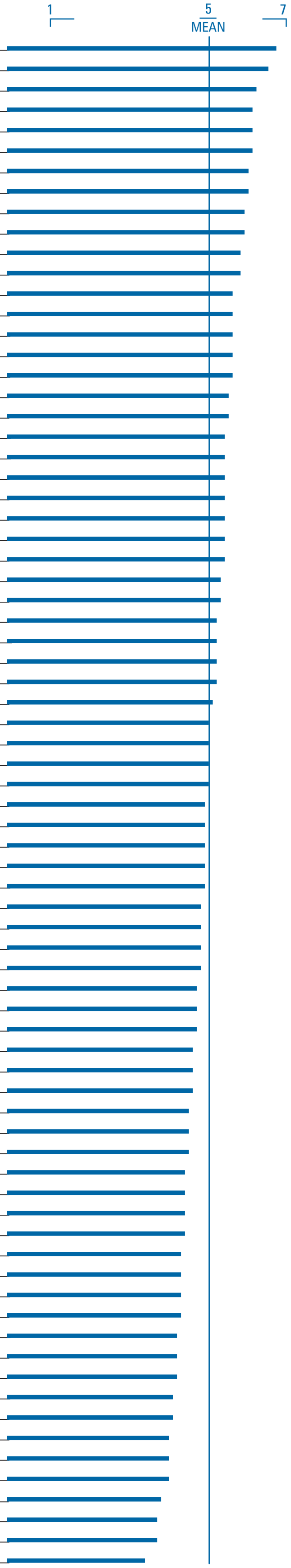
Software products sold in your country (1=need to be highly modified to fit local needs, 7=fit local needs)

RANK	COUNTRY	VALUE
1	United States	6.5
2	United Kingdom	6.3
3	Finland	6.2
3	France	6.2
3	Sweden	6.2
6	Germany	6.1
7	Canada	5.9
7	Netherlands	5.9
9	Estonia	5.8
9	Singapore	5.8
11	Austria	5.7
11	Ireland	5.7
11	Italy	5.7
14	Australia	5.6
14	New Zealand	5.6
16	Denmark	5.5
16	Norway	5.5
16	Romania	5.5
16	Spain	5.5
16	Switzerland	5.5
21	Hong Kong SAR	5.4
21	Hungary	5.4
21	Mauritius	5.4
21	Portugal	5.4
21	Uruguay	5.4
26	Brazil	5.3
26	India	5.3
26	Israel	5.3
26	South Africa	5.3
30	Belgium	5.2
30	Chile	5.2
30	Czech Republic	5.2
30	Iceland	5.2
30	Japan	5.2
35	Argentina	5.1
35	Taiwan	5.1
37	Korea	5.0
37	Malaysia	5.0
37	Mexico	5.0
37	Philippines	5.0
41	Colombia	4.9
41	Dominican Republic	4.9
41	Indonesia	4.9
41	Jamaica	4.9
41	Lithuania	4.9
41	Poland	4.9
41	Russian Federation	4.9
41	Zimbabwe	4.9
49	Costa Rica	4.8
49	Panama	4.8
49	Trinidad and Tobago	4.8
49	Venezuela	4.8
53	Greece	4.7
53	Latvia	4.7
53	Ukraine	4.7
56	Jordan	4.6
56	Sri Lanka	4.6
58	Egypt	4.5
59	Bulgaria	4.4
59	Guatemala	4.4
59	Turkey	4.4
62	Bolivia	4.3
62	Nicaragua	4.3
62	Peru	4.3
62	Thailand	4.3
66	China	4.2
66	Slovak Republic	4.2
66	Slovenia	4.2
69	Nigeria	4.1
70	El Salvador	4.0
71	Ecuador	3.9
71	Paraguay	3.9
73	Bangladesh	3.7
73	Honduras	3.7
75	Vietnam	3.1

3.5 Competition in the domestic software market

How many local software and software services companies are competing in domestic markets? (1=none, 7=a large number, the domestic market is competitive)

RANK	COUNTRY	VALUE
1	United States	6.7
2	Israel	6.5
3	Sweden	6.2
4	Germany	6.1
4	India	6.1
4	United Kingdom	6.1
7	Finland	6.0
7	France	6.0
9	Ireland	5.9
9	Netherlands	5.9
11	Iceland	5.8
11	Japan	5.8
13	Belgium	5.6
13	Canada	5.6
13	Hungary	5.6
13	Italy	5.6
13	Spain	5.6
18	Denmark	5.5
18	Estonia	5.5
20	Austria	5.4
20	Costa Rica	5.4
20	Czech Republic	5.4
20	Korea	5.4
20	Norway	5.4
20	Slovak Republic	5.4
20	Uruguay	5.4
27	South Africa	5.3
27	Switzerland	5.3
29	Brazil	5.2
29	Hong Kong SAR	5.2
29	New Zealand	5.2
29	Singapore	5.2
33	Greece	5.1
34	Australia	5.0
34	Portugal	5.0
34	Slovenia	5.0
34	Taiwan	5.0
38	Argentina	4.9
38	Chile	4.9
38	Dominican Republic	4.9
38	Panama	4.9
38	Poland	4.9
43	Bulgaria	4.8
43	Latvia	4.8
43	Lithuania	4.8
43	Sri Lanka	4.8
47	Jordan	4.7
47	Philippines	4.7
47	Russian Federation	4.7
50	China	4.6
50	Nigeria	4.6
50	Ukraine	4.6
53	Colombia	4.5
53	Egypt	4.5
53	Peru	4.5
56	Ecuador	4.4
56	El Salvador	4.4
56	Guatemala	4.4
56	Indonesia	4.4
60	Honduras	4.3
60	Malaysia	4.3
60	Mexico	4.3
60	Venezuela	4.3
64	Bangladesh	4.2
64	Mauritius	4.2
64	Thailand	4.2
67	Turkey	4.1
67	Zimbabwe	4.1
69	Jamaica	4.0
69	Nicaragua	4.0
69	Vietnam	4.0
72	Paraguay	3.8
73	Bolivia	3.7
73	Trinidad and Tobago	3.7
75	Romania	3.4



Information and Communication Technology Policy

Section IV

4.1 Internet access cost, 2001

Average annual ISP cost for 20 hours of monthly Internet Access as percentage of GDP per capita (PPP), 2001

RANK	COUNTRY	VALUE
1	Sweden	0.12
2	Belgium	0.29
3	Finland	0.37
4	Norway	0.37
5	Iceland	0.46
6	Japan	0.49
7	Switzerland	0.57
8	United States	0.65
9	Taiwan	0.68
10	Denmark	0.71
11	Canada	0.77
12	Netherlands	0.79
13	Hong Kong SAR	0.84
14	Singapore	0.84
15	Austria	0.84
16	United Kingdom	0.91
17	Ireland	0.91
18	New Zealand	0.96
19	France	1.03
20	Australia	1.14
21	Israel	1.20
22	Germany	1.30
23	Korea	1.50
24	Portugal	1.60
25	Spain	1.65
26	Greece	1.81
27	Italy	2.02
28	Slovenia	2.28
29	Uruguay	2.63
30	Slovak Republic	2.88
31	Argentina	3.20
32	Trinidad and Tobago	3.30
33	Estonia	3.38
34	Thailand	4.02
35	Turkey	4.47
36	Chile	4.54
37	Czech Republic	4.70
38	Malaysia	4.85
39	Hungary	5.02
40	Mauritius	5.10
41	Mexico	5.17
42	Brazil	5.26
43	South Africa	5.26
44	Costa Rica	5.43
45	Venezuela	6.04
46	Poland	7.65
47	Colombia	8.08
48	Jamaica	8.40
49	Panama	8.44
50	Latvia	8.66
51	China	9.33
52	Bulgaria	9.37
53	Bolivia	9.83
54	Russian Federation	10.64
55	Indonesia	11.05
56	Sri Lanka	11.19
57	Egypt	11.24
58	El Salvador	11.52
59	Romania	11.81
60	Jordan	14.46
61	Guatemala	15.57
62	Dominican Republic	15.62
63	India	16.82
64	Philippines	19.71
65	Paraguay	20.39
66	Ecuador	25.03
67	Honduras	32.07
68	Ukraine	32.74
69	Vietnam	42.83
70	Zimbabwe	51.53
71	Nigeria	55.13
72	Bangladesh	81.07
	Lithuania	n.a.
	Nicaragua	n.a.
	Peru	n.a.

4.2 Perception of effect of telecommunications competition on quality and price

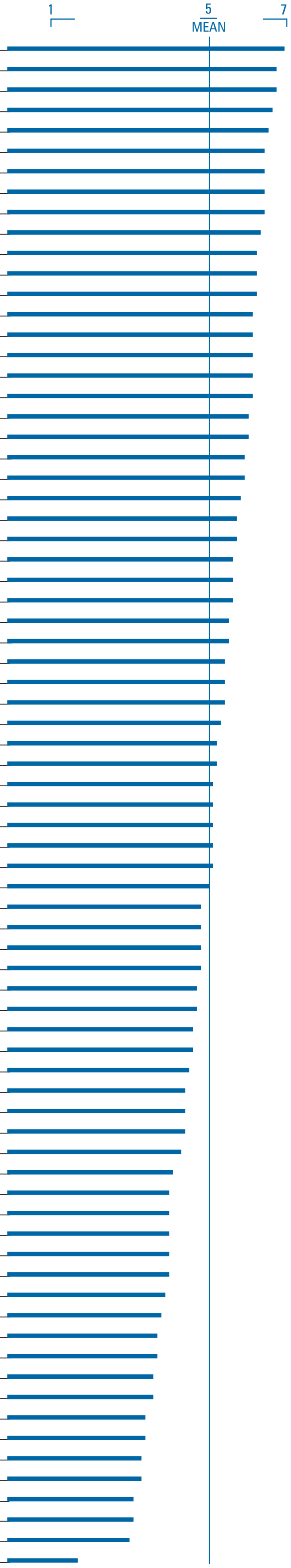
Is there sufficient competition in the telecommunications sector in your country to ensure high quality, infrequent interruptions, and low prices? (1=no, 7=yes, equal to the best in the world)

RANK	COUNTRY	VALUE
1	Finland	6.8
2	Sweden	6.6
3	Chile	6.4
3	Germany	6.4
3	Hong Kong SAR	6.4
3	United States	6.4
7	Austria	6.3
7	Canada	6.3
7	United Kingdom	6.3
10	Norway	6.1
11	Dominican Republic	6.0
11	Singapore	6.0
13	France	5.9
13	Italy	5.9
13	Switzerland	5.9
16	Iceland	5.8
16	Korea	5.8
18	Netherlands	5.7
18	Portugal	5.7
18	Taiwan	5.7
21	Australia	5.6
21	Belgium	5.6
21	Denmark	5.6
21	El Salvador	5.6
25	Brazil	5.5
25	New Zealand	5.5
25	Venezuela	5.5
28	Argentina	5.4
29	Spain	5.3
30	Estonia	5.1
30	Israel	5.1
32	Colombia	5.0
32	Japan	5.0
32	Slovak Republic	5.0
35	Jordan	4.9
36	Hungary	4.8
36	Philippines	4.8
38	Czech Republic	4.7
38	Ireland	4.7
38	Malaysia	4.7
41	India	4.6
41	Sri Lanka	4.6
43	Egypt	4.5
43	Thailand	4.5
45	Greece	4.4
45	Peru	4.4
47	Guatemala	4.2
48	Indonesia	4.1
49	Jamaica	4.0
50	Panama	3.9
50	Uruguay	3.9
52	Turkey	3.7
53	Bolivia	3.6
53	Russian Federation	3.6
55	Mexico	3.5
55	Slovenia	3.5
57	China	3.4
57	Poland	3.4
59	Latvia	3.3
60	Romania	3.2
61	Ukraine	3.1
62	Paraguay	3.0
62	Zimbabwe	3.0
64	Lithuania	2.9
65	Costa Rica	2.8
65	South Africa	2.8
67	Bangladesh	2.7
67	Bulgaria	2.7
67	Nicaragua	2.7
67	Vietnam	2.7
71	Ecuador	2.6
71	Trinidad and Tobago	2.6
73	Nigeria	2.5
74	Honduras	2.2
75	Mauritius	1.9

4.3 Perception of effect of ISP competition on quality and price

Is there sufficient competition in the ISP sector in your country to ensure high quality, infrequent interruptions, and low prices? (1=no, 7=yes, equal to the best in the world)

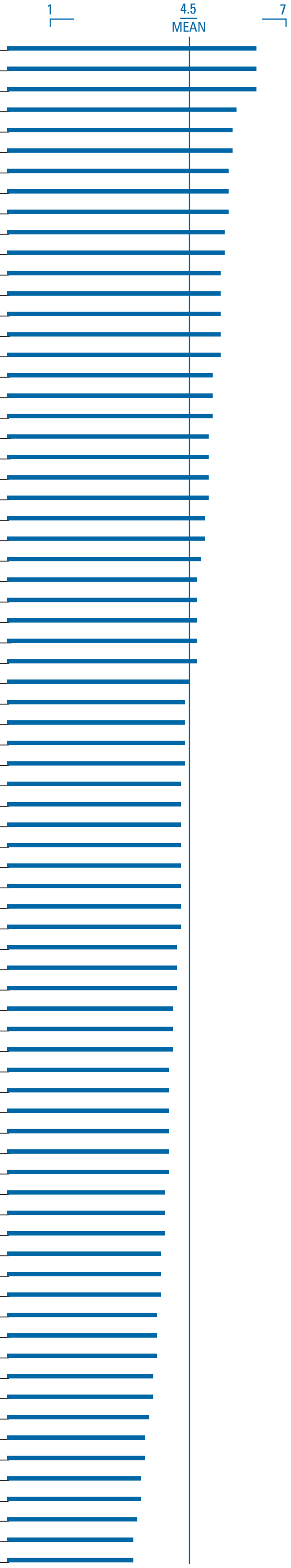
RANK	COUNTRY	VALUE
1	Finland	6.9
2	Iceland	6.7
2	United States	6.7
4	Sweden	6.6
5	France	6.5
6	Canada	6.4
6	Germany	6.4
6	Hong Kong SAR	6.4
6	Netherlands	6.4
10	Belgium	6.3
11	Austria	6.2
11	Switzerland	6.2
11	United Kingdom	6.2
14	Australia	6.1
14	Israel	6.1
14	Korea	6.1
14	New Zealand	6.1
14	Norway	6.1
19	Denmark	6.0
19	Estonia	6.0
21	Italy	5.9
21	Singapore	5.9
23	Czech Republic	5.8
24	Argentina	5.7
24	Chile	5.7
26	Brazil	5.6
26	Spain	5.6
26	Turkey	5.6
29	Japan	5.5
29	Portugal	5.5
31	Jordan	5.4
31	South Africa	5.4
31	Taiwan	5.4
34	Hungary	5.3
35	Egypt	5.2
35	Slovak Republic	5.2
37	Dominican Republic	5.1
37	El Salvador	5.1
37	Greece	5.1
37	India	5.1
37	Venezuela	5.1
42	Ireland	5.0
43	Latvia	4.8
43	Panama	4.8
43	Philippines	4.8
43	Uruguay	4.8
47	Colombia	4.7
47	Poland	4.7
49	Indonesia	4.6
49	Thailand	4.6
51	Jamaica	4.5
52	Malaysia	4.4
52	Mexico	4.4
52	Slovenia	4.4
55	Ukraine	4.3
56	Lithuania	4.1
57	Bulgaria	4.0
57	Guatemala	4.0
57	Peru	4.0
57	Sri Lanka	4.0
57	Zimbabwe	4.0
62	Ecuador	3.9
63	Bangladesh	3.8
64	Bolivia	3.7
64	Russian Federation	3.7
66	Nicaragua	3.6
66	Romania	3.6
68	China	3.4
68	Trinidad and Tobago	3.4
70	Honduras	3.3
70	Paraguay	3.3
72	Nigeria	3.1
72	Vietnam	3.1
74	Costa Rica	3.0
75	Mauritius	1.7



4.4 Legal framework supporting IT businesses

The legal framework in your country supports the development of online and IT businesses (including ISPs) (1=no, strongly impedes, 7=yes, significantly promotes)

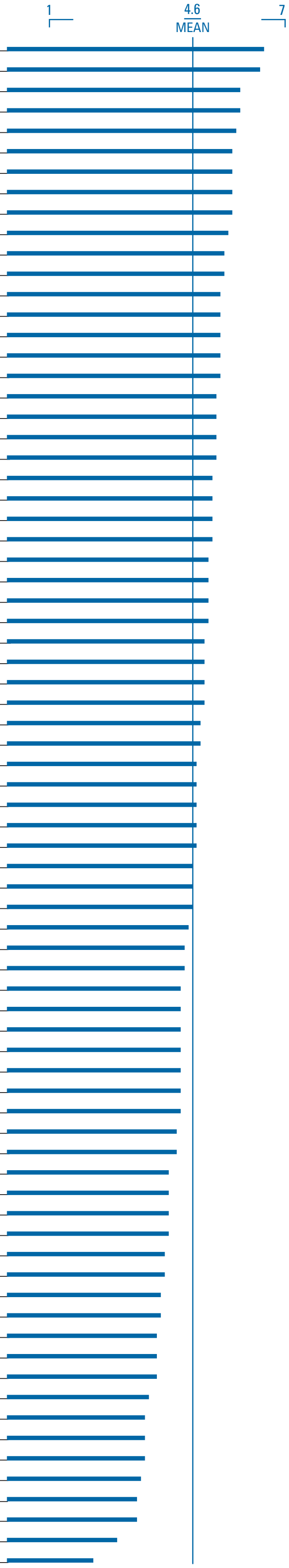
RANK	COUNTRY	VALUE
1	Finland	6.2
1	Singapore	6.2
1	United States	6.2
4	Sweden	5.7
5	Canada	5.6
5	Netherlands	5.6
7	Australia	5.5
7	Iceland	5.5
7	United Kingdom	5.5
10	Austria	5.4
10	Hong Kong SAR	5.4
12	Denmark	5.3
12	Estonia	5.3
12	Ireland	5.3
12	Malaysia	5.3
12	New Zealand	5.3
17	France	5.1
17	Germany	5.1
17	Switzerland	5.1
20	Israel	5.0
20	Korea	5.0
20	Norway	5.0
20	Slovak Republic	5.0
24	India	4.9
24	Spain	4.9
26	Italy	4.8
27	Belgium	4.7
27	Brazil	4.7
27	Jordan	4.7
27	Portugal	4.7
27	South Africa	4.7
32	Philippines	4.5
33	Czech Republic	4.4
33	Taiwan	4.4
33	Trinidad and Tobago	4.4
33	Uruguay	4.4
37	Chile	4.3
37	Colombia	4.3
37	Dominican Republic	4.3
37	Egypt	4.3
37	Jamaica	4.3
37	Mauritius	4.3
37	Slovenia	4.3
37	Turkey	4.3
45	China	4.2
45	Hungary	4.2
45	Japan	4.2
48	Argentina	4.1
48	Nigeria	4.1
48	Panama	4.1
51	Costa Rica	4.0
51	El Salvador	4.0
51	Latvia	4.0
51	Peru	4.0
51	Venezuela	4.0
51	Zimbabwe	4.0
57	Greece	3.9
57	Ukraine	3.9
57	Vietnam	3.9
60	Lithuania	3.8
60	Mexico	3.8
60	Thailand	3.8
63	Bangladesh	3.7
63	Poland	3.7
63	Sri Lanka	3.7
66	Bulgaria	3.6
66	Indonesia	3.6
68	Honduras	3.5
69	Guatemala	3.4
69	Nicaragua	3.4
71	Ecuador	3.3
71	Russian Federation	3.3
73	Paraguay	3.2
74	Bolivia	3.1
74	Romania	3.1



4.5 ICTs as overall priority for the Government

Information and communication technologies (ICTs) are an overall priority for the government (1=strongly disagree, 7=highly successful)

RANK	COUNTRY	VALUE
1	Singapore	6.4
2	Finland	6.3
3	Estonia	5.8
3	Sweden	5.8
5	Taiwan	5.7
6	Hong Kong SAR	5.6
6	Ireland	5.6
6	Jordan	5.6
6	Spain	5.6
10	Iceland	5.5
11	Malaysia	5.4
11	Mauritius	5.4
13	Austria	5.3
13	China	5.3
13	Egypt	5.3
13	India	5.3
13	Netherlands	5.3
18	Chile	5.2
18	Denmark	5.2
18	United Kingdom	5.2
18	United States	5.2
22	Australia	5.1
22	Canada	5.1
22	Jamaica	5.1
22	Japan	5.1
26	Brazil	5.0
26	France	5.0
26	Korea	5.0
26	Portugal	5.0
30	Costa Rica	4.9
30	Hungary	4.9
30	Norway	4.9
30	Uruguay	4.9
34	El Salvador	4.8
34	Germany	4.8
36	Israel	4.7
36	Latvia	4.7
36	Mexico	4.7
36	New Zealand	4.7
36	Switzerland	4.7
41	Belgium	4.6
41	South Africa	4.6
41	Thailand	4.6
44	Colombia	4.5
45	Dominican Republic	4.4
45	Slovak Republic	4.4
47	Czech Republic	4.3
47	Italy	4.3
47	Panama	4.3
47	Philippines	4.3
47	Russian Federation	4.3
47	Sri Lanka	4.3
47	Venezuela	4.3
54	Argentina	4.2
54	Greece	4.2
56	Bulgaria	4.0
56	Peru	4.0
56	Slovenia	4.0
56	Trinidad and Tobago	4.0
60	Lithuania	3.9
60	Vietnam	3.9
62	Indonesia	3.8
62	Nigeria	3.8
64	Bangladesh	3.7
64	Honduras	3.7
64	Nicaragua	3.7
67	Ecuador	3.5
68	Poland	3.4
68	Turkey	3.4
68	Ukraine	3.4
71	Guatemala	3.3
72	Bolivia	3.2
72	Paraguay	3.2
74	Zimbabwe	2.7
75	Romania	2.1



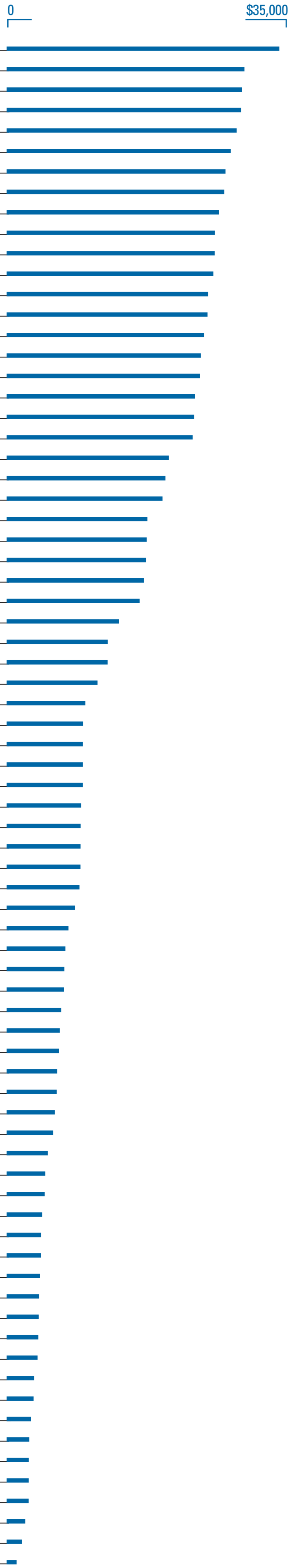
Business and Economic Environment

Section V

5.1 Income per capita, 2000

Global Domestic Product per capita (PPP), 2000

RANK	COUNTRY	VALUE
1	United States	33,886
2	Norway	29,500
3	Iceland	29,167
4	Ireland	29,080
5	Switzerland	28,518
6	Canada	27,783
7	Denmark	27,120
8	Belgium	26,958
9	Austria	26,314
10	Japan	25,796
11	Australia	25,758
12	Netherlands	25,598
13	Germany	24,931
14	Finland	24,864
15	Hong Kong SAR	24,448
16	France	24,032
17	Sweden	23,884
18	Italy	23,304
19	United Kingdom	23,197
20	Singapore	23,000
21	New Zealand	20,010
22	Israel	19,577
23	Spain	19,202
24	Korea	17,311
25	Taiwan	17,223
26	Slovenia	17,127
27	Portugal	16,882
28	Greece	16,326
29	Czech Republic	13,721
30	Hungary	12,335
31	Argentina	12,314
32	Slovak Republic	11,035
33	Mauritius	9,512
34	Costa Rica	9,236
35	South Africa	9,189
36	Chile	9,187
37	Estonia	9,178
38	Poland	8,971
39	Malaysia	8,924
40	Mexico	8,914
41	Uruguay	8,904
42	Trinidad and Tobago	8,771
43	Russian Federation	8,213
44	Brazil	7,389
45	Lithuania	6,999
46	Turkey	6,870
47	Latvia	6,838
48	Thailand	6,469
49	Romania	6,309
50	Panama	6,169
51	Dominican Republic	5,962
52	Colombia	5,923
53	Venezuela	5,677
54	Bulgaria	5,469
55	Peru	4,797
56	El Salvador	4,477
57	Paraguay	4,396
58	Jordan	4,079
59	Philippines	3,956
60	China	3,953
61	Guatemala	3,784
62	Ukraine	3,693
63	Jamaica	3,657
64	Egypt	3,602
65	Sri Lanka	3,512
66	Ecuador	3,068
67	Indonesia	3,014
68	Zimbabwe	2,697
69	Honduras	2,469
70	Bolivia	2,408
71	India	2,403
72	Nicaragua	2,396
73	Vietnam	1,974
74	Bangladesh	1,561
75	Nigeria	871

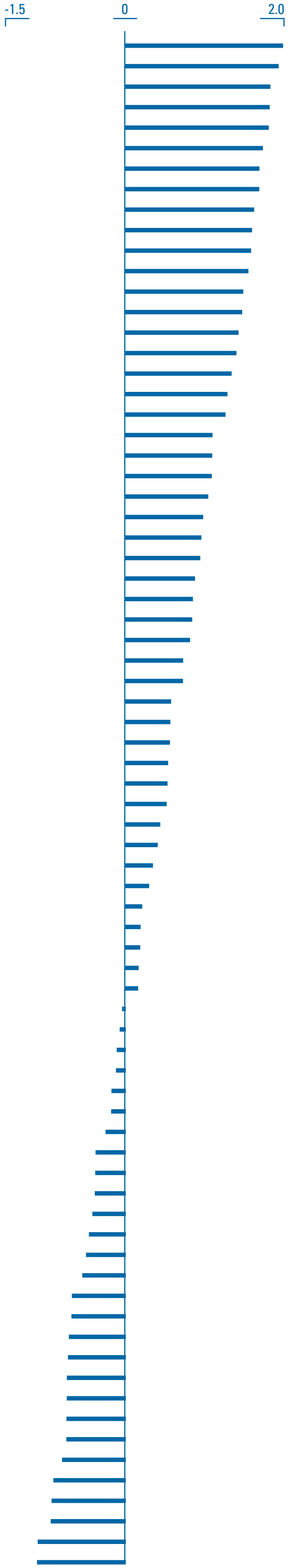


Source: World Bank, *World Development Indicators 2001* and IMF World Economic Outlook, May 2001

5.2 Rule of Law, 2000

Index of Rule of Law (Scale from -2.153 to 1.996)

RANK	COUNTRY	VALUE
1	Switzerland	1.996
2	Singapore	1.939
3	Norway	1.833
4	New Zealand	1.824
5	Austria	1.812
6	Finland	1.736
7	Denmark	1.691
8	United Kingdom	1.689
9	Sweden	1.623
10	Australia	1.596
11	Netherlands	1.584
12	Canada	1.549
13	Germany	1.483
14	Iceland	1.469
15	Japan	1.422
16	Ireland	1.395
17	Hong Kong SAR	1.333
18	Mauritius	1.279
19	United States	1.254
20	Chile	1.086
21	Portugal	1.083
22	France	1.077
23	Spain	1.032
24	Israel	0.966
25	Korea	0.943
26	Taiwan	0.928
27	Italy	0.861
28	Malaysia	0.834
29	Slovenia	0.825
30	Belgium	0.797
31	Jordan	0.708
32	Hungary	0.706
33	Costa Rica	0.553
34	Czech Republic	0.543
35	Poland	0.538
36	Trinidad and Tobago	0.514
37	Estonia	0.507
38	Greece	0.496
39	Thailand	0.413
40	Dominican Republic	0.380
41	Argentina	0.319
42	Uruguay	0.270
43	Lithuania	0.180
44	India	0.160
45	Latvia	0.155
46	Slovak Republic	0.134
47	Egypt	0.128
48	Turkey	-0.010
49	China	-0.040
50	Philippines	-0.078
51	Romania	-0.088
52	Zimbabwe	-0.146
53	Bulgaria	-0.150
54	Brazil	-0.222
55	South Africa	-0.351
56	Bolivia	-0.355
57	Sri Lanka	-0.361
58	Panama	-0.392
59	Vietnam	-0.437
60	Mexico	-0.474
61	Peru	-0.522
62	El Salvador	-0.656
63	Venezuela	-0.662
64	Paraguay	-0.695
65	Ukraine	-0.707
66	Ecuador	-0.721
67	Russian Federation	-0.722
68	Nicaragua	-0.726
69	Jamaica	-0.728
70	Colombia	-0.783
71	Honduras	-0.895
72	Indonesia	-0.918
73	Bangladesh	-0.929
74	Nigeria	-1.097
75	Guatemala	-1.106

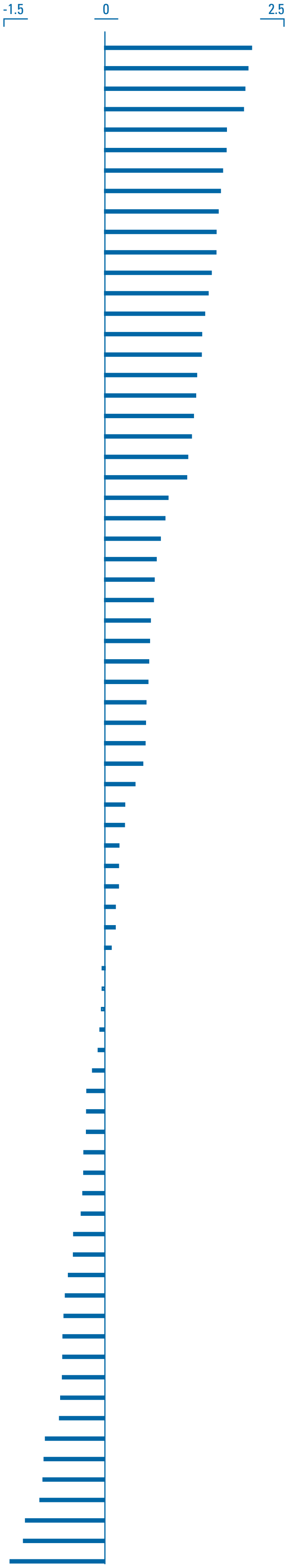


Source: Kaufmann, Kraay and Zoido-Lobaton 2000

5.3 Government Effectiveness, 2000

Index of Government Effectiveness (Scale from -1.883 to 2.082)

RANK	COUNTRY	VALUE
1	Singapore	2.082
2	Netherlands	2.030
3	Switzerland	1.986
4	United Kingdom	1.966
5	Denmark	1.721
6	Canada	1.717
7	Norway	1.666
8	Finland	1.635
9	Spain	1.603
10	Sweden	1.573
11	New Zealand	1.571
12	Iceland	1.504
13	Australia	1.459
14	Germany	1.409
15	United States	1.366
16	Ireland	1.361
17	Taiwan	1.294
18	France	1.280
19	Hong Kong SAR	1.248
20	Austria	1.219
21	Chile	1.166
22	Portugal	1.151
23	Belgium	0.883
24	Japan	0.839
25	Italy	0.773
26	Malaysia	0.714
27	Israel	0.685
28	Poland	0.674
29	Jordan	0.630
30	Uruguay	0.618
31	Hungary	0.606
32	Czech Republic	0.595
33	Slovenia	0.567
34	Greece	0.560
35	Costa Rica	0.554
36	Trinidad and Tobago	0.521
37	Korea	0.409
38	Argentina	0.262
39	Estonia	0.258
40	Mexico	0.179
41	Peru	0.173
42	Mauritius	0.172
43	Lithuania	0.127
44	Philippines	0.126
45	Latvia	0.068
46	China	0.016
47	Thailand	0.010
48	South Africa	-0.010
49	Slovak Republic	-0.032
50	Colombia	-0.057
51	Egypt	-0.138
52	Brazil	-0.220
53	Bolivia	-0.223
54	Guatemala	-0.225
55	El Salvador	-0.262
56	India	-0.264
57	Panama	-0.277
58	Vietnam	-0.300
59	Honduras	-0.409
60	Turkey	-0.412
61	Jamaica	-0.484
62	Indonesia	-0.528
63	Nicaragua	-0.547
64	Ecuador	-0.562
65	Bangladesh	-0.565
66	Romania	-0.570
67	Russian Federation	-0.595
68	Sri Lanka	-0.612
69	Bulgaria	-0.814
70	Dominican Republic	-0.833
71	Venezuela	-0.849
72	Ukraine	-0.893
73	Paraguay	-1.100
74	Zimbabwe	-1.129
75	Nigeria	-1.321

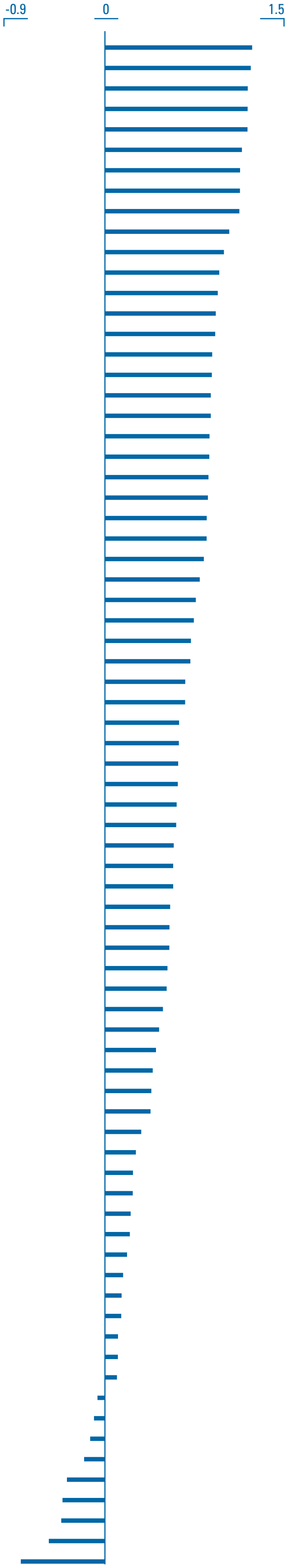


Source: Kaufmann, Kraay and Zoido-Lobaton 2000

5.4 Regulatory Burden, 2000

Index of Regulatory Burden (Scale from -3.142 to 1.245)

RANK	COUNTRY	VALUE
1	Singapore	1.245
2	El Salvador	1.233
3	Hong Kong SAR	1.207
4	United Kingdom	1.206
5	New Zealand	1.205
6	Ireland	1.157
7	Netherlands	1.141
8	Finland	1.140
9	United States	1.135
10	Denmark	1.048
11	Panama	1.002
12	Australia	0.962
13	Uruguay	0.949
14	Norway	0.932
15	Costa Rica	0.927
16	Austria	0.901
17	Chile	0.898
18	Germany	0.889
19	Portugal	0.889
20	Switzerland	0.878
21	Bolivia	0.876
22	Canada	0.869
23	Spain	0.864
24	Hungary	0.854
25	Sweden	0.853
26	Taiwan	0.829
27	Belgium	0.794
28	Jamaica	0.760
29	Estonia	0.743
30	Trinidad and Tobago	0.718
31	France	0.713
32	Peru	0.669
33	Argentina	0.668
34	Sri Lanka	0.616
35	Iceland	0.614
36	Mexico	0.608
37	Greece	0.605
38	Turkey	0.595
39	Italy	0.591
40	Czech Republic	0.570
41	Philippines	0.565
42	Poland	0.565
43	Dominican Republic	0.539
44	Israel	0.533
45	Slovenia	0.532
46	Bulgaria	0.516
47	Latvia	0.509
48	Malaysia	0.477
49	Guatemala	0.444
50	Jordan	0.417
51	Japan	0.389
52	Ecuador	0.377
53	Paraguay	0.370
54	Colombia	0.290
55	South Africa	0.244
56	Korea	0.219
57	Mauritius	0.217
58	Romania	0.199
59	Thailand	0.192
60	Slovak Republic	0.168
61	Brazil	0.134
62	Indonesia	0.121
63	Egypt	0.118
64	Venezuela	0.090
65	Lithuania	0.089
66	Honduras	0.081
67	India	-0.040
68	China	-0.070
69	Nicaragua	-0.103
70	Bangladesh	-0.155
71	Russian Federation	-0.303
72	Zimbabwe	-0.341
73	Nigeria	-0.352
74	Vietnam	-0.459
75	Ukraine	-0.721



Source: Kaufmann, Kraay and Zoido-Lobaton, May 2000

5.5 Number of days to start a new firm

Considering license and permit requirements, what is the typical number of days required to start a new firm in your country?

RANK	COUNTRY	VALUE	0 — 40.2 MEAN — 120
1	Iceland	5.0	
2	United Kingdom	7.0	
3	Hong Kong SAR	8.5	
4	Israel	10.0	
4	Netherlands	10.0	
4	New Zealand	10.0	
4	Norway	10.0	
8	Ireland	15.0	
8	Romania	15.0	
10	Latvia	20.0	
10	Ukraine	20.0	
12	Singapore	21.0	
13	Canada	22.0	
14	Finland	22.5	
15	Switzerland	24.0	
16	Jamaica	25.0	
16	Sweden	25.0	
18	Russian Federation	26.0	
19	Australia	30.0	
19	Bulgaria	30.0	
19	China	30.0	
19	Denmark	30.0	
19	El Salvador	30.0	
19	Estonia	30.0	
19	France	30.0	
19	Germany	30.0	
19	Guatemala	30.0	
19	Japan	30.0	
19	Jordan	30.0	
19	Korea	30.0	
19	Lithuania	30.0	
19	Panama	30.0	
19	Paraguay	30.0	
19	Philippines	30.0	
19	Poland	30.0	
19	Slovak Republic	30.0	
19	Sri Lanka	30.0	
19	Taiwan	30.0	
19	Thailand	30.0	
19	United States	30.0	
19	Uruguay	30.0	
19	Vietnam	30.0	
43	Nigeria	30.5	
44	Trinidad and Tobago	32.5	
45	Austria	35.0	
46	Argentina	45.0	
46	Colombia	45.0	
46	Hungary	45.0	
46	Indonesia	45.0	
46	South Africa	45.0	
46	Turkey	45.0	
52	Nicaragua	47.5	
53	Dominican Republic	55.0	
54	Bolivia	60.0	
54	Brazil	60.0	
54	Chile	60.0	
54	Costa Rica	60.0	
54	Czech Republic	60.0	
54	Ecuador	60.0	
54	Egypt	60.0	
54	Greece	60.0	
54	Malaysia	60.0	
54	Mauritius	60.0	
54	Peru	60.0	
54	Portugal	60.0	
54	Slovenia	60.0	
54	Spain	60.0	
54	Venezuela	60.0	
69	Honduras	75.0	
70	Bangladesh	90.0	
70	Belgium	90.0	
70	India	90.0	
70	Mexico	90.0	
70	Zimbabwe	90.0	
75	Italy	105.0	

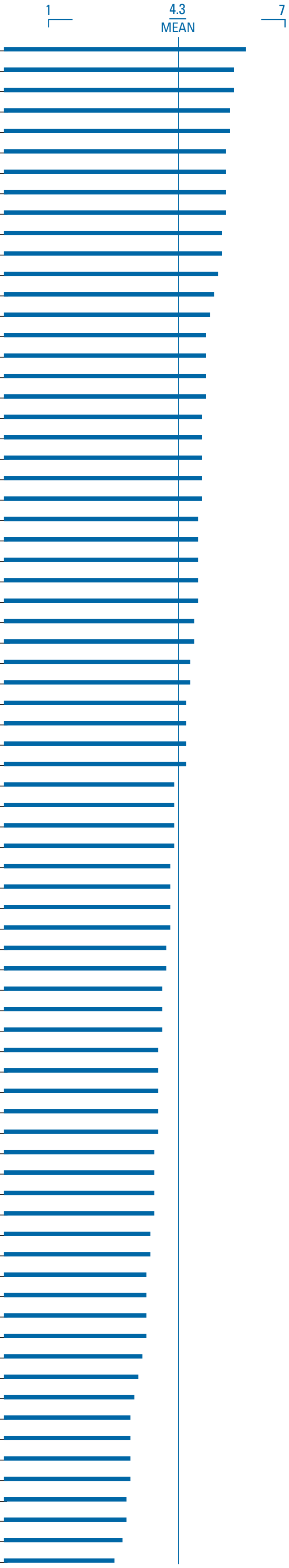
5.6 Women's participation in the economy

Women's participation in the economy is (1=limited and usually takes place in less important jobs, 7=equal to that of men)

RANK	COUNTRY	VALUE	1 — 4.6 MEAN — 7
1	Hong Kong SAR	6.3	
2	Slovak Republic	6.2	
3	Finland	6.1	
3	Singapore	6.1	
5	Denmark	5.8	
6	Romania	5.7	
7	Canada	5.6	
7	Iceland	5.6	
7	Philippines	5.6	
7	Sweden	5.6	
11	Latvia	5.4	
11	United States	5.4	
13	Estonia	5.3	
13	Thailand	5.3	
13	United Kingdom	5.3	
16	Hungary	5.2	
16	New Zealand	5.2	
18	Bulgaria	5.1	
18	China	5.1	
18	Jamaica	5.1	
18	Norway	5.1	
18	Panama	5.1	
18	Taiwan	5.1	
24	Australia	5.0	
24	Portugal	5.0	
24	Venezuela	5.0	
27	El Salvador	4.9	
27	France	4.9	
27	Malaysia	4.9	
30	Egypt	4.8	
30	Turkey	4.8	
32	Belgium	4.7	
32	Costa Rica	4.7	
32	Dominican Republic	4.7	
32	Slovenia	4.7	
32	Trinidad and Tobago	4.7	
32	Vietnam	4.7	
38	Czech Republic	4.6	
38	Lithuania	4.6	
38	Poland	4.6	
38	Sri Lanka	4.6	
42	Colombia	4.5	
43	Austria	4.4	
43	Germany	4.4	
43	Israel	4.4	
43	Ukraine	4.4	
47	Nicaragua	4.3	
47	Nigeria	4.3	
49	Ireland	4.2	
49	Jordan	4.2	
49	Netherlands	4.2	
49	Switzerland	4.2	
53	Indonesia	4.1	
53	Peru	4.1	
53	Spain	4.1	
56	Italy	4.0	
56	Russian Federation	4.0	
58	Brazil	3.9	
58	Honduras	3.9	
58	Mexico	3.9	
58	Uruguay	3.9	
62	Greece	3.8	
62	Guatemala	3.8	
62	Mauritius	3.8	
65	Argentina	3.6	
65	Chile	3.6	
65	India	3.6	
65	Japan	3.6	
65	South Africa	3.6	
70	Ecuador	3.5	
71	Bolivia	3.4	
72	Zimbabwe	3.3	
73	Korea	3.2	
73	Paraguay	3.2	
75	Bangladesh	2.6	

5.7 Minority groups' participation in the economy

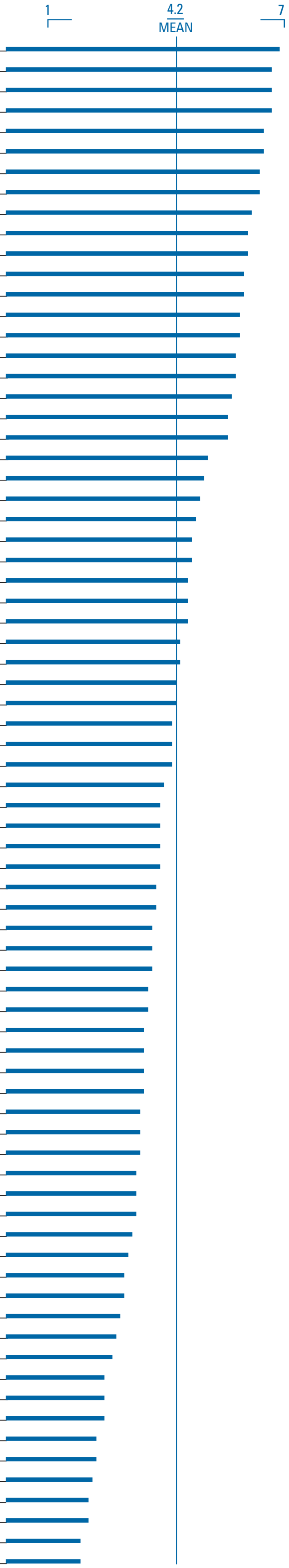
Minority groups' participation in the economy is (1=limited and usually take place in less important jobs, 7=equal to that of other groups)



RANK	COUNTRY	VALUE
1	Ukraine	6.0
2	Poland	5.7
2	Romania	5.7
4	Iceland	5.6
4	Turkey	5.6
6	China	5.5
6	Jamaica	5.5
6	Jordan	5.5
6	Singapore	5.5
10	Hong Kong SAR	5.4
10	Indonesia	5.4
12	Canada	5.3
13	Latvia	5.2
14	Zimbabwe	5.1
15	Slovak Republic	5.0
15	Slovenia	5.0
15	Trinidad and Tobago	5.0
15	United Kingdom	5.0
19	Estonia	4.9
19	India	4.9
19	Lithuania	4.9
19	Mauritius	4.9
19	Sri Lanka	4.9
24	Finland	4.8
24	South Africa	4.8
24	Taiwan	4.8
24	United States	4.8
24	Venezuela	4.8
29	Australia	4.7
29	Bangladesh	4.7
31	Austria	4.6
31	Malaysia	4.6
33	Germany	4.5
33	Russian Federation	4.5
33	Switzerland	4.5
33	Thailand	4.5
37	Costa Rica	4.2
37	Japan	4.2
37	New Zealand	4.2
37	Nigeria	4.2
41	Egypt	4.1
41	Israel	4.1
41	Italy	4.1
41	Netherlands	4.1
45	El Salvador	4.0
45	Panama	4.0
47	Argentina	3.9
47	Czech Republic	3.9
47	France	3.9
50	Belgium	3.8
50	Dominican Republic	3.8
50	Peru	3.8
50	Philippines	3.8
50	Vietnam	3.8
55	Brazil	3.7
55	Chile	3.7
55	Hungary	3.7
55	Sweden	3.7
59	Portugal	3.6
59	Uruguay	3.6
61	Denmark	3.5
61	Mexico	3.5
61	Nicaragua	3.5
61	Norway	3.5
65	Ireland	3.4
66	Honduras	3.3
67	Korea	3.2
68	Colombia	3.1
68	Guatemala	3.1
68	Paraguay	3.1
68	Spain	3.1
72	Bolivia	3.0
72	Bulgaria	3.0
74	Greece	2.9
75	Ecuador	2.7

5.8 Country's position in technology

Your country's position in technology (1=generally lags behind most other countries, 7=is among the world leaders)

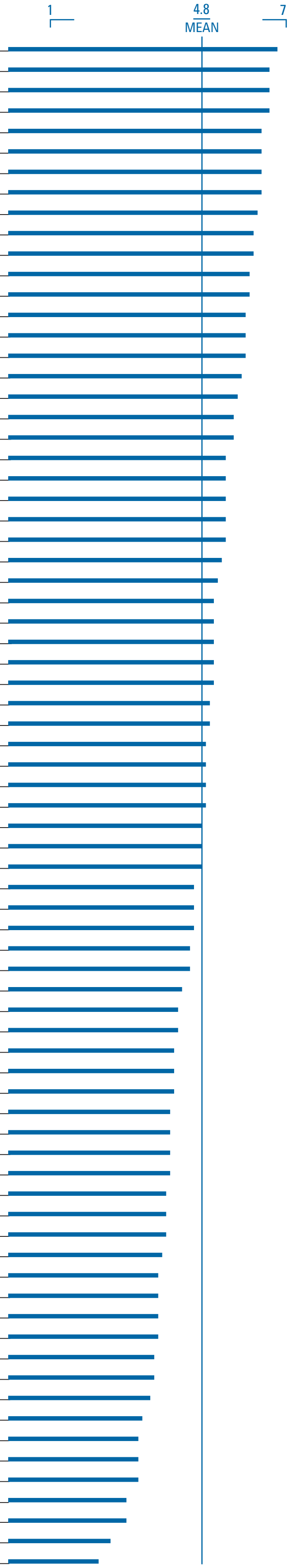


RANK	COUNTRY	VALUE
1	United States	6.8
2	Finland	6.6
2	Israel	6.6
2	Sweden	6.6
5	Japan	6.4
5	Switzerland	6.4
7	Germany	6.3
7	Netherlands	6.3
9	Iceland	6.1
10	France	6.0
10	United Kingdom	6.0
12	Canada	5.9
12	Singapore	5.9
14	Denmark	5.8
14	Ireland	5.8
16	Australia	5.7
16	Austria	5.7
18	Belgium	5.6
19	Norway	5.5
19	Taiwan	5.5
21	Hong Kong SAR	5.0
22	Korea	4.9
23	New Zealand	4.8
24	Czech Republic	4.7
25	Chile	4.6
25	Spain	4.6
27	Hungary	4.5
27	India	4.5
27	South Africa	4.5
30	Estonia	4.3
30	Italy	4.3
32	Slovak Republic	4.2
32	Trinidad and Tobago	4.2
34	Brazil	4.1
34	Costa Rica	4.1
34	Slovenia	4.1
37	Poland	3.9
38	Jamaica	3.8
38	Latvia	3.8
38	Malaysia	3.8
38	Thailand	3.8
42	China	3.7
42	Jordan	3.7
44	Argentina	3.6
44	Portugal	3.6
44	Uruguay	3.6
47	Mexico	3.5
47	Venezuela	3.5
49	Dominican Republic	3.4
49	Greece	3.4
49	Lithuania	3.4
49	Philippines	3.4
53	Indonesia	3.3
53	Panama	3.3
53	Turkey	3.3
56	Egypt	3.2
56	Russian Federation	3.2
56	Sri Lanka	3.2
59	Zimbabwe	3.1
60	Ukraine	3.0
61	Colombia	2.9
61	Mauritius	2.9
63	Peru	2.8
64	El Salvador	2.7
65	Bulgaria	2.6
66	Guatemala	2.4
66	Nigeria	2.4
66	Paraguay	2.4
69	Ecuador	2.2
69	Nicaragua	2.2
71	Vietnam	2.1
72	Bangladesh	2.0
72	Romania	2.0
74	Bolivia	1.8
74	Honduras	1.8

5.9 New government's respect for previous government's commitments

New governments (1=do not honor the contractual commitments and obligations of previous regimes, 7=honor the contractual commitments and obligations of previous regimes)

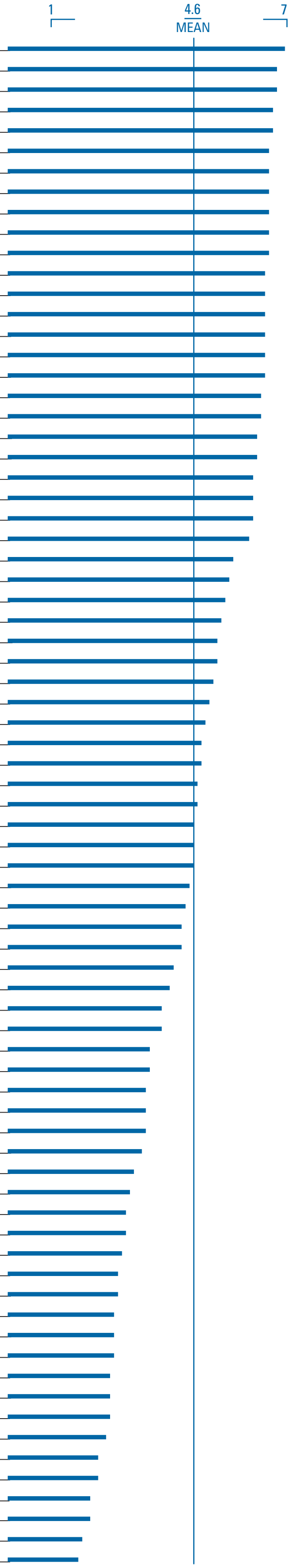
RANK	COUNTRY	VALUE
1	Switzerland	6.7
2	Finland	6.5
2	Iceland	6.5
2	Netherlands	6.5
5	Denmark	6.3
5	Germany	6.3
5	Hong Kong SAR	6.3
5	Singapore	6.3
9	United States	6.2
10	Israel	6.1
10	United Kingdom	6.1
12	Belgium	6.0
12	Sweden	6.0
14	Australia	5.9
14	France	5.9
14	Ireland	5.9
17	Canada	5.8
18	Austria	5.7
19	Norway	5.6
19	South Africa	5.6
21	Japan	5.4
21	Jordan	5.4
21	Mauritius	5.4
21	Portugal	5.4
21	Uruguay	5.4
26	Chile	5.3
27	Poland	5.2
28	China	5.1
28	Czech Republic	5.1
28	India	5.1
28	New Zealand	5.1
28	Turkey	5.1
33	Argentina	5.0
33	Spain	5.0
35	Egypt	4.9
35	Italy	4.9
35	Mexico	4.9
35	Thailand	4.9
39	Estonia	4.8
39	Philippines	4.8
39	Trinidad and Tobago	4.8
42	Greece	4.6
42	Jamaica	4.6
42	Malaysia	4.6
45	Costa Rica	4.5
45	Slovenia	4.5
47	Bulgaria	4.3
48	Brazil	4.2
48	Hungary	4.2
50	Bangladesh	4.1
50	Sri Lanka	4.1
50	Zimbabwe	4.1
53	El Salvador	4.0
53	Korea	4.0
53	Russian Federation	4.0
53	Slovak Republic	4.0
57	Colombia	3.9
57	Peru	3.9
57	Venezuela	3.9
60	Indonesia	3.8
61	Latvia	3.7
61	Nigeria	3.7
61	Panama	3.7
61	Vietnam	3.7
65	Honduras	3.6
65	Taiwan	3.6
67	Lithuania	3.5
68	Ecuador	3.3
69	Dominican Republic	3.2
69	Nicaragua	3.2
69	Romania	3.2
72	Bolivia	2.9
72	Paraguay	2.9
74	Ukraine	2.5
75	Guatemala	2.2



5.10 Trust in public postal system

Do you trust your country's postal system sufficiently to have a friend mail a small package worth US$100 to you? (1=not at all, 7=yes, trust the system entirely)

RANK	COUNTRY	VALUE
1	Finland	6.9
2	Japan	6.7
2	Switzerland	6.7
4	France	6.6
4	New Zealand	6.6
6	Australia	6.5
6	Austria	6.5
6	Denmark	6.5
6	Hong Kong SAR	6.5
6	Iceland	6.5
6	Netherlands	6.5
12	Belgium	6.4
12	Israel	6.4
12	Norway	6.4
12	Singapore	6.4
12	United Kingdom	6.4
12	United States	6.4
18	Germany	6.3
18	Sweden	6.3
20	Canada	6.2
20	Taiwan	6.2
22	Ireland	6.1
22	Portugal	6.1
22	Slovenia	6.1
25	Slovak Republic	6.0
26	Estonia	5.6
27	Korea	5.5
28	Hungary	5.4
29	Jordan	5.3
30	Czech Republic	5.2
30	Spain	5.2
32	Brazil	5.1
33	Thailand	5.0
34	Greece	4.9
35	Turkey	4.8
35	Uruguay	4.8
37	Egypt	4.7
37	Vietnam	4.7
39	China	4.6
39	Poland	4.6
39	Trinidad and Tobago	4.6
42	Chile	4.5
43	Italy	4.4
44	Latvia	4.3
44	Malaysia	4.3
46	Mauritius	4.1
47	India	4.0
48	Argentina	3.8
48	Lithuania	3.8
50	Jamaica	3.5
50	Sri Lanka	3.5
52	Bulgaria	3.4
52	Indonesia	3.4
52	Russian Federation	3.4
55	Zimbabwe	3.3
56	Costa Rica	3.1
57	South Africa	3.0
58	Dominican Republic	2.9
58	Romania	2.9
60	Colombia	2.8
61	Bolivia	2.7
61	Mexico	2.7
63	El Salvador	2.6
63	Panama	2.6
63	Peru	2.6
66	Guatemala	2.5
66	Philippines	2.5
66	Ukraine	2.5
69	Nicaragua	2.4
70	Bangladesh	2.2
70	Paraguay	2.2
72	Ecuador	2.0
72	Venezuela	2.0
74	Honduras	1.8
75	Nigeria	1.7

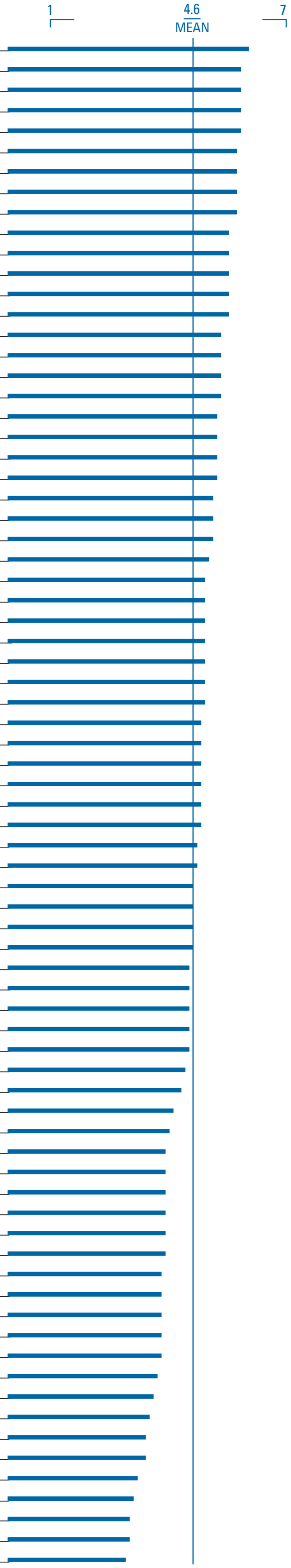


Section VI

Networked Learning

6.1 Investment in employees' development of IT skills

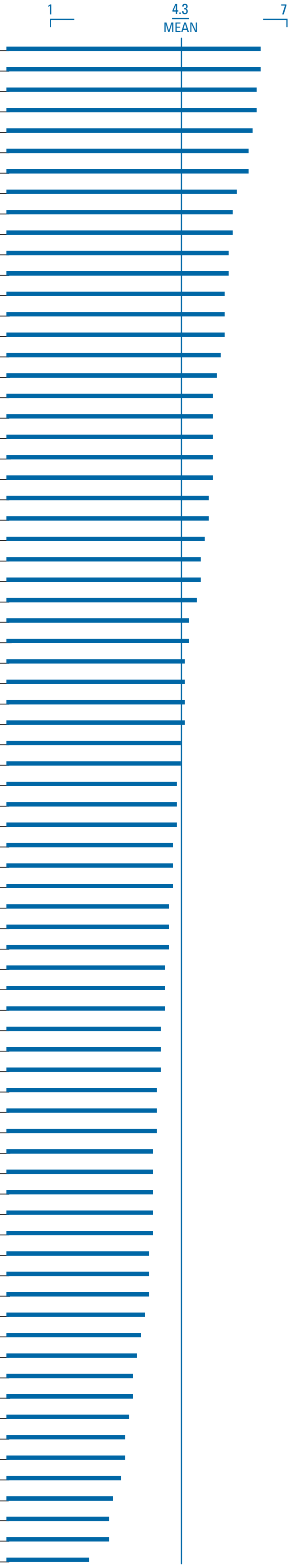
Your company's investment in employees' development of IT skills is (1=minimal, close to nothing, 7=a top priority)



RANK	COUNTRY	VALUE
1	United States	6.0
2	Finland	5.8
2	Germany	5.8
2	Spain	5.8
2	United Kingdom	5.8
6	Belgium	5.7
6	Iceland	5.7
6	Netherlands	5.7
6	Sweden	5.7
10	Austria	5.5
10	Denmark	5.5
10	Ireland	5.5
10	Singapore	5.5
10	Switzerland	5.5
15	Australia	5.3
15	Canada	5.3
15	Norway	5.3
15	Taiwan	5.3
19	Czech Republic	5.2
19	Hong Kong SAR	5.2
19	Slovak Republic	5.2
19	Turkey	5.2
23	Hungary	5.1
23	Israel	5.1
23	Japan	5.1
26	Greece	5.0
27	Brazil	4.9
27	France	4.9
27	Mauritius	4.9
27	New Zealand	4.9
27	Philippines	4.9
27	Portugal	4.9
27	South Africa	4.9
34	Argentina	4.8
34	Chile	4.8
34	India	4.8
34	Nigeria	4.8
34	Slovenia	4.8
34	Thailand	4.8
40	Costa Rica	4.7
40	Mexico	4.7
42	Estonia	4.6
42	Italy	4.6
42	Latvia	4.6
42	Zimbabwe	4.6
46	El Salvador	4.5
46	Indonesia	4.5
46	Malaysia	4.5
46	Poland	4.5
46	Venezuela	4.5
51	Jordan	4.4
52	Korea	4.3
53	Sri Lanka	4.1
54	Trinidad and Tobago	4.0
55	Dominican Republic	3.9
55	Ecuador	3.9
55	Egypt	3.9
55	Jamaica	3.9
55	Nicaragua	3.9
55	Uruguay	3.9
61	China	3.8
61	Colombia	3.8
61	Panama	3.8
61	Peru	3.8
61	Vietnam	3.8
66	Paraguay	3.7
67	Bangladesh	3.6
68	Bolivia	3.5
69	Guatemala	3.4
69	Lithuania	3.4
71	Ukraine	3.2
72	Honduras	3.1
73	Romania	3.0
73	Russian Federation	3.0
75	Bulgaria	2.9

6.2 Quality of IT training and educational programs

Your country's training and educational programs for IT (1= lag far behind most other countries, 7=are among the best in the world)

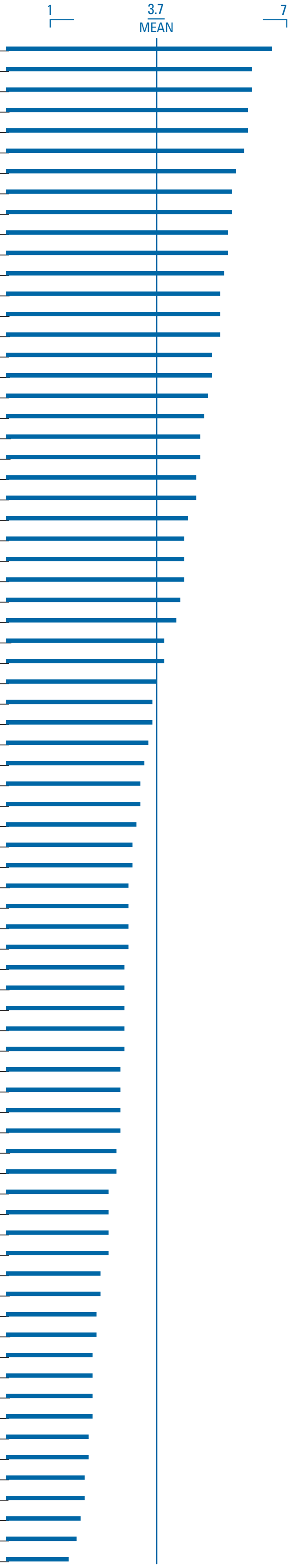


RANK	COUNTRY	VALUE
1	Finland	6.3
1	Netherlands	6.3
3	Sweden	6.2
3	United States	6.2
5	Singapore	6.1
6	Iceland	6.0
6	Israel	6.0
8	Canada	5.7
9	India	5.6
9	Ireland	5.6
11	Taiwan	5.5
11	United Kingdom	5.5
13	Denmark	5.4
13	France	5.4
13	Switzerland	5.4
16	Austria	5.3
17	Norway	5.2
18	Australia	5.1
18	Belgium	5.1
18	Estonia	5.1
18	Germany	5.1
18	Hong Kong SAR	5.1
23	Hungary	5.0
23	Spain	5.0
25	New Zealand	4.9
26	Costa Rica	4.8
26	Czech Republic	4.8
28	Korea	4.7
29	Chile	4.5
29	Slovenia	4.5
31	Italy	4.4
31	Japan	4.4
31	Philippines	4.4
31	Uruguay	4.4
35	Portugal	4.3
35	Thailand	4.3
37	Jordan	4.2
37	Latvia	4.2
37	Malaysia	4.2
40	Brazil	4.1
40	Greece	4.1
40	Jamaica	4.1
43	Slovak Republic	4.0
43	South Africa	4.0
43	Trinidad and Tobago	4.0
46	Dominican Republic	3.9
46	Poland	3.9
46	Sri Lanka	3.9
49	Argentina	3.8
49	Egypt	3.8
49	Zimbabwe	3.8
52	Bulgaria	3.7
52	Turkey	3.7
52	Venezuela	3.7
55	Indonesia	3.6
55	Mexico	3.6
55	Panama	3.6
55	Peru	3.6
55	Ukraine	3.6
60	Colombia	3.5
60	El Salvador	3.5
60	Lithuania	3.5
63	China	3.4
64	Mauritius	3.3
65	Paraguay	3.2
66	Guatemala	3.1
66	Russian Federation	3.1
68	Nicaragua	3.0
69	Nigeria	2.9
69	Vietnam	2.9
71	Ecuador	2.8
72	Bolivia	2.6
73	Bangladesh	2.5
73	Honduras	2.5
75	Romania	2.0

6.3 Internet access in schools

Internet access in schools is (1=very limited, 7=pervasive—most children have frequent access/widely used)

RANK	COUNTRY	VALUE
1	Finland	6.6
2	Canada	6.1
2	Singapore	6.1
4	Iceland	6.0
4	Sweden	6.0
6	Denmark	5.9
7	United States	5.7
8	Australia	5.6
8	Korea	5.6
10	Taiwan	5.5
10	United Kingdom	5.5
12	New Zealand	5.4
13	Estonia	5.3
13	Hong Kong SAR	5.3
13	Norway	5.3
16	Hungary	5.1
16	Netherlands	5.1
18	Austria	5.0
19	Czech Republic	4.9
20	Slovenia	4.8
20	Switzerland	4.8
22	Belgium	4.7
22	Germany	4.7
24	Ireland	4.5
25	Chile	4.4
25	Portugal	4.4
25	Slovak Republic	4.4
28	Israel	4.3
29	France	4.2
30	Latvia	3.9
30	Spain	3.9
32	Japan	3.7
33	Poland	3.6
33	Thailand	3.6
35	Costa Rica	3.5
36	Argentina	3.4
37	Brazil	3.3
37	Uruguay	3.3
39	China	3.2
40	Mexico	3.1
40	Turkey	3.1
42	Colombia	3.0
42	Malaysia	3.0
42	Philippines	3.0
42	Trinidad and Tobago	3.0
46	India	2.9
46	Italy	2.9
46	Lithuania	2.9
46	Peru	2.9
46	South Africa	2.9
51	Bulgaria	2.8
51	Indonesia	2.8
51	Jamaica	2.8
51	Jordan	2.8
55	Greece	2.7
55	Panama	2.7
57	Dominican Republic	2.5
57	Ecuador	2.5
57	El Salvador	2.5
57	Mauritius	2.5
61	Egypt	2.3
61	Venezuela	2.3
63	Paraguay	2.2
63	Sri Lanka	2.2
65	Bolivia	2.1
65	Russian Federation	2.1
65	Ukraine	2.1
65	Vietnam	2.1
69	Guatemala	2.0
69	Nicaragua	2.0
71	Honduras	1.9
71	Zimbabwe	1.9
73	Nigeria	1.8
74	Romania	1.7
75	Bangladesh	1.5

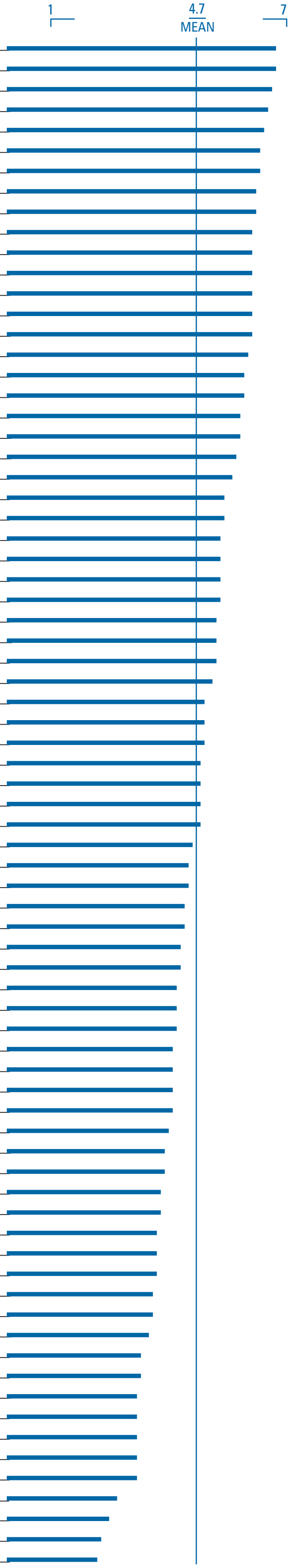


ICT Opportunities

Section VIII

7.1 Brain drain of IT-skilled workforce

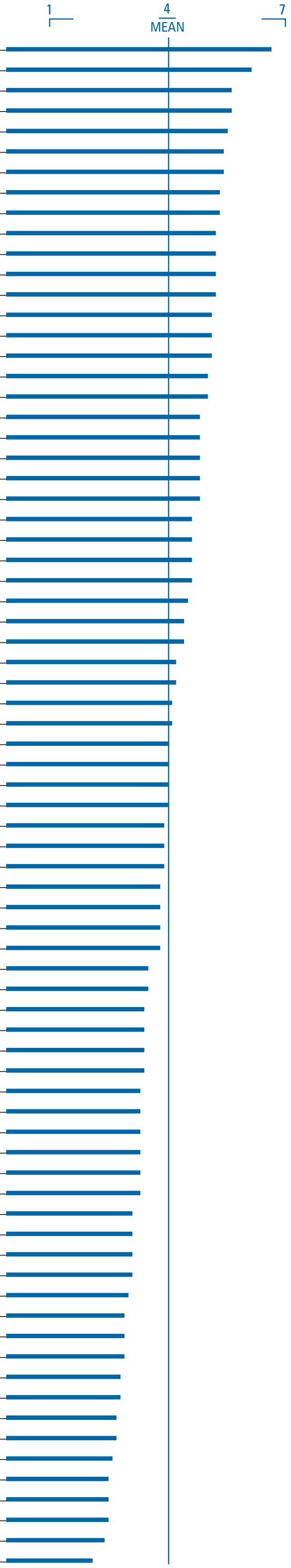
Highly skilled IT workers in your industry (1=have to leave the country to find good jobs, 7=have their pick of highly desirable, paid jobs within the country)



RANK	COUNTRY	VALUE
1	Netherlands	6.7
1	United States	6.7
3	Finland	6.6
4	Germany	6.5
5	Ireland	6.4
6	Norway	6.3
6	United Kingdom	6.3
8	Austria	6.2
8	Singapore	6.2
10	Belgium	6.1
10	Denmark	6.1
10	Iceland	6.1
10	Israel	6.1
10	Sweden	6.1
10	Switzerland	6.1
16	Spain	6.0
17	Italy	5.9
17	Japan	5.9
19	Hong Kong SAR	5.8
19	Taiwan	5.8
21	France	5.7
22	Canada	5.6
23	Brazil	5.4
23	Portugal	5.4
25	Australia	5.3
25	Chile	5.3
25	Costa Rica	5.3
25	Poland	5.3
29	Czech Republic	5.2
29	Estonia	5.2
29	Greece	5.2
32	Turkey	5.1
33	Malaysia	4.9
33	Slovenia	4.9
33	Thailand	4.9
36	Egypt	4.8
36	Hungary	4.8
36	Korea	4.8
36	Slovak Republic	4.8
40	South Africa	4.6
41	China	4.5
41	Indonesia	4.5
43	Dominican Republic	4.4
43	India	4.4
45	New Zealand	4.3
45	Panama	4.3
47	Honduras	4.2
47	Mauritius	4.2
47	Mexico	4.2
50	Argentina	4.1
50	Jamaica	4.1
50	Latvia	4.1
50	Trinidad and Tobago	4.1
54	Vietnam	4.0
55	El Salvador	3.9
55	Venezuela	3.9
57	Guatemala	3.8
57	Uruguay	3.8
59	Jordan	3.7
59	Nigeria	3.7
59	Russian Federation	3.7
62	Lithuania	3.6
62	Zimbabwe	3.6
64	Peru	3.5
65	Colombia	3.3
65	Paraguay	3.3
67	Bolivia	3.2
67	Ecuador	3.2
67	Nicaragua	3.2
67	Philippines	3.2
67	Sri Lanka	3.2
72	Ukraine	2.7
73	Bulgaria	2.5
74	Bangladesh	2.3
75	Romania	2.2

7.2 Brain drain of scientists and engineers

Scientists and engineers in your country (1= normally leave to pursue opportunities in other countries, 7= almost always remain in the country)



RANK	COUNTRY	VALUE
1	United States	6.6
2	Finland	6.1
3	Japan	5.6
3	Norway	5.6
5	Netherlands	5.5
6	Belgium	5.4
6	Germany	5.4
8	France	5.3
8	Taiwan	5.3
10	Austria	5.2
10	Chile	5.2
10	Indonesia	5.2
10	Singapore	5.2
14	Czech Republic	5.1
14	Denmark	5.1
14	Iceland	5.1
17	Switzerland	5.0
17	Thailand	5.0
19	Costa Rica	4.8
19	Israel	4.8
19	Spain	4.8
19	Sweden	4.8
19	United Kingdom	4.8
24	Brazil	4.6
24	Canada	4.6
24	Hong Kong SAR	4.6
24	Ireland	4.6
28	Greece	4.5
29	Estonia	4.4
29	Portugal	4.4
31	Australia	4.2
31	Slovenia	4.2
33	Italy	4.1
33	Korea	4.1
35	Egypt	4.0
35	Hungary	4.0
35	Panama	4.0
35	Turkey	4.0
39	Mexico	3.9
39	Poland	3.9
39	Russian Federation	3.9
42	China	3.8
42	Malaysia	3.8
42	Mauritius	3.8
42	Trinidad and Tobago	3.8
46	Dominican Republic	3.5
46	New Zealand	3.5
48	Guatemala	3.4
48	Honduras	3.4
48	Slovak Republic	3.4
48	Venezuela	3.4
52	Argentina	3.3
52	El Salvador	3.3
52	Latvia	3.3
52	Lithuania	3.3
52	Romania	3.3
52	Vietnam	3.3
58	Colombia	3.1
58	Jamaica	3.1
58	Paraguay	3.1
58	Ukraine	3.1
62	Uruguay	3.0
63	India	2.9
63	Jordan	2.9
63	South Africa	2.9
66	Nicaragua	2.8
66	Peru	2.8
68	Ecuador	2.7
68	Sri Lanka	2.7
70	Bolivia	2.6
71	Bulgaria	2.5
71	Nigeria	2.5
71	Philippines	2.5
74	Bangladesh	2.4
75	Zimbabwe	2.1

Section VIII

Social Capital

8.1 No schooling in the total population, 2000

Percentage of no schooling in the total population above 15 years old, 2000

RANK	COUNTRY	VALUE
1	Denmark	0.0
1	New Zealand	0.0
3	Japan	0.2
4	Finland	0.4
5	Latvia	0.5
6	France	0.8
6	United States	0.8
8	Norway	1.1
9	Russian Federation	1.2
10	Canada	1.4
11	Iceland	1.7
12	Australia	1.9
12	Estonia	1.9
12	Poland	1.9
15	Sweden	2.0
16	Czech Republic	2.1
16	Slovak Republic	2.1
18	Slovenia	2.3
19	Hungary	2.4
20	Austria	2.8
21	Jamaica	2.9
22	Philippines	3.1
23	Spain	3.3
23	United Kingdom	3.3
25	Argentina	3.6
25	Ireland	3.6
27	Netherlands	3.7
28	Germany	3.9
29	Romania	4.3
30	Switzerland	4.6
31	Trinidad and Tobago	5.0
32	Greece	5.1
32	Uruguay	5.1
34	Belgium	5.5
34	Bulgaria	5.5
36	Paraguay	5.7
37	Korea	6.5
38	Chile	7.1
39	Lithuania	7.4
40	Panama	9.1
41	Mexico	9.7
42	Venezuela	9.8
43	Taiwan	10.0
44	Costa Rica	10.4
45	Israel	10.9
46	Hong Kong SAR	11.3
47	Portugal	11.5
48	Peru	11.9
49	Italy	12.4
50	Thailand	12.6
51	Zimbabwe	12.7
52	Mauritius	13.1
53	Vietnam	13.2
54	Sri Lanka	14.0
55	Ecuador	15.1
56	Brazil	16.0
57	Malaysia	16.2
58	Singapore	16.4
59	Honduras	16.6
60	China	18.0
61	Colombia	20.3
62	Turkey	20.8
63	South Africa	22.1
64	Jordan	24.6
65	Bolivia	27.4
66	El Salvador	27.9
67	Nicaragua	28.9
68	Dominican Republic	31.4
69	Indonesia	32.1
70	Egypt	35.9
71	Guatemala	39.5
72	India	43.9
73	Bangladesh	50.1
	Nigeria	n.a.
	Ukraine	n.a.

Source: Barro-Lee, 2000

8.2 Average years of schooling in the total population, 2000

Total average years of schooling in the total population over 15 years old, 2000

RANK	COUNTRY	VALUE
1	United States	12.2
2	Norway	11.9
3	New Zealand	11.5
4	Canada	11.4
5	Sweden	11.4
6	Australia	10.6
7	Korea	10.5
8	Switzerland	10.4
9	Finland	10.1
10	Denmark	10.1
11	Russian Federation	10.0
12	Poland	9.9
13	Germany	9.7
14	Bulgaria	9.7
15	Japan	9.7
16	Romania	9.5
17	Hong Kong SAR	9.5
18	Czech Republic	9.5
19	Latvia	9.5
20	Lithuania	9.4
21	United Kingdom	9.3
22	Netherlands	9.2
23	Israel	9.2
24	Slovak Republic	9.2
25	Ireland	9.0
26	Estonia	9.0
27	Hungary	8.8
28	Austria	8.8
29	Iceland	8.7
30	Belgium	8.7
31	Taiwan	8.5
32	Greece	8.5
33	Argentina	8.5
34	France	8.4
35	Singapore	8.1
36	Panama	7.9
37	Chile	7.9
38	Malaysia	7.9
39	South Africa	7.9
40	Trinidad and Tobago	7.6
41	Philippines	7.6
42	Jordan	7.4
43	Slovenia	7.4
44	Peru	7.3
45	Spain	7.3
46	Uruguay	7.2
47	Italy	7.0
48	Mexico	6.7
49	Ecuador	6.5
50	Thailand	6.1
51	Sri Lanka	6.1
52	Costa Rica	6.0
53	Paraguay	5.7
54	China	5.7
55	Venezuela	5.6
56	Mauritius	5.5
57	Bolivia	5.5
58	Jamaica	5.2
59	Dominican Republic	5.2
60	Egypt	5.1
61	Colombia	5.0
62	Portugal	4.9
63	Zimbabwe	4.9
64	Turkey	4.8
65	India	4.8
66	Indonesia	4.7
67	Brazil	4.6
68	El Salvador	4.5
69	Nicaragua	4.4
70	Honduras	4.1
71	Vietnam	3.8
72	Guatemala	3.1
73	Bangladesh	2.4
	Nigeria	n.a.
	Ukraine	n.a.

Source: Barro-Lee, 2000

8.3 Illiteracy, 1999

Illiteracy rate, adult total (percentage of 15 and above), 1999

RANK	COUNTRY	VALUE
1	Latvia	0.20
2	Poland	0.30
3	Slovenia	0.40
4	Ukraine	0.41
5	Lithuania	0.50
5	Russian Federation	0.50
7	Hungary	0.70
8	Australia	1.00
8	Austria	1.00
8	Belgium	1.00
8	Canada	1.00
8	Czech Republic	1.00
8	Denmark	1.00
8	Estonia	1.00
8	Finland	1.00
8	France	1.00
8	Germany	1.00
8	Iceland	1.00
8	Ireland	1.00
8	Japan	1.00
8	Netherlands	1.00
8	New Zealand	1.00
8	Norway	1.00
8	Slovak Republic	1.00
8	Sweden	1.00
8	Switzerland	1.00
8	Taiwan	1.00
8	United Kingdom	1.00
8	United States	1.00
30	Italy	1.60
31	Bulgaria	1.70
32	Romania	2.00
33	Uruguay	2.30
34	Korea	2.40
34	Spain	2.40
36	Greece	2.90
37	Argentina	3.30
38	Israel	4.20
39	Chile	4.40
40	Costa Rica	4.50
41	Thailand	4.70
42	Philippines	4.90
43	Trinidad and Tobago	6.46
44	Hong Kong SAR	6.70
45	Vietnam	6.90
46	Paraguay	7.00
47	Venezuela	7.70
48	Singapore	7.90
49	Portugal	8.10
50	Panama	8.30
51	Colombia	8.50
52	Sri Lanka	8.60
53	Mexico	8.90
54	Ecuador	9.00
55	Peru	10.40
56	Jordan	10.80
57	Zimbabwe	12.00
58	Malaysia	13.00
59	Jamaica	13.60
60	Indonesia	13.70
61	Bolivia	15.00
62	Brazil	15.10
62	South Africa	15.10
64	Turkey	15.40
65	Mauritius	15.80
66	China	16.50
67	Dominican Republic	16.80
68	El Salvador	21.70
69	Honduras	26.00
70	Nicaragua	31.80
71	Guatemala	31.90
72	Nigeria	37.40
73	India	43.50
74	Egypt	45.40
75	Bangladesh	59.20

Source: World Bank, *World Development Indicators 2001*

8.4 Political Rights, 2000

Index of Political Rights 2001 (Scale from 1=free to 7=not free)

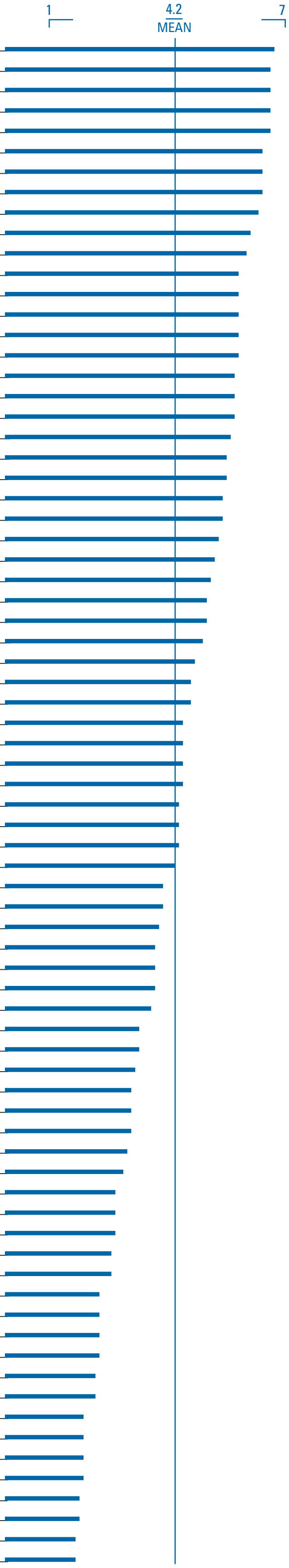
RANK	COUNTRY	VALUE
1	Argentina	1.00
1	Australia	1.00
1	Austria	1.00
1	Belgium	1.00
1	Bolivia	1.00
1	Canada	1.00
1	Costa Rica	1.00
1	Czech Republic	1.00
1	Denmark	1.00
1	Estonia	1.00
1	Finland	1.00
1	France	1.00
1	Germany	1.00
1	Greece	1.00
1	Hungary	1.00
1	Iceland	1.00
1	Ireland	1.00
1	Israel	1.00
1	Italy	1.00
1	Japan	1.00
1	Latvia	1.00
1	Lithuania	1.00
1	Mauritius	1.00
1	Netherlands	1.00
1	New Zealand	1.00
1	Norway	1.00
1	Panama	1.00
1	Poland	1.00
1	Portugal	1.00
1	Slovak Republic	1.00
1	Slovenia	1.00
1	South Africa	1.00
1	Spain	1.00
1	Sweden	1.00
1	Switzerland	1.00
1	Taiwan	1.00
1	United Kingdom	1.00
1	United States	1.00
1	Uruguay	1.00
40	Bulgaria	2.00
40	Chile	2.00
40	Dominican Republic	2.00
40	El Salvador	2.00
40	India	2.00
40	Jamaica	2.00
40	Korea	2.00
40	Mexico	2.00
40	Philippines	2.00
40	Romania	2.00
40	Thailand	2.00
40	Trinidad and Tobago	2.00
52	Bangladesh	3.00
52	Brazil	3.00
52	Ecuador	3.00
52	Guatemala	3.00
52	Honduras	3.00
52	Indonesia	3.00
52	Nicaragua	3.00
52	Peru	3.00
52	Sri Lanka	3.00
52	Venezuela	3.00
62	Colombia	4.00
62	Jordan	4.00
62	Nigeria	4.00
62	Paraguay	4.00
62	Turkey	4.00
62	Ukraine	4.00
68	Hong Kong SAR	5.00
68	Malaysia	5.00
68	Russian Federation	5.00
68	Singapore	5.00
72	Egypt	6.00
72	Zimbabwe	6.00
74	China	7.00
74	Vietnam	7.00

Source: Freedom House, 2001

8.5 Quality of public schools

The public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)

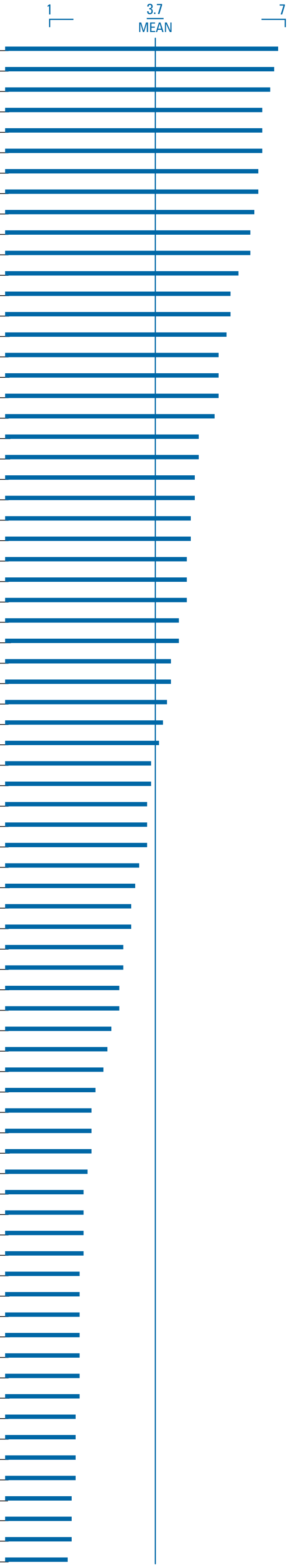
RANK	COUNTRY	VALUE
1	Switzerland	6.7
2	Austria	6.6
2	Finland	6.6
2	France	6.6
2	Slovak Republic	6.6
6	Belgium	6.4
6	Netherlands	6.4
6	Singapore	6.4
9	Ireland	6.3
10	Germany	6.1
11	Iceland	6.0
12	Canada	5.8
12	Denmark	5.8
12	Hungary	5.8
12	Japan	5.8
12	Taiwan	5.8
17	Czech Republic	5.7
17	New Zealand	5.7
17	Norway	5.7
20	Israel	5.6
21	Australia	5.5
21	Slovenia	5.5
23	Estonia	5.4
23	Sweden	5.4
25	Hong Kong SAR	5.3
26	United States	5.2
27	Spain	5.1
28	Italy	5.0
28	Romania	5.0
30	United Kingdom	4.9
31	Poland	4.7
32	Bulgaria	4.6
32	Trinidad and Tobago	4.6
34	Costa Rica	4.4
34	Korea	4.4
34	Latvia	4.4
34	Russian Federation	4.4
38	Lithuania	4.3
38	Portugal	4.3
38	Uruguay	4.3
41	Malaysia	4.2
42	Jamaica	3.9
42	Thailand	3.9
44	Mauritius	3.8
45	Jordan	3.7
45	Sri Lanka	3.7
45	Ukraine	3.7
48	Greece	3.6
49	China	3.3
49	Vietnam	3.3
51	Egypt	3.2
52	South Africa	3.1
52	Turkey	3.1
52	Zimbabwe	3.1
55	Argentina	3.0
56	Colombia	2.9
57	Brazil	2.7
57	Chile	2.7
57	Indonesia	2.7
60	Mexico	2.6
60	Panama	2.6
62	Dominican Republic	2.3
62	El Salvador	2.3
62	India	2.3
62	Philippines	2.3
66	Paraguay	2.2
66	Peru	2.2
68	Ecuador	1.9
68	Honduras	1.9
68	Nigeria	1.9
68	Venezuela	1.9
72	Bangladesh	1.8
72	Guatemala	1.8
74	Bolivia	1.7
74	Nicaragua	1.7



8.6 Difference in quality of schooling for rich and poor children

The difference in the quality of the schools available to rich and poor children in your country is (1=large, 7=small)

RANK	COUNTRY	VALUE
1	Finland	6.8
2	Iceland	6.7
3	Austria	6.6
4	Netherlands	6.4
4	Slovak Republic	6.4
4	Switzerland	6.4
7	Denmark	6.3
7	Norway	6.3
9	Germany	6.2
10	Belgium	6.1
10	Slovenia	6.1
12	Taiwan	5.8
13	Czech Republic	5.6
13	Singapore	5.6
15	Japan	5.5
16	France	5.3
16	Israel	5.3
16	Sweden	5.3
19	Canada	5.2
20	Estonia	4.8
20	Ireland	4.8
22	Italy	4.7
22	Lithuania	4.7
24	Hong Kong SAR	4.6
24	Hungary	4.6
26	New Zealand	4.5
26	Poland	4.5
26	Trinidad and Tobago	4.5
29	Australia	4.3
29	Korea	4.3
31	Portugal	4.1
31	Spain	4.1
33	Latvia	4.0
34	Bulgaria	3.9
35	Jamaica	3.8
36	Malaysia	3.6
36	Romania	3.6
38	Mauritius	3.5
38	Russian Federation	3.5
38	United Kingdom	3.5
41	Greece	3.3
42	United States	3.2
43	China	3.1
43	Uruguay	3.1
45	Sri Lanka	2.9
45	Vietnam	2.9
47	Costa Rica	2.8
47	Jordan	2.8
49	Ukraine	2.6
50	Thailand	2.5
51	Argentina	2.4
52	Paraguay	2.2
53	Egypt	2.1
53	Indonesia	2.1
53	Panama	2.1
56	Ecuador	2.0
57	Colombia	1.9
57	Honduras	1.9
57	India	1.9
57	Turkey	1.9
61	Bolivia	1.8
61	Brazil	1.8
61	Chile	1.8
61	El Salvador	1.8
61	Philippines	1.8
61	South Africa	1.8
61	Zimbabwe	1.8
68	Dominican Republic	1.7
68	Guatemala	1.7
68	Mexico	1.7
68	Nigeria	1.7
72	Nicaragua	1.6
72	Peru	1.6
72	Venezuela	1.6
75	Bangladesh	1.5



Section IX

e-Commerce

9.1 Business to consumer e-commerce transactions

In your company, Internet-based transactions with consumers are (1=behind other local companies, 5 =equal to the best in the world)

RANK	COUNTRY	VALUE
1	Germany	3.7
2	United States	3.5
3	Sweden	3.2
4	Canada	3.1
4	Denmark	3.1
4	Taiwan	3.1
7	Argentina	3.0
7	Finland	3.0
7	France	3.0
7	Iceland	3.0
11	Italy	2.9
11	Singapore	2.9
11	Switzerland	2.9
14	Australia	2.8
14	Austria	2.8
14	Brazil	2.8
14	Hong Kong SAR	2.8
14	Japan	2.8
14	Netherlands	2.8
14	Poland	2.8
14	United Kingdom	2.8
22	Belgium	2.7
22	Czech Republic	2.7
22	Norway	2.7
22	South Africa	2.7
22	Turkey	2.7
27	Israel	2.6
28	Egypt	2.5
28	Indonesia	2.5
28	Ireland	2.5
28	Korea	2.5
28	Latvia	2.5
28	Mexico	2.5
28	New Zealand	2.5
28	Portugal	2.5
28	Spain	2.5
28	Venezuela	2.5
38	Chile	2.4
38	Estonia	2.4
38	India	2.4
38	Malaysia	2.4
38	Slovenia	2.4
38	Thailand	2.4
44	Hungary	2.3
44	Jordan	2.3
46	Bangladesh	2.2
46	Greece	2.2
46	Paraguay	2.2
49	China	2.1
49	Costa Rica	2.1
49	Nigeria	2.1
49	Philippines	2.1
49	Romania	2.1
49	Russian Federation	2.1
49	Sri Lanka	2.1
49	Trinidad and Tobago	2.1
57	Nicaragua	2.0
57	Ukraine	2.0
57	Vietnam	2.0
60	Ecuador	1.9
60	El Salvador	1.9
60	Honduras	1.9
60	Panama	1.9
60	Uruguay	1.9
60	Zimbabwe	1.9
66	Bolivia	1.8
66	Colombia	1.8
66	Dominican Republic	1.8
66	Guatemala	1.8
66	Jamaica	1.8
66	Lithuania	1.8
66	Mauritius	1.8
66	Peru	1.8
74	Bulgaria	1.7
75	Slovak Republic	1.5

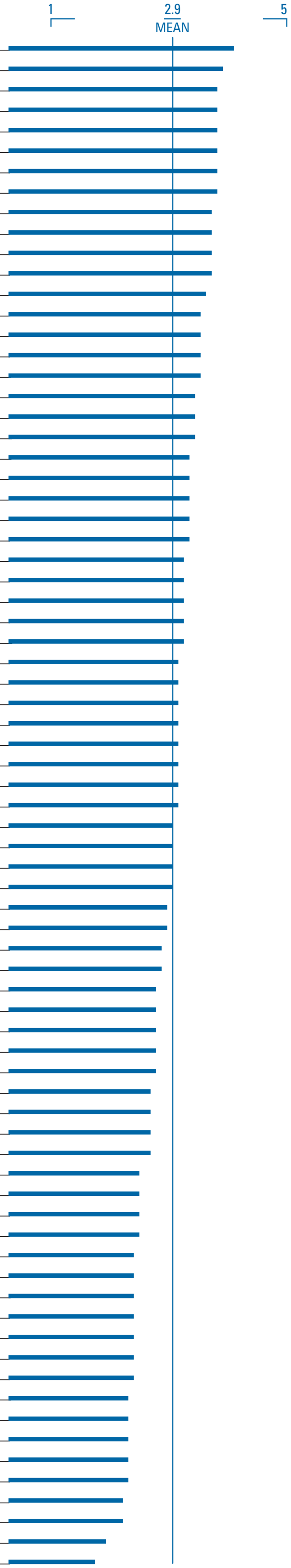
9.2 Business to business e-commerce transactions

In your company, Internet-based interactions with suppliers are (1=behind other companies, 5=equal to the best in the world)

RANK	COUNTRY	VALUE
1	Finland	3.5
2	Germany	3.3
3	United States	3.2
4	Sweden	3.1
5	Taiwan	3.0
6	Canada	2.9
6	Italy	2.9
6	Netherlands	2.9
6	United Kingdom	2.9
10	Brazil	2.8
10	Denmark	2.8
10	France	2.8
10	Singapore	2.8
10	Switzerland	2.8
15	Austria	2.7
15	Czech Republic	2.7
15	Hong Kong SAR	2.7
15	Iceland	2.7
15	Norway	2.7
15	Poland	2.7
15	South Africa	2.7
22	Argentina	2.6
22	Belgium	2.6
22	Egypt	2.6
22	Turkey	2.6
26	Australia	2.5
26	Ireland	2.5
26	Japan	2.5
26	Korea	2.5
26	Mauritius	2.5
26	Portugal	2.5
32	Bangladesh	2.4
32	Estonia	2.4
32	Greece	2.4
32	Indonesia	2.4
32	Malaysia	2.4
32	Mexico	2.4
32	New Zealand	2.4
32	Spain	2.4
40	Hungary	2.3
40	India	2.3
40	Israel	2.3
40	Jordan	2.3
40	Latvia	2.3
40	Slovenia	2.3
40	Thailand	2.3
40	Venezuela	2.3
48	Chile	2.2
48	El Salvador	2.2
48	Nicaragua	2.2
48	Paraguay	2.2
52	Nigeria	2.1
52	Sri Lanka	2.1
52	Trinidad and Tobago	2.1
55	China	2.0
55	Costa Rica	2.0
55	Dominican Republic	2.0
55	Guatemala	2.0
55	Jamaica	2.0
55	Philippines	2.0
55	Slovak Republic	2.0
55	Uruguay	2.0
63	Bolivia	1.9
63	Ecuador	1.9
63	Honduras	1.9
63	Lithuania	1.9
63	Panama	1.9
63	Peru	1.9
63	Ukraine	1.9
63	Zimbabwe	1.9
71	Russian Federation	1.8
71	Vietnam	1.8
73	Bulgaria	1.7
73	Colombia	1.7
75	Romania	1.5

9.3 Business Intranet sophistication

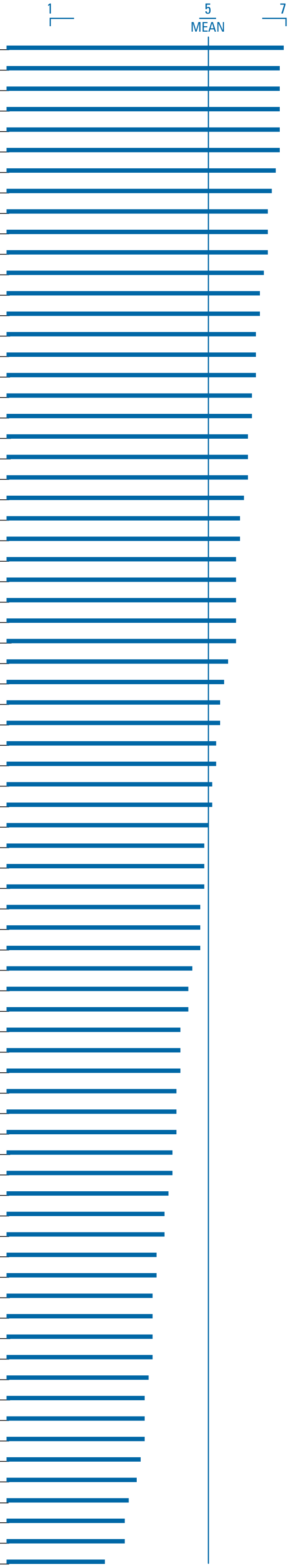
In your company, Intranet sophistication is (1=behind other local companies, 7=equal to the best in the World)



RANK	COUNTRY	VALUE
1	Germany	4.0
2	United States	3.8
3	Canada	3.7
3	Denmark	3.7
3	France	3.7
3	Netherlands	3.7
3	Sweden	3.7
3	Switzerland	3.7
9	Argentina	3.6
9	Belgium	3.6
9	Brazil	3.6
9	Finland	3.6
13	Taiwan	3.5
14	Hong Kong SAR	3.4
14	Israel	3.4
14	Singapore	3.4
14	United Kingdom	3.4
18	Italy	3.3
18	Mexico	3.3
18	South Africa	3.3
21	Australia	3.2
21	Austria	3.2
21	Czech Republic	3.2
21	Greece	3.2
21	Japan	3.2
26	Egypt	3.1
26	Iceland	3.1
26	Korea	3.1
26	Poland	3.1
26	Turkey	3.1
31	Chile	3.0
31	Hungary	3.0
31	India	3.0
31	Indonesia	3.0
31	Ireland	3.0
31	New Zealand	3.0
31	Norway	3.0
31	Spain	3.0
39	Estonia	2.9
39	Malaysia	2.9
39	Portugal	2.9
39	Slovenia	2.9
43	Costa Rica	2.8
43	Venezuela	2.8
45	Jordan	2.7
45	Thailand	2.7
47	China	2.6
47	Latvia	2.6
47	Mauritius	2.6
47	Nigeria	2.6
47	Philippines	2.6
52	Bangladesh	2.5
52	Peru	2.5
52	Slovak Republic	2.5
52	Uruguay	2.5
56	Bolivia	2.3
56	El Salvador	2.3
56	Nicaragua	2.3
56	Sri Lanka	2.3
60	Bulgaria	2.2
60	Colombia	2.2
60	Ecuador	2.2
60	Guatemala	2.2
60	Lithuania	2.2
60	Panama	2.2
60	Trinidad and Tobago	2.2
67	Dominican Republic	2.1
67	Honduras	2.1
67	Jamaica	2.1
67	Russian Federation	2.1
67	Zimbabwe	2.1
72	Paraguay	2.0
72	Ukraine	2.0
74	Vietnam	1.7
75	Romania	1.5

9.4 Commercial websites

In your country, how common are web pages by companies? (1=rare, 7=as common as in the world's leading countries)

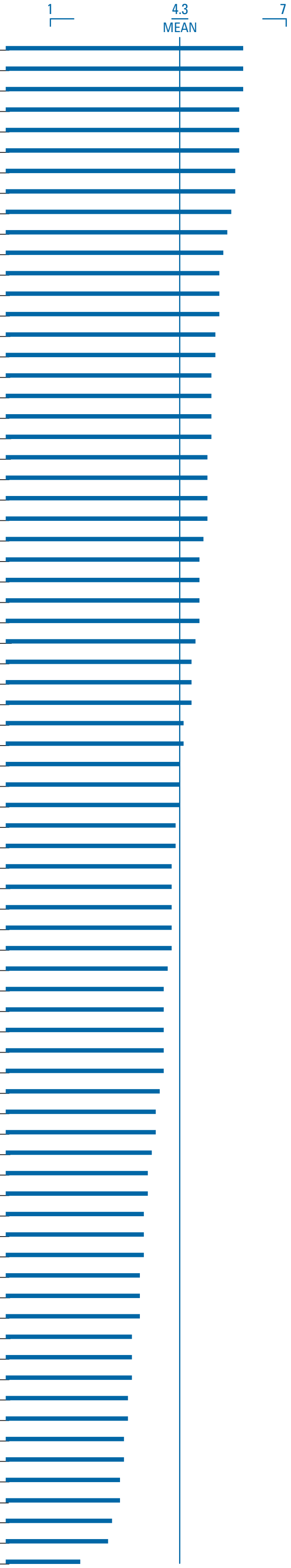


RANK	COUNTRY	VALUE
1	Finland	6.9
2	Canada	6.8
2	Iceland	6.8
2	Sweden	6.8
2	United Kingdom	6.8
2	United States	6.8
7	Switzerland	6.7
8	Netherlands	6.6
9	Australia	6.5
9	Germany	6.5
9	Norway	6.5
12	Denmark	6.4
13	Austria	6.3
13	Hong Kong SAR	6.3
15	France	6.2
15	Japan	6.2
15	Korea	6.2
18	Israel	6.1
18	New Zealand	6.1
20	Belgium	6.0
20	Brazil	6.0
20	Singapore	6.0
23	Italy	5.9
24	South Africa	5.8
24	Spain	5.8
26	Argentina	5.7
26	Czech Republic	5.7
26	Estonia	5.7
26	Ireland	5.7
26	Taiwan	5.7
31	Hungary	5.5
32	Slovak Republic	5.4
33	Poland	5.3
33	Venezuela	5.3
35	Slovenia	5.2
35	Turkey	5.2
37	Chile	5.1
37	India	5.1
39	Portugal	5.0
40	Mexico	4.9
40	Thailand	4.9
40	Uruguay	4.9
43	Latvia	4.8
43	Malaysia	4.8
43	Philippines	4.8
46	Panama	4.6
47	Greece	4.5
47	Jordan	4.5
49	Costa Rica	4.3
49	Egypt	4.3
49	Indonesia	4.3
52	Colombia	4.2
52	Dominican Republic	4.2
52	Trinidad and Tobago	4.2
55	Lithuania	4.1
55	Ukraine	4.1
57	Jamaica	4.0
58	Russian Federation	3.9
58	Sri Lanka	3.9
60	Bulgaria	3.7
60	Peru	3.7
62	China	3.6
62	Ecuador	3.6
62	Guatemala	3.6
62	Nigeria	3.6
66	El Salvador	3.5
67	Honduras	3.4
67	Vietnam	3.4
67	Zimbabwe	3.4
70	Nicaragua	3.3
71	Paraguay	3.2
72	Bolivia	3.0
73	Bangladesh	2.9
73	Mauritius	2.9
75	Romania	2.4

9.5 Domestic venture capital investment in e-commerce

Domestic venture capital and private equity markets in your country are (1=unwilling to invest in local e-commerce ventures, 7=willing to invest in local e-commerce ventures)

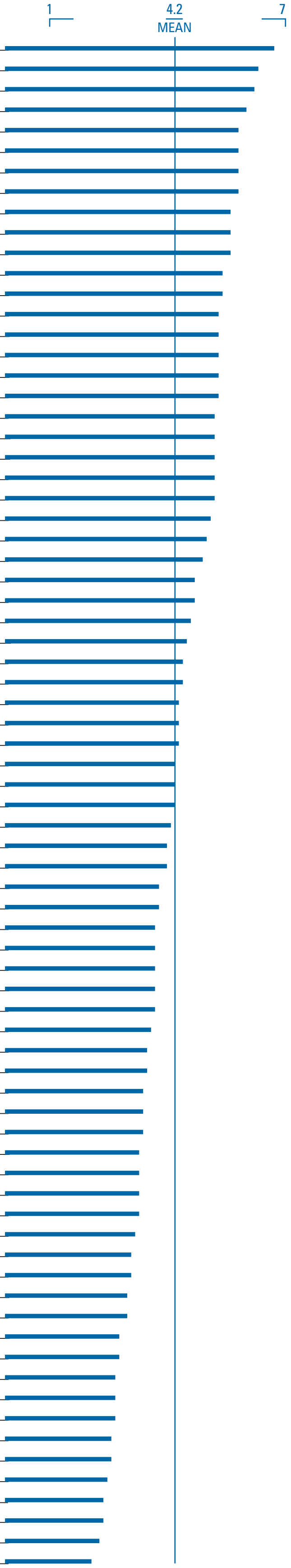
RANK	COUNTRY	VALUE
1	Germany	5.9
1	United Kingdom	5.9
1	United States	5.9
4	Finland	5.8
4	France	5.8
4	Iceland	5.8
7	Netherlands	5.7
7	Switzerland	5.7
9	Canada	5.6
10	Sweden	5.5
11	Ireland	5.4
12	Hong Kong SAR	5.3
12	India	5.3
12	Singapore	5.3
15	Australia	5.2
15	Denmark	5.2
17	Italy	5.1
17	South Africa	5.1
17	Taiwan	5.1
17	Zimbabwe	5.1
21	Belgium	5.0
21	Israel	5.0
21	New Zealand	5.0
21	Norway	5.0
25	Austria	4.9
26	Korea	4.8
26	Philippines	4.8
26	Poland	4.8
26	Spain	4.8
30	Japan	4.7
31	Brazil	4.6
31	Hungary	4.6
31	Portugal	4.6
34	Greece	4.4
34	Malaysia	4.4
36	Sri Lanka	4.3
36	Thailand	4.3
36	Trinidad and Tobago	4.3
39	China	4.2
39	Slovak Republic	4.2
41	Chile	4.1
41	Egypt	4.1
41	Indonesia	4.1
41	Jamaica	4.1
41	Nigeria	4.1
46	Turkey	4.0
47	Estonia	3.9
47	Jordan	3.9
47	Latvia	3.9
47	Mauritius	3.9
47	Panama	3.9
52	Slovenia	3.8
53	Argentina	3.7
53	Mexico	3.7
55	Dominican Republic	3.6
56	Czech Republic	3.5
56	El Salvador	3.5
58	Bangladesh	3.4
58	Costa Rica	3.4
58	Paraguay	3.4
61	Peru	3.3
61	Ukraine	3.3
61	Uruguay	3.3
64	Lithuania	3.1
64	Nicaragua	3.1
64	Vietnam	3.1
67	Bulgaria	3.0
67	Guatemala	3.0
69	Colombia	2.9
69	Honduras	2.9
71	Russian Federation	2.8
71	Venezuela	2.8
73	Bolivia	2.6
74	Ecuador	2.5
75	Romania	1.8



9.6 Competition in dot-com market

Competition in your country's dot-com marketplace is (1=non-existent, 7=equal to the most vibrant in the world)

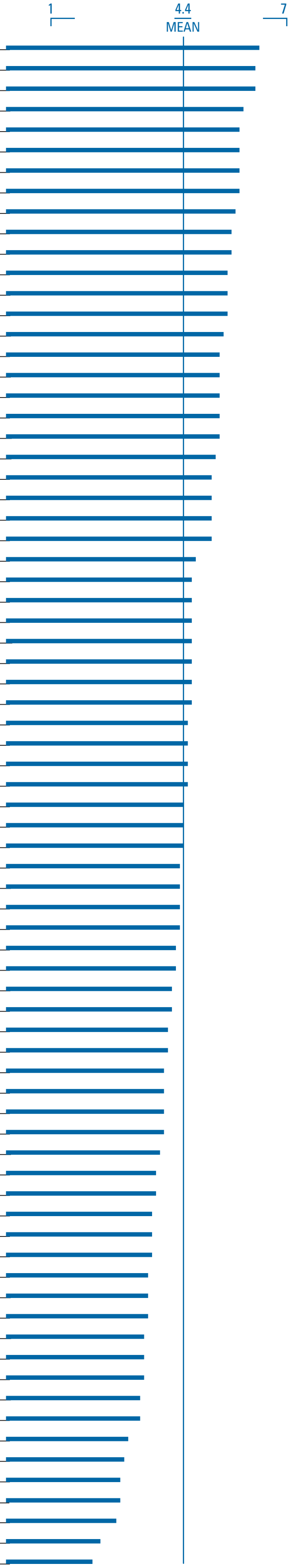
RANK	COUNTRY	VALUE
1	United States	6.7
2	Sweden	6.3
3	United Kingdom	6.2
4	Germany	6.0
5	Finland	5.8
5	France	5.8
5	Hong Kong SAR	5.8
5	Israel	5.8
9	Canada	5.6
9	India	5.6
9	Korea	5.6
12	Netherlands	5.4
12	Norway	5.4
14	Australia	5.3
14	Brazil	5.3
14	Iceland	5.3
14	Japan	5.3
14	Spain	5.3
19	Estonia	5.2
19	Ireland	5.2
19	Singapore	5.2
19	Switzerland	5.2
19	Taiwan	5.2
24	Austria	5.1
25	Italy	5.0
26	Denmark	4.9
27	New Zealand	4.7
27	Poland	4.7
29	Belgium	4.6
30	South Africa	4.5
31	Argentina	4.4
31	Turkey	4.4
33	China	4.3
33	Czech Republic	4.3
33	Indonesia	4.3
36	Portugal	4.2
36	Slovak Republic	4.2
36	Uruguay	4.2
39	Chile	4.1
40	Panama	4.0
40	Philippines	4.0
42	Hungary	3.8
42	Malaysia	3.8
44	Latvia	3.7
44	Mexico	3.7
44	Russian Federation	3.7
44	Thailand	3.7
44	Ukraine	3.7
49	Dominican Republic	3.6
50	Bulgaria	3.5
50	Colombia	3.5
52	Egypt	3.4
52	Jordan	3.4
52	Slovenia	3.4
55	Greece	3.3
55	Lithuania	3.3
55	Paraguay	3.3
55	Sri Lanka	3.3
59	Venezuela	3.2
60	Honduras	3.1
60	Jamaica	3.1
62	Guatemala	3.0
62	Romania	3.0
64	Ecuador	2.8
64	Peru	2.8
66	Costa Rica	2.7
66	Nigeria	2.7
66	Vietnam	2.7
69	Nicaragua	2.6
69	Trinidad and Tobago	2.6
71	Zimbabwe	2.5
72	Bangladesh	2.4
72	El Salvador	2.4
74	Bolivia	2.3
75	Mauritius	2.1



9.7 Prevalence of Internet start-ups

Internet business start-ups in your country are currently (1=not found, 7=happening everywhere)

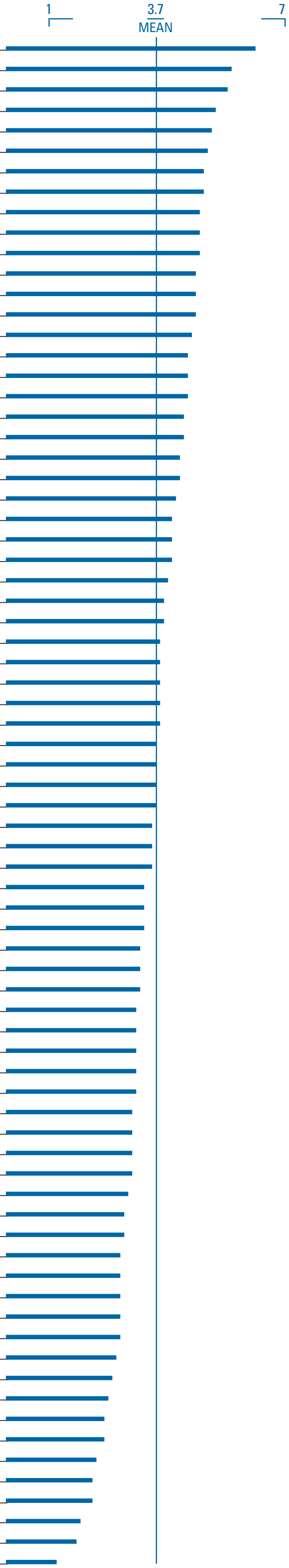
RANK	COUNTRY	VALUE
1	Israel	6.3
2	Germany	6.2
2	United States	6.2
4	Korea	5.9
5	Finland	5.8
5	France	5.8
5	Netherlands	5.8
5	Sweden	5.8
9	Japan	5.7
10	Hong Kong SAR	5.6
10	United Kingdom	5.6
12	Estonia	5.5
12	Norway	5.5
12	Spain	5.5
15	Italy	5.4
16	Canada	5.3
16	Iceland	5.3
16	India	5.3
16	Ireland	5.3
16	Taiwan	5.3
21	Singapore	5.2
22	Austria	5.1
22	Brazil	5.1
22	Denmark	5.1
22	Switzerland	5.1
26	Czech Republic	4.7
27	Argentina	4.6
27	Australia	4.6
27	New Zealand	4.6
27	Poland	4.6
27	Slovak Republic	4.6
27	South Africa	4.6
27	Thailand	4.6
34	Belgium	4.5
34	Chile	4.5
34	Indonesia	4.5
34	Russian Federation	4.5
38	Egypt	4.4
38	Philippines	4.4
38	Ukraine	4.4
41	China	4.3
41	Hungary	4.3
41	Panama	4.3
41	Uruguay	4.3
45	Lithuania	4.2
45	Portugal	4.2
47	Jordan	4.1
47	Mexico	4.1
49	Bulgaria	4.0
49	Malaysia	4.0
51	Colombia	3.9
51	Latvia	3.9
51	Slovenia	3.9
51	Turkey	3.9
55	Venezuela	3.8
56	Dominican Republic	3.7
56	Sri Lanka	3.7
58	Costa Rica	3.6
58	Guatemala	3.6
58	Honduras	3.6
61	Jamaica	3.5
61	Nigeria	3.5
61	Trinidad and Tobago	3.5
64	Ecuador	3.4
64	Greece	3.4
64	Paraguay	3.4
67	Bangladesh	3.3
67	Peru	3.3
69	Romania	3.0
70	El Salvador	2.9
71	Bolivia	2.8
71	Nicaragua	2.8
73	Vietnam	2.7
74	Zimbabwe	2.3
75	Mauritius	2.1



9.8 Use of Internet-based payment systems

Online Internet payment systems in your country are (1=not available, 7=used by most people)

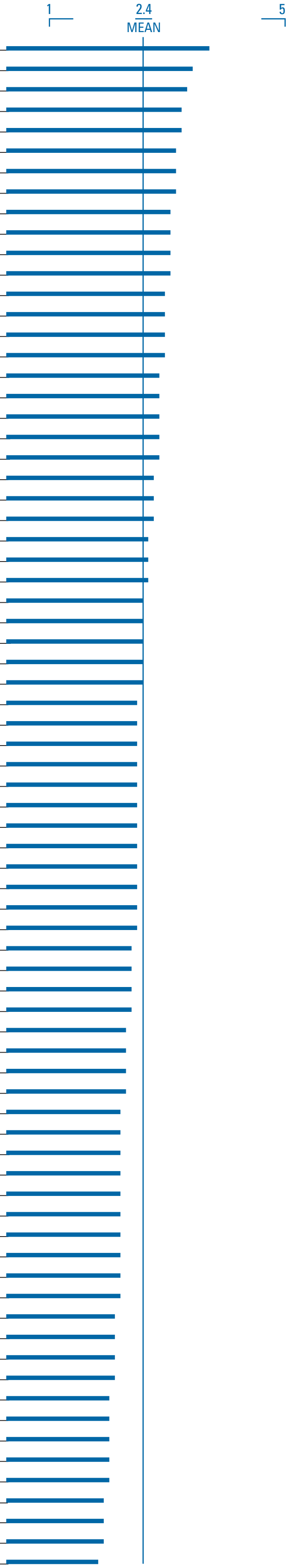
RANK	COUNTRY	VALUE
1	Finland	6.2
2	Estonia	5.6
3	Sweden	5.5
4	Iceland	5.2
5	Canada	5.1
6	Norway	5.0
7	Netherlands	4.9
7	United States	4.9
9	Australia	4.8
9	Korea	4.8
9	New Zealand	4.8
12	Denmark	4.7
12	Singapore	4.7
12	Turkey	4.7
15	United Kingdom	4.6
16	Germany	4.5
16	Hong Kong SAR	4.5
16	Switzerland	4.5
19	Belgium	4.4
19	Brazil	4.4
21	Austria	4.3
21	Ireland	4.3
23	Slovenia	4.2
24	France	4.1
24	Latvia	4.1
24	South Africa	4.1
27	Trinidad and Tobago	4.0
28	Israel	3.9
28	Italy	3.9
30	Japan	3.8
30	Peru	3.8
30	Philippines	3.8
30	Portugal	3.8
30	Sri Lanka	3.8
35	Chile	3.7
35	Czech Republic	3.7
35	Spain	3.7
35	Taiwan	3.7
39	Panama	3.6
39	Slovak Republic	3.6
39	Venezuela	3.6
42	Colombia	3.4
42	Malaysia	3.4
42	Mexico	3.4
45	Argentina	3.3
45	El Salvador	3.3
45	Poland	3.3
48	China	3.2
48	Costa Rica	3.2
48	Hungary	3.2
48	Thailand	3.2
48	Uruguay	3.2
53	Dominican Republic	3.1
53	India	3.1
53	Lithuania	3.1
53	Nicaragua	3.1
57	Ukraine	3.0
58	Greece	2.9
58	Mauritius	2.9
60	Guatemala	2.8
60	Indonesia	2.8
60	Jamaica	2.8
60	Paraguay	2.8
60	Zimbabwe	2.8
65	Jordan	2.7
66	Russian Federation	2.6
67	Egypt	2.5
68	Bulgaria	2.4
68	Nigeria	2.4
70	Ecuador	2.2
71	Bolivia	2.1
71	Honduras	2.1
73	Bangladesh	1.8
74	Vietnam	1.7
75	Romania	1.2



9.9 Sophistication of online marketing

In your company, online marketing is (1=behind other local companies, 5=equal to the best in the world)

RANK	COUNTRY	VALUE
1	Germany	3.6
2	Finland	3.3
3	United States	3.2
4	Denmark	3.1
4	Switzerland	3.1
6	France	3.0
6	Poland	3.0
6	Taiwan	3.0
9	Argentina	2.9
9	Brazil	2.9
9	Netherlands	2.9
9	Singapore	2.9
13	Austria	2.8
13	Hong Kong SAR	2.8
13	Sweden	2.8
13	United Kingdom	2.8
17	Belgium	2.7
17	Canada	2.7
17	Italy	2.7
17	Japan	2.7
17	Portugal	2.7
22	Australia	2.6
22	Iceland	2.6
22	Spain	2.6
25	Indonesia	2.5
25	Korea	2.5
25	Norway	2.5
28	Czech Republic	2.4
28	Egypt	2.4
28	Israel	2.4
28	Slovenia	2.4
28	South Africa	2.4
33	Chile	2.3
33	China	2.3
33	Estonia	2.3
33	Greece	2.3
33	India	2.3
33	Ireland	2.3
33	Jordan	2.3
33	Latvia	2.3
33	Mexico	2.3
33	New Zealand	2.3
33	Nigeria	2.3
33	Thailand	2.3
45	Bangladesh	2.2
45	Malaysia	2.2
45	Paraguay	2.2
45	Turkey	2.2
49	El Salvador	2.1
49	Hungary	2.1
49	Russian Federation	2.1
49	Uruguay	2.1
53	Costa Rica	2.0
53	Dominican Republic	2.0
53	Mauritius	2.0
53	Nicaragua	2.0
53	Panama	2.0
53	Philippines	2.0
53	Romania	2.0
53	Slovak Republic	2.0
53	Trinidad and Tobago	2.0
53	Venezuela	2.0
63	Guatemala	1.9
63	Honduras	1.9
63	Sri Lanka	1.9
63	Ukraine	1.9
67	Bolivia	1.8
67	Colombia	1.8
67	Ecuador	1.8
67	Lithuania	1.8
67	Peru	1.8
72	Bulgaria	1.7
72	Vietnam	1.7
72	Zimbabwe	1.7
75	Jamaica	1.6



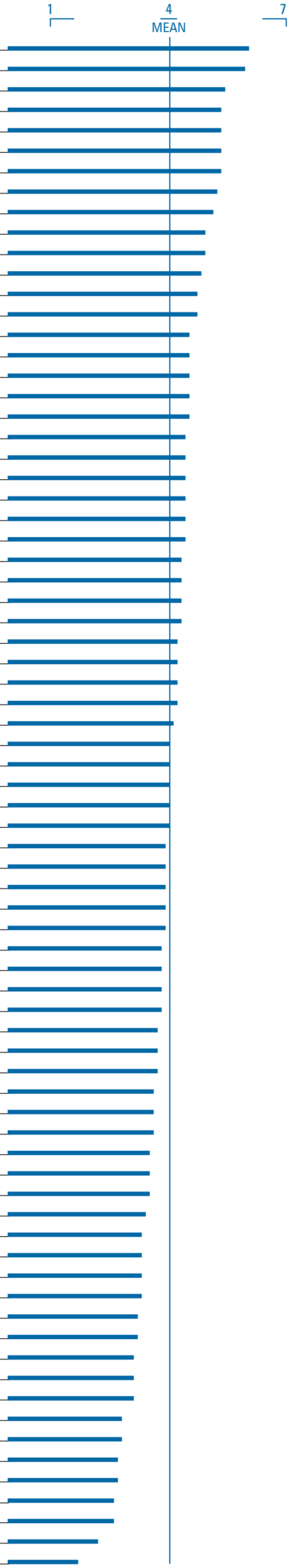
Section X

e-Government

10.1 Government effectiveness promoting the use of ICT

Government programs promoting the use of ICT are (1=not very successful, 7=highly successful)

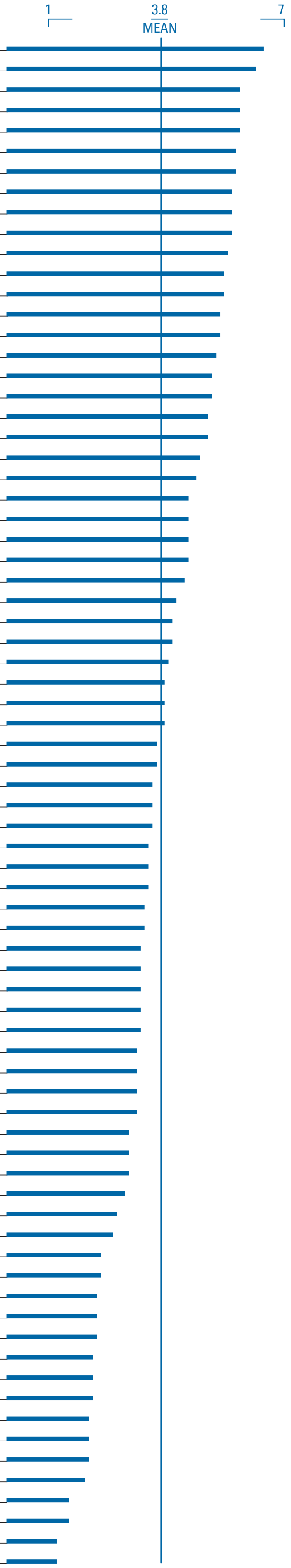
RANK	COUNTRY	VALUE
1	Singapore	6.0
2	Finland	5.9
3	Estonia	5.4
4	Egypt	5.3
4	Iceland	5.3
4	Ireland	5.3
4	Taiwan	5.3
8	Sweden	5.2
9	Jordan	5.1
10	Hong Kong SAR	4.9
10	India	4.9
12	Korea	4.8
13	Austria	4.7
13	Canada	4.7
15	Brazil	4.5
15	China	4.5
15	Denmark	4.5
15	Germany	4.5
15	United States	4.5
20	Jamaica	4.4
20	Mauritius	4.4
20	Netherlands	4.4
20	Spain	4.4
20	Switzerland	4.4
20	United Kingdom	4.4
26	Belgium	4.3
26	Hungary	4.3
26	Israel	4.3
26	Portugal	4.3
30	France	4.2
30	Malaysia	4.2
30	Norway	4.2
30	Slovak Republic	4.2
34	Chile	4.1
35	El Salvador	4.0
35	Latvia	4.0
35	New Zealand	4.0
35	South Africa	4.0
35	Uruguay	4.0
40	Australia	3.9
40	Costa Rica	3.9
40	Japan	3.9
40	Slovenia	3.9
40	Thailand	3.9
45	Italy	3.8
45	Mexico	3.8
45	Trinidad and Tobago	3.8
45	Vietnam	3.8
49	Czech Republic	3.7
49	Philippines	3.7
49	Venezuela	3.7
52	Argentina	3.6
52	Dominican Republic	3.6
52	Sri Lanka	3.6
55	Colombia	3.5
55	Nigeria	3.5
55	Panama	3.5
58	Bulgaria	3.4
59	Greece	3.3
59	Lithuania	3.3
59	Poland	3.3
59	Turkey	3.3
63	Indonesia	3.2
63	Peru	3.2
65	Nicaragua	3.1
65	Russian Federation	3.1
65	Ukraine	3.1
68	Bangladesh	2.8
68	Paraguay	2.8
70	Bolivia	2.7
70	Ecuador	2.7
72	Guatemala	2.6
72	Honduras	2.6
74	Zimbabwe	2.2
75	Romania	1.7



10.2 Availability of online government services

Are government services (downloadable permit applications, tax payments, government tenders, etc.) available on the Internet in your country? (1=not available, 7=commonly available)

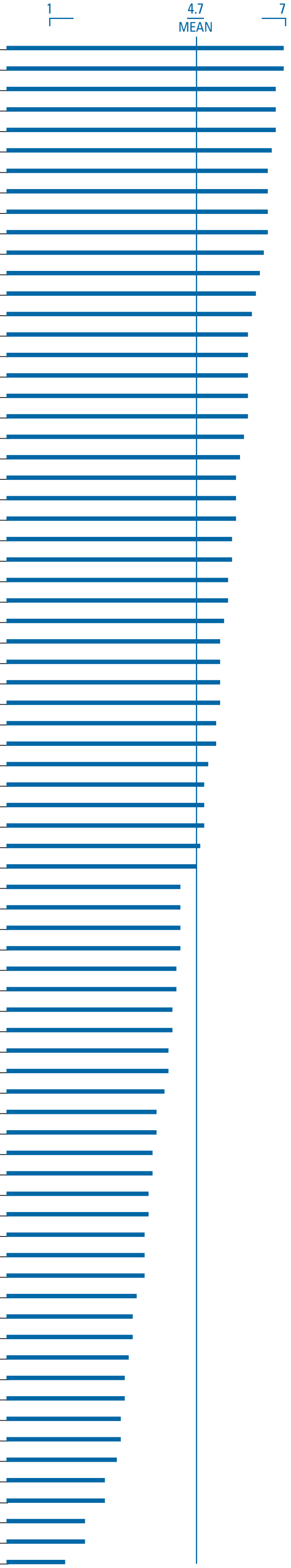
RANK	COUNTRY	VALUE
1	Singapore	6.4
2	Iceland	6.2
3	Estonia	5.8
3	Finland	5.8
3	Norway	5.8
6	Hong Kong SAR	5.7
6	Sweden	5.7
8	Brazil	5.6
8	Canada	5.6
8	Denmark	5.6
11	United Kingdom	5.5
12	Taiwan	5.4
12	United States	5.4
14	Australia	5.3
14	Chile	5.3
16	Netherlands	5.2
17	Austria	5.1
17	Ireland	5.1
19	New Zealand	5.0
19	Spain	5.0
21	Portugal	4.8
22	France	4.7
23	Czech Republic	4.5
23	Italy	4.5
23	Korea	4.5
23	Lithuania	4.5
27	Hungary	4.4
28	Switzerland	4.2
29	Argentina	4.1
29	Poland	4.1
31	Germany	4.0
32	India	3.9
32	Israel	3.9
32	Mexico	3.9
35	Belgium	3.7
35	Slovenia	3.7
37	Colombia	3.6
37	Peru	3.6
37	South Africa	3.6
40	China	3.5
40	Panama	3.5
40	Ukraine	3.5
43	Slovak Republic	3.4
43	Uruguay	3.4
45	Dominican Republic	3.3
45	El Salvador	3.3
45	Jamaica	3.3
45	Latvia	3.3
45	Malaysia	3.3
50	Costa Rica	3.2
50	Japan	3.2
50	Thailand	3.2
50	Turkey	3.2
54	Bulgaria	3.0
54	Greece	3.0
54	Guatemala	3.0
57	Ecuador	2.9
58	Jordan	2.7
59	Russian Federation	2.6
60	Nicaragua	2.3
60	Philippines	2.3
62	Egypt	2.2
62	Nigeria	2.2
62	Vietnam	2.2
65	Bolivia	2.1
65	Mauritius	2.1
65	Paraguay	2.1
68	Honduras	2.0
68	Indonesia	2.0
68	Venezuela	2.0
71	Sri Lanka	1.9
72	Bangladesh	1.5
72	Trinidad and Tobago	1.5
74	Romania	1.2
74	Zimbabwe	1.2



10.3 Government websites

In your country, how common are Web pages by government offices/public agencies? (1=rare, 7=as common as in the world's leading countries)

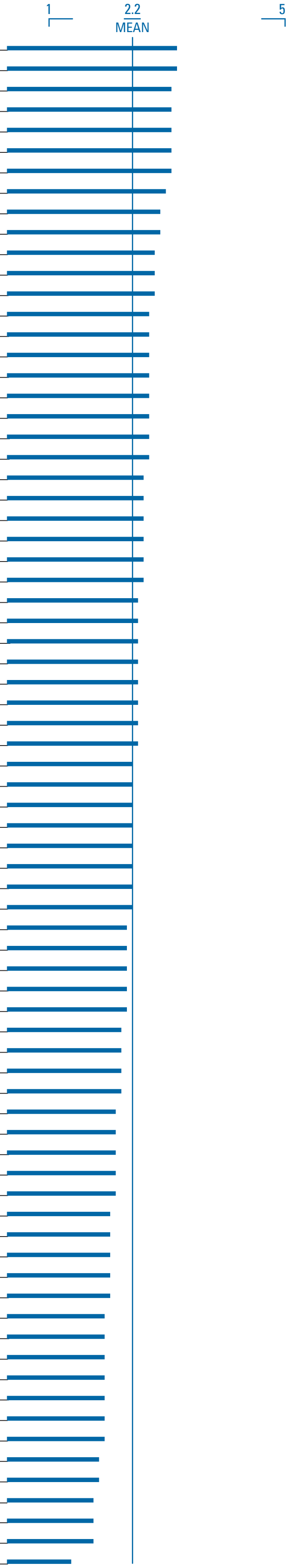
RANK	COUNTRY	VALUE
1	Finland	6.9
1	Iceland	6.9
3	Canada	6.7
3	Sweden	6.7
3	United States	6.7
6	Singapore	6.6
7	Australia	6.5
7	Denmark	6.5
7	Hong Kong SAR	6.5
7	United Kingdom	6.5
11	Netherlands	6.4
12	Norway	6.3
13	Austria	6.2
14	Estonia	6.1
15	France	6.0
15	Japan	6.0
15	New Zealand	6.0
15	Switzerland	6.0
15	Taiwan	6.0
20	Israel	5.9
21	Korea	5.8
22	Brazil	5.7
22	Germany	5.7
22	Ireland	5.7
25	Hungary	5.6
25	Italy	5.6
27	Belgium	5.5
27	Spain	5.5
29	Slovak Republic	5.4
30	Czech Republic	5.3
30	Latvia	5.3
30	Mexico	5.3
30	Poland	5.3
34	Portugal	5.2
34	Slovenia	5.2
36	South Africa	5.0
37	Chile	4.9
37	Lithuania	4.9
37	Thailand	4.9
40	Argentina	4.8
41	Uruguay	4.7
42	Bulgaria	4.3
42	Jordan	4.3
42	Peru	4.3
42	Turkey	4.3
46	Colombia	4.2
46	India	4.2
48	Costa Rica	4.1
48	Malaysia	4.1
50	Greece	4.0
50	Jamaica	4.0
52	Philippines	3.9
53	Panama	3.7
53	Venezuela	3.7
55	China	3.6
55	Russian Federation	3.6
57	Dominican Republic	3.5
57	El Salvador	3.5
59	Indonesia	3.4
59	Nicaragua	3.4
59	Ukraine	3.4
62	Guatemala	3.2
63	Ecuador	3.1
63	Sri Lanka	3.1
65	Nigeria	3.0
66	Bolivia	2.9
66	Vietnam	2.9
68	Egypt	2.8
68	Trinidad and Tobago	2.8
70	Honduras	2.7
71	Mauritius	2.4
71	Paraguay	2.4
73	Bangladesh	1.9
73	Zimbabwe	1.9
75	Romania	1.4



10.4 Business Internet-based interactions with government

In your company, Internet-based transactions with government are (1=behind other local companies, 5=equal to the best in the world)

RANK	COUNTRY	VALUE
1	Finland	3.0
1	Iceland	3.0
3	Denmark	2.9
3	Germany	2.9
3	Taiwan	2.9
3	United Kingdom	2.9
3	United States	2.9
8	Sweden	2.8
9	Canada	2.7
9	Singapore	2.7
11	Australia	2.6
11	Netherlands	2.6
11	Turkey	2.6
14	Argentina	2.5
14	Austria	2.5
14	Brazil	2.5
14	Estonia	2.5
14	France	2.5
14	Hong Kong SAR	2.5
14	Norway	2.5
14	Switzerland	2.5
22	Belgium	2.4
22	Chile	2.4
22	Egypt	2.4
22	Italy	2.4
22	Korea	2.4
22	Mexico	2.4
28	Japan	2.3
28	Latvia	2.3
28	New Zealand	2.3
28	Poland	2.3
28	South Africa	2.3
28	Spain	2.3
28	Thailand	2.3
28	Venezuela	2.3
36	Bangladesh	2.2
36	Czech Republic	2.2
36	Hungary	2.2
36	India	2.2
36	Indonesia	2.2
36	Ireland	2.2
36	Israel	2.2
36	Paraguay	2.2
44	China	2.1
44	Greece	2.1
44	Mauritius	2.1
44	Philippines	2.1
44	Slovenia	2.1
49	Malaysia	2.0
49	Nigeria	2.0
49	Portugal	2.0
49	Slovak Republic	2.0
53	Costa Rica	1.9
53	El Salvador	1.9
53	Lithuania	1.9
53	Panama	1.9
53	Uruguay	1.9
58	Jordan	1.8
58	Peru	1.8
58	Russian Federation	1.8
58	Sri Lanka	1.8
58	Trinidad and Tobago	1.8
63	Colombia	1.7
63	Dominican Republic	1.7
63	Ecuador	1.7
63	Jamaica	1.7
63	Nicaragua	1.7
63	Ukraine	1.7
63	Zimbabwe	1.7
70	Bolivia	1.6
70	Guatemala	1.6
72	Bulgaria	1.5
72	Honduras	1.5
72	Vietnam	1.5
75	Romania	1.1



General Infrastructure

Section XI

11.1 Electricity consumption, 1998

Electric power consumption (kwh per capita), 1998

RANK	COUNTRY	VALUE
1	Norway	24,607
2	Iceland	20,150
3	Canada	15,071
4	Finland	14,129
5	Sweden	13,955
6	United States	11,832
7	Australia	8,717
8	New Zealand	8,215
9	Japan	7,322
10	Belgium	7,249
11	Switzerland	6,980
12	Singapore	6,771
13	France	6,287
14	Austria	6,175
15	Denmark	6,033
16	Netherlands	5,908
17	Taiwan	5,807
18	Germany	5,681
19	Israel	5,475
20	United Kingdom	5,327
21	Hong Kong SAR	5,244
22	Slovenia	5,096
23	Ireland	4,760
24	Czech Republic	4,747
25	Korea	4,497
26	Italy	4,431
27	Mauritius	4,327
28	Spain	4,195
29	Russian Federation	3,937
30	Slovak Republic	3,899
31	South Africa	3,832
32	Greece	3,739
33	Estonia	3,531
34	Trinidad and Tobago	3,478
35	Portugal	3,395
36	Bulgaria	3,166
37	Hungary	2,888
38	Venezuela	2,566
39	Malaysia	2,554
40	Poland	2,458
41	Ukraine	2,350
42	Jamaica	2,252
43	Chile	2,082
44	Lithuania	1,909
45	Argentina	1,891
46	Latvia	1,879
47	Brazil	1,793
48	Uruguay	1,788
49	Romania	1,626
50	Mexico	1,513
51	Costa Rica	1,450
52	Turkey	1,353
53	Thailand	1,345
54	Panama	1,211
55	Jordan	1,205
56	Zimbabwe	896
57	Colombia	866
58	Egypt	861
59	Paraguay	756
60	China	746
61	Peru	642
62	Dominican Republic	627
63	Ecuador	625
64	El Salvador	559
65	Philippines	451
66	Honduras	446
67	Bolivia	409
68	India	384
69	Guatemala	322
70	Indonesia	320
71	Nicaragua	281
72	Sri Lanka	244
73	Vietnam	232
74	Nigeria	85
75	Bangladesh	81

Source: World Bank, *World Development Indicators 2001*

11.2 Efficiency of electrical system, 1998

Electric power transmission and distribution losses (% of output), 1998

RANK	COUNTRY	VALUE
1	Paraguay	2.73
2	Japan	3.22
3	Singapore	4.16
4	Finland	4.23
5	Netherlands	4.30
6	Germany	4.37
7	Belgium	4.74
8	Costa Rica	5.28
9	Slovenia	5.52
10	Israel	5.67
11	Denmark	5.67
12	Austria	5.98
13	Switzerland	6.08
14	France	6.14
15	Australia	6.48
16	Sweden	6.61
17	United States	6.75
18	Greece	6.87
19	Canada	6.96
20	Iceland	6.97
21	Malaysia	7.00
22	Korea	7.04
23	China	7.10
24	Italy	7.30
25	Norway	7.60
26	United Kingdom	7.61
27	Czech Republic	7.66
28	Trinidad and Tobago	8.09
29	Slovak Republic	8.09
30	South Africa	8.15
31	Chile	8.18
32	Portugal	8.33
33	Thailand	8.70
34	Lithuania	9.06
35	Ireland	9.20
36	Spain	9.59
37	Jamaica	9.91
38	Jordan	10.30
39	Poland	10.89
40	Russian Federation	11.28
41	Bolivia	11.78
42	Indonesia	11.83
43	Hong Kong SAR	11.83
44	Romania	12.06
45	Egypt	12.17
46	Peru	12.85
47	El Salvador	13.19
48	Hungary	13.22
49	New Zealand	13.41
50	Bulgaria	13.49
51	Mexico	14.54
52	Argentina	15.13
53	Uruguay	15.30
54	Vietnam	15.60
55	Bangladesh	15.67
56	Philippines	16.35
57	Brazil	16.79
58	Zimbabwe	17.01
59	Ukraine	17.37
60	India	17.86
61	Estonia	18.40
62	Sri Lanka	18.60
63	Turkey	18.73
64	Latvia	20.20
65	Guatemala	20.53
66	Honduras	20.54
67	Ecuador	21.39
68	Colombia	21.39
69	Panama	22.77
70	Venezuela	23.22
71	Dominican Republic	27.73
72	Nicaragua	28.99
73	Nigeria	31.81
	Mauritius	n.a.
	Taiwan	n.a.

Source: World Bank, *World Development Indicators 2001*

11.3 Quality of highways, 1999

Percentage of highways paved 2000

RANK	COUNTRY	VALUE
1	Austria	100.0
1	Czech Republic	100.0
1	Denmark	100.0
1	France	100.0
1	Hong Kong SAR	100.0
1	Israel	100.0
1	Italy	100.0
1	Jordan	100.0
1	Switzerland	100.0
1	United Kingdom	100.0
11	Germany	99.2
12	Slovak Republic	99.0
13	Spain	99.0
14	Thailand	97.5
15	Singapore	97.3
16	Ukraine	96.5
17	Mauritius	96.0
18	Sri Lanka	95.0
19	Ireland	94.1
20	Bulgaria	92.0
21	Greece	91.8
22	Lithuania	91.0
23	Slovenia	90.6
24	Uruguay	90.0
25	Netherlands	90.0
26	Taiwan	89.6
27	Portugal	86.0
28	Belgium	80.7
29	Egypt	78.1
30	Sweden	77.5
31	Malaysia	75.1
32	Japan	74.9
33	Korea	74.5
34	Norway	74.5
35	Jamaica	70.1
36	Romania	67.6
37	Poland	65.6
38	Finland	64.0
39	United States	58.8
40	New Zealand	58.1
41	Trinidad and Tobago	51.1
42	Paraguay	50.8
43	Dominican Republic	49.4
44	Zimbabwe	47.4
45	Indonesia	46.3
46	India	45.7
47	Hungary	43.4
48	Australia	38.7
49	Latvia	38.6
50	Russian Federation	35.4
51	Canada	35.3
52	Panama	33.6
53	Venezuela	33.6
54	Nigeria	30.9
55	Mexico	29.7
56	Argentina	29.5
57	Guatemala	27.6
58	Iceland	27.1
59	Vietnam	25.1
60	Turkey	25.0
61	China	22.4
62	Estonia	22.1
63	Costa Rica	21.0
64	Honduras	20.3
65	El Salvador	19.8
66	Philippines	19.8
67	Ecuador	18.9
68	Chile	13.8
69	Colombia	12.0
70	Peru	11.9
71	South Africa	11.8
72	Nicaragua	11.1
73	Bangladesh	9.5
74	Brazil	9.3
75	Bolivia	5.5

Source: World Bank, *World Development Indicators 2001*

11.4 Television penetration, 2000

Television sets per 1000 inhabitants, 2000

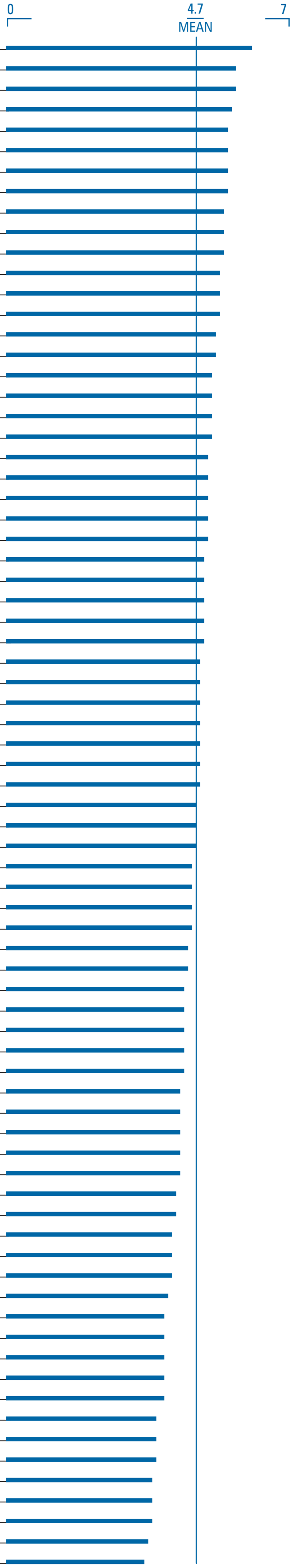
RANK	COUNTRY	VALUE
1	United States	844
2	Latvia	741
3	Japan	719
4	Canada	715
5	Australia	706
6	United Kingdom	652
7	Norway	648
8	Finland	643
9	France	623
10	Denmark	621
11	Netherlands	600
12	Germany	580
13	Portugal	560
14	Estonia	555
15	Spain	547
16	Sweden	531
17	Uruguay	531
18	Belgium	523
19	Iceland	520
20	Switzerland	518
21	New Zealand	518
22	Austria	516
23	Italy	488
24	Czech Republic	487
25	Greece	480
26	Hungary	448
27	Hong Kong SAR	434
28	Russian Federation	421
29	Lithuania	420
30	Slovak Republic	417
31	Taiwan	416
32	Ukraine	413
33	Bulgaria	408
34	Ireland	406
35	Poland	387
36	Korea	361
37	Slovenia	356
38	Trinidad and Tobago	337
39	Brazil	333
40	Turkey	332
41	Israel	328
42	Romania	312
43	Singapore	308
44	Argentina	293
45	China	292
46	Thailand	289
47	Mexico	267
48	Chile	240
49	Mauritius	230
50	Costa Rica	229
51	Paraguay	205
52	Ecuador	205
53	Colombia	199
54	Panama	192
55	El Salvador	191
56	Jamaica	189
57	Venezuela	185
58	Vietnam	184
59	Egypt	183
60	Zimbabwe	180
61	Malaysia	174
62	Peru	147
63	Indonesia	143
64	South Africa	129
65	Bolivia	118
66	Philippines	110
67	Sri Lanka	102
68	Dominican Republic	96
69	Honduras	95
70	Jordan	83
71	India	75
72	Nicaragua	69
73	Nigeria	68
74	Guatemala	61
75	Bangladesh	7

Source: International Telecommunications Union Database, August 2001

11.5 Typical driving speed between cities

Taking into account the average quality of roads outside the major cities, what is your typical driving speed on a journey between cities? (1=10 km/hr, 7=150 km/hr)

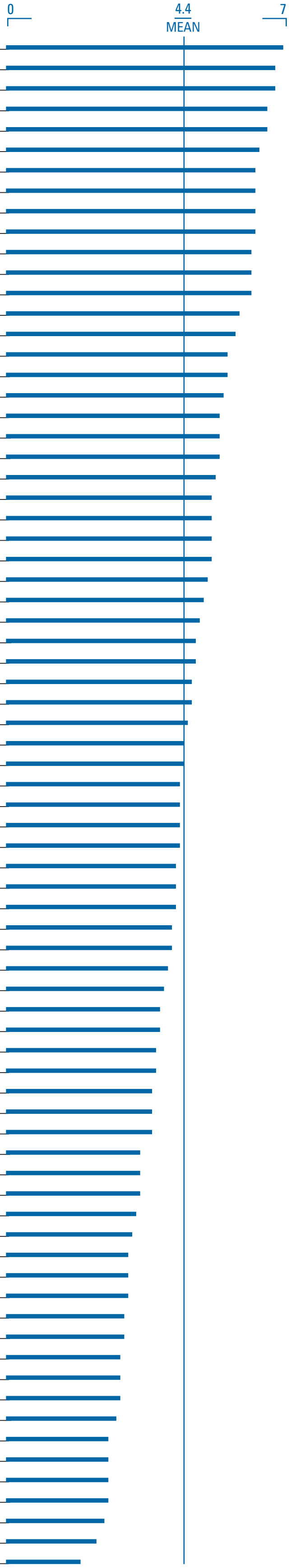
RANK	COUNTRY	VALUE
1	Germany	6.1
2	France	5.7
2	South Africa	5.7
4	Austria	5.6
5	Canada	5.5
5	Netherlands	5.5
5	Spain	5.5
5	United States	5.5
9	Belgium	5.4
9	Switzerland	5.4
9	Zimbabwe	5.4
12	Australia	5.3
12	Denmark	5.3
12	Thailand	5.3
15	Czech Republic	5.2
15	Malaysia	5.2
17	New Zealand	5.1
17	Portugal	5.1
17	Sweden	5.1
17	United Kingdom	5.1
21	Argentina	5.0
21	Estonia	5.0
21	Iceland	5.0
21	Mexico	5.0
21	Uruguay	5.0
26	Egypt	4.9
26	Italy	4.9
26	Jordan	4.9
26	Lithuania	4.9
26	Turkey	4.9
31	Finland	4.8
31	Greece	4.8
31	Honduras	4.8
31	Israel	4.8
31	Slovak Republic	4.8
31	Trinidad and Tobago	4.8
31	Venezuela	4.8
38	Hungary	4.7
38	Singapore	4.7
38	Slovenia	4.7
41	Chile	4.6
41	Dominican Republic	4.6
41	Russian Federation	4.6
41	Ukraine	4.6
45	Panama	4.5
45	Poland	4.5
47	Brazil	4.4
47	China	4.4
47	Korea	4.4
47	Latvia	4.4
47	Nigeria	4.4
52	Hong Kong SAR	4.3
52	Japan	4.3
52	Nicaragua	4.3
52	Norway	4.3
52	Peru	4.3
57	Bulgaria	4.2
57	Ecuador	4.2
59	El Salvador	4.1
59	Ireland	4.1
59	Jamaica	4.1
62	Mauritius	4.0
63	Bolivia	3.9
63	Guatemala	3.9
63	Indonesia	3.9
63	Paraguay	3.9
63	Taiwan	3.9
68	Bangladesh	3.7
68	Colombia	3.7
68	Costa Rica	3.7
71	India	3.6
71	Sri Lanka	3.6
71	Vietnam	3.6
74	Philippines	3.5
75	Romania	3.4



11.6 Quality of port facilities and waterways

Port facilities and waterways in your country are (1= underdeveloped, 7= as developed as the world's best)

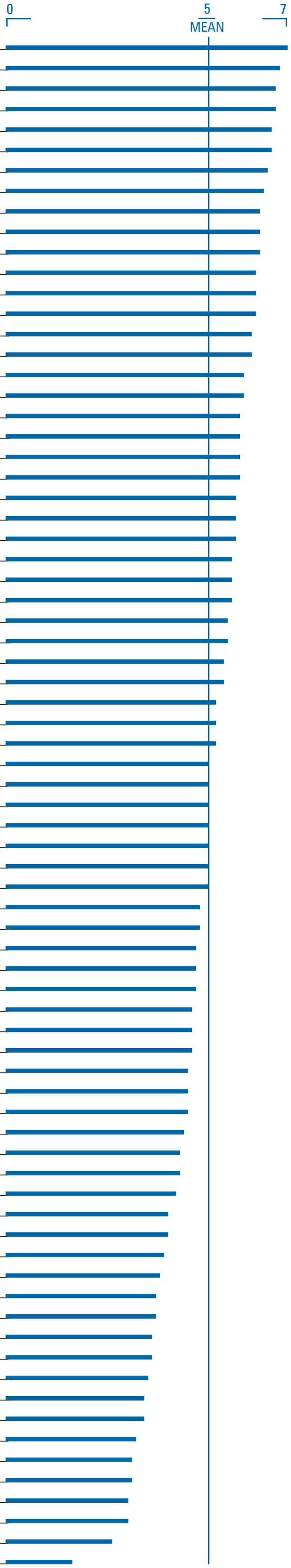
RANK	COUNTRY	VALUE
1	Singapore	6.9
2	Hong Kong SAR	6.7
2	Netherlands	6.7
4	Finland	6.5
4	Germany	6.5
6	France	6.3
7	Belgium	6.2
7	Canada	6.2
7	Denmark	6.2
7	Sweden	6.2
11	Iceland	6.1
11	Japan	6.1
11	United States	6.1
14	Norway	5.8
15	Malaysia	5.7
16	New Zealand	5.5
16	United Kingdom	5.5
18	Australia	5.4
19	Estonia	5.3
19	South Africa	5.3
19	Spain	5.3
22	Switzerland	5.2
23	Israel	5.1
23	Jamaica	5.1
23	Mauritius	5.1
23	Taiwan	5.1
27	Panama	5.0
28	Latvia	4.9
29	Austria	4.8
30	Korea	4.7
30	Trinidad and Tobago	4.7
32	Romania	4.6
32	Slovenia	4.6
34	Italy	4.5
35	Egypt	4.4
35	Thailand	4.4
37	Argentina	4.3
37	Greece	4.3
37	Ukraine	4.3
37	Uruguay	4.3
41	Ireland	4.2
41	Lithuania	4.2
41	Slovak Republic	4.2
44	Chile	4.1
44	Portugal	4.1
46	Russian Federation	4.0
47	Jordan	3.9
48	Sri Lanka	3.8
48	Turkey	3.8
50	Bulgaria	3.7
50	China	3.7
52	Ecuador	3.6
52	Honduras	3.6
52	Poland	3.6
55	Czech Republic	3.3
55	India	3.3
55	Mexico	3.3
58	Brazil	3.2
59	Indonesia	3.1
60	Dominican Republic	3.0
60	El Salvador	3.0
60	Hungary	3.0
63	Nigeria	2.9
63	Venezuela	2.9
65	Costa Rica	2.8
65	Guatemala	2.8
65	Peru	2.8
68	Zimbabwe	2.7
69	Bangladesh	2.5
69	Colombia	2.5
69	Philippines	2.5
69	Vietnam	2.5
73	Paraguay	2.4
74	Nicaragua	2.2
75	Bolivia	1.8



11.7 Quality of air transport

Air transport in your country is (1=infrequent and inefficient, 7=as extensive and efficient as the world's best)

RANK	COUNTRY	VALUE
1	Singapore	7.0
2	Hong Kong SAR	6.8
3	Netherlands	6.7
3	United States	6.7
5	France	6.6
5	Germany	6.6
7	Switzerland	6.5
8	Finland	6.4
9	Australia	6.3
9	Canada	6.3
9	Denmark	6.3
12	New Zealand	6.2
12	Sweden	6.2
12	United Kingdom	6.2
15	Austria	6.1
15	Norway	6.1
17	Iceland	5.9
17	South Africa	5.9
19	Belgium	5.8
19	Chile	5.8
19	Israel	5.8
19	Jamaica	5.8
23	Malaysia	5.7
23	Taiwan	5.7
23	Trinidad and Tobago	5.7
26	Japan	5.6
26	Mauritius	5.6
26	Panama	5.6
29	Spain	5.5
29	Thailand	5.5
31	Brazil	5.4
31	Italy	5.4
33	Dominican Republic	5.2
33	Jordan	5.2
33	Turkey	5.2
36	El Salvador	5.0
36	Estonia	5.0
36	Greece	5.0
36	Ireland	5.0
36	Korea	5.0
36	Portugal	5.0
36	Romania	5.0
43	Latvia	4.8
43	Mexico	4.8
45	Czech Republic	4.7
45	India	4.7
45	Venezuela	4.7
48	Argentina	4.6
48	Colombia	4.6
48	Egypt	4.6
51	Costa Rica	4.5
51	Poland	4.5
51	Slovenia	4.5
54	Ukraine	4.4
55	Hungary	4.3
55	Uruguay	4.3
57	Lithuania	4.2
58	Indonesia	4.0
58	Sri Lanka	4.0
60	Guatemala	3.9
61	Philippines	3.8
62	China	3.7
62	Ecuador	3.7
64	Peru	3.6
64	Russian Federation	3.6
66	Nicaragua	3.5
67	Nigeria	3.4
67	Paraguay	3.4
69	Vietnam	3.2
70	Honduras	3.1
70	Zimbabwe	3.1
72	Bangladesh	3.0
72	Bolivia	3.0
74	Bulgaria	2.6
75	Slovak Republic	1.6



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The Information for Development Program (*info*Dev) is a multidonor grant program at the World Bank that supports innovative projects demonstrating the development opportunities offered by information and communication technologies (ICTs).

*info*Dev's mission is to promote both the application of these technologies and sharing of the best ICT practices for social and economic development, with a special emphasis on the needs of the poor in developing economies.