

*Information Technology
for Sustainable Development*

KNOWLEDGE SOCIETIES

...IN A NUTSHELL

Andreas Credit & Robin Mansell

**KNOWLEDGE
SOCIETIES
... IN A NUTSHELL**

This page intentionally left blank

KNOWLEDGE SOCIETIES ... IN A NUTSHELL

*Information Technology
for Sustainable Development*

Andreas Credé & Robin Mansell

for the United Nations Commission on Science and Technology for Development
and the International Development Research Centre

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

Ottawa Cairo Dakar Johannesburg Montevideo Nairobi New Delhi Singapore

Published by the International Development Research Centre
PO Box 8500, Ottawa, ON, Canada K1G 3H9

© International Development Research Centre 1998

Canadian Cataloging in Publication Data

Credé, Andreas

Knowledge societies . . . in a nutshell : information technology for sustainable development

Issued also in French under title : Les sociétés du savoir . . . en bref

Issued also in Spanish under title : Las sociedades de conocimiento . . . en síntesis

Includes bibliographical references.

ISBN 0-88936-858-9

1. Information technology Developing countries
2. Technological innovations Developing countries
3. Sustainable development Developing countries

I. Mansell, Robin E.

II. International Development Research Centre (Canada)

III. Title

HC79.I55C731998 338 .9 26 097124 C98-980194-2

A microfiche edition is available.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, or otherwise, without the prior permission of the International Development Research Centre.

IDRC Books endeavours to produce environmentally friendly publications. All paper used is recycled as well as recyclable. All inks and coatings are vegetable-based products.

Contents

CONTENTS

FOREWORD	<u>vii</u>
INTRODUCTION	<u>ix</u>
The key opportunities	<u>xi</u>
CHAPTER 1 IDENTIFYING NEW ICT OPPORTUNITIES	<u>1</u>
New types of learning and education	<u>2</u>
A wired civil society	<u>3</u>
New forms of commerce	<u>4</u>
Opportunities for trade	<u>5</u>
Potential uses of ICTs	<u>6</u>
ICTs and employment	<u>7</u>
New technical infrastructures	<u>8</u>
CHAPTER 2 BUILDING THE CAPABILITIES	<u>11</u>
Illiteracy, skills, and knowledge-based development	<u>12</u>
New social capabilities	<u>13</u>
Tacit knowledge and the learning economy	<u>13</u>
Acquiring new skills	<u>15</u>
Lifelong learning	<u>15</u>
Tools for building innovative knowledge societies	<u>16</u>
CHAPTER 3 CONSTRUCTING THE INFRASTRUCTURE	<u>19</u>
The Missing Link revisited	<u>20</u>
Communication-network development	<u>21</u>
Expansion of the Internet	<u>22</u>
Benefits of network expansion	<u>23</u>
ICT production capacity	<u>24</u>
Building new coalitions of resources	<u>24</u>

CHAPTER 4 ADDRESSING KEY GOVERNANCE ISSUES	<u>27</u>
International institutions governing ICTs	<u>28</u>
Opening up but keeping control	<u>29</u>
Governing trade in services and equipment	<u>30</u>
Protecting intellectual property	<u>31</u>
Privacy and information security	<u>32</u>
Governance and the networked economy	<u>33</u>
CHAPTER 5 FORMULATING ICT STRATEGIES	<u>35</u>
Technology choices and capacity-building	<u>36</u>
Strategies for market liberalization	<u>37</u>
Promoting improved access	<u>38</u>
Harnessing ICTs for development	<u>40</u>
Integrating ICT strategies	<u>41</u>
Guidelines for ICT strategies	<u>43</u>
CHAPTER 6 ICTs FOR SUSTAINABLE DEVELOPMENT	<u>45</u>
APPENDIX I. ACRONYMS AND ABBREVIATIONS	<u>47</u>
ABOUT THE AUTHORS	<u>48</u>
ABOUT THE INSTITUTIONS	<u>49</u>
ABOUT THE PUBLISHER	<u>49</u>

Foreword

FOREWORD

In May 1997, the United Nations Commission on Science and Technology for Development (UNCSTD) addressed the issue of information and communication technologies (ICTs). The Working Group on Information Technology and Development, a group of delegates to the Commission, had spent 18 months preparing for the discussion. Its mandate was to explore the ramifications of the so-called ICT revolution for developing countries. It studied how the new technologies might contribute to the creation of wealth and the improvement of social benefits for the world's populations and what the implications of ICTs might be for governance, education, and health. It considered what developing countries must do to gain access to the ICTs they need and how they can build the infrastructure to use them effectively. It also debated the roles of governments and the private sector.

In the process of reaching its conclusions, the Working Group reviewed the relevant activities of the United Nations system, commissioned review papers, and consulted numerous authorities. The results were presented to UNCSTD in a short policy paper. However, the material was so rich and comprehensive that the Commission decided to prepare a sourcebook of knowledge on the topic, based on the material available to the Working Group. Robin Mansell, Professor of Information and Communication Technology Policy, Science Policy Research Unit (SPRU), University of Sussex, Brighton, UK, and Uta Wehn, Research Officer, SPRU, edited the sourcebook, which was published in March 1998 by Oxford University Press.

Given the breadth of that sourcebook, Canada's International Development Research Centre, which has supported the activities of UNCSTD over the past years, decided to commission a short summary for

wider circulation. Professor Mansell and one of her colleagues at SPRU, Andreas Credé, a Visiting Research Fellow, completed this task. We hope that both the book and this summary will contribute to the debate on how developing countries can make optimum use of ICTs.

Geoffrey Oldham

Delegate for the United Kingdom and Co-chair Working Group on Information Technology and Development, UNCSTD

Fernando Chaparro

Delegate for Colombia and Co-chair

Working Group on Information Technology and Development, UNCSTD

March 1998

Introduction

INTRODUCTION

Information and communication technologies (ICTs) will become crucially important for sustainable development in developing countries. Although the costs of using ICTs to build national information infrastructures to contribute to innovative knowledge societies are high, the costs of not doing so are likely to be much higher. These are the main conclusions of a new sourcebook prepared for the United Nations Commission on Science and Technology for Development (UNCSTD).¹

This summary captures some of the main insights contained in the comprehensive sourcebook, which assesses the implications of the emergence of global and national information infrastructures for all facets of economies and societies. The UNCSTD Working Group on Information Technology and Development looked at how digital communication networks, information-technology applications, and new electronic services are transforming the manufacturing, natural-resource, and service industries and the everyday lives of people around the world.

The UNCSTD report puts science and technology (S&T) policies for ICTs and sustainable development at the centre of its analysis. It surveys the development, diffusion, and use of ICTs and concludes that people's skills, capabilities, and opportunities for learning are at least as important as – if not more important than – their capabilities to produce the new technologies. Creative uses of new services and applications depend on capabilities to assemble the necessary components of national information infrastructures, including the hardware, software, and knowledge needed to harness ICTs to development priorities.

¹ Mansell, R.; Wehn, U., ed. 1998. *Knowledge societies: information technology for sustainable development*. Oxford University Press, Oxford, UK. 384 pp., ISBN 0-19-829410-7, £15.99 paperback. The sources for all data used in this summary can be found in this full-length report.

The report is aimed at those in government departments, private firms, nongovernmental organizations (NGOs), and research organizations who play a role in shaping ICT strategies and policies designed to capture the social and economic benefits of technological innovations. It is also aimed at those who develop and use the new applications and services in the civil and business sectors of society. The report covers developments in the content and software industries, the computing and financial-services sectors, and electronic commerce; it also covers issues related to communication policy, regulation, and intellectual-property rights. It examines how ICTs are enabling participation in civil society, contributing to education and training, and giving rise to new concerns about the protection of privacy and commercial security.

The material in the report reflects the experiences of countries in developing regions of the world, where ICTs are only beginning to make a difference to businesses and to people in their everyday lives. The report also reviews the experiences of developing countries that have taken major steps to improve the accessibility of their communication networks and to develop innovative ICT applications.

If ICTs are to be applied successfully for sustainable development, certain pitfalls must be overcome, and new capabilities must be established and sustained. The availability of electricity does much more than simply permit electric lighting and traction in places where generating plants and electricity-distribution systems have been constructed. Similarly, innovations in ICTs and their diffusion lead to much more than faster communication and the simple automation of tasks. Major organizational changes, transformations in the structure of markets, and changes in global trading patterns also occur. The application of ICTs is opening up many new opportunities with the potential to create new sources of wealth and to improve the quality of life.

The potential benefits and opportunities afforded by ICTs do not flow automatically from these technologies and services. The UNCSTD report shows that action must be taken now if the risks associated with ICTs are to be minimized. The sourcebook contains guidelines for establishing effective ICT strategies. It suggests how resources can be focused on the social and economic priorities that countries establish in response to their own particular development needs. This sourcebook provides no simple recipes or blueprints for action but offers insights into the accumulated experiences of countries at various stages in their use of ICTs to benefit their societies.

This summary sets out some of the main messages and insights of the sourcebook. It focuses especially on the dangers to be expected if ICT strategies are not tailored to the specific and changing needs of developing countries.

THE KEY OPPORTUNITIES

ICTs can be truly transformative. The most effective actions of decision-makers in developing ICT strategies are based on the recognition that, like all other technologies, ICTs do not operate in isolation. The benefits and risks depend on the social, economic, and organizational context in which the ICTs are applied. Decision-makers in business, government, and NGOs, as well as people in civil society, have the opportunity to create the appropriate conditions for harnessing ICTs to development needs.

Experience drawn from many countries around the world shows that significant barriers stand in the way of reaping the social and economic benefits of ICTs. Experience shows that the various stakeholders in developing countries can substantially reduce these barriers without jeopardizing other priorities for development.

This summary covers the principle areas in which ICT strategies and policies can be expected to have the greatest impacts and to facilitate the emergence of innovative, knowledge-based development.

This page intentionally left blank



Chapter 1

IDENTIFYING NEW ICT OPPORTUNITIES

Developing countries need to develop their own ICT strategies by drawing creatively on available experience to configure their technical and human resources. Investment in ICTs should be made to achieve the greatest social and economic benefits at the lowest cost. Each developing country needs to prepare itself to make maximum use of the new opportunities.

Many opportunities become available when the main barriers are successfully overcome (Table 1). These opportunities correspond to practical steps that policymakers and business people can take to minimize the risks of exclusion from future knowledge societies.

Table 1 – FACTORS IN THE FAILURE OF ICT ADOPTION

CORE FACTORS	SYMPTOMS	CONSEQUENCES
Institutional weaknesses	Insufficient planning	Inadequately designed systems
	Unclear objectives	Cost overruns
Human resources	Shortage of qualified personnel	Insufficient support
	Lack of professional training	Isolation from sources of technology
Funding arrangements	Underestimated project costs	Unfinished projects
	Lack of recurring expenditure	Higher costs for software development and repairs
Local environment	Lack of vendor representation	Lack of professionals to solve technical problems
	Lack of backup equipment and spares	Implementation problems and delays
Technology and information changes	Limited hardware and software availability	Incompatible hardware or software
	Inappropriate software	Overreliance on customized applications

Developing countries' experiences with, and capabilities to produce and use, ICTs are very different. The evidence suggests that it is unrealistic to focus exclusively either on the use of ICTs or on their domestic production. The greatest need is for strategies to create opportunities for the use of ICTs in sectors of the economy in which they have the greatest potential. In most cases, this means that developing countries must develop capabilities to adapt, maintain, customize, and reconfigure existing ICT solutions to their specific requirements.

Measures of the extent of use of any specific technology are not very effective indicators of the capabilities of people to engage in knowledge-based development. ICTs are capital goods that can improve productivity and be used to raise the quality of other goods and services. New skills, investment in equipment, and organizational change are needed to realize the potential of these technologies. This means it is very important to focus on many different aspects of ICT use. Decisions about how ICTs are incorporated into social and economic activities are crucial to their effectiveness.

NEW TYPES OF LEARNING AND EDUCATION

World population growth poses tremendous problems for the ideal of education for all and, even more so, for the provision of opportunities for lifelong learning. In 2000, the proportion of the population below working age in developing countries will be 56%; in industrialized countries, 31.2%. In 2025, about 100 million children worldwide will be without formal schooling.

The youthfulness of the population in developing countries has significant implications for the demand for teachers, regardless of whether formal or informal education is provided. In many developing countries, major efforts are directed to getting young people into primary and secondary education. Government policies are needed to take advantage of ICTs. The benefits are not straightforward. Strategies are needed to minimize the risks of, for example, becoming overly dependent on imported training materials that cannot be customized for local conditions.

By the mid-1990s, many industrialized countries had distance-teaching institutions. These institutions have been collaborating with educationalists in developing countries to offer new educational products and services. The content and structure of the new programs are often geared to highly individualized forms of learning. In contrast, in Africa and Latin America, community learning and oral traditions are emphasized. Group

learning, face-to-face tutorials, and audio and audiovisual presentations are very important. Distance-education systems must be continually restructured and adapted to meet the changing needs of developing countries. This creates difficulties when resources for teacher training, hardware, and software, and even electricity are scarce.

TELEMATICS FOR AFRICAN DEVELOPMENT

The Telematics for African Development Consortium focuses on distance education for those who were previously excluded from education by the Apartheid regime or financial constraints. Developing specific applications for distance education using the Internet and the wireless wide-area bandwidth, the project relies on many collaborators from a range of private- and public-sector organizations, including a telecommunication operator, a broadcaster, and a distance-education university.

Although the global information infrastructure offers new access to external learning resources, developing countries need to devise effective strategies to incorporate new ICT-based learning tools into existing curricula and to introduce flexible approaches to education and training. Course materials must reflect relevant local cultural and social circumstances while drawing selectively on newly available software-based teaching and learning products.

The evidence from countries around the world shows the crucial importance of allocating resources to maintain the communication networks that support education programs and to properly update course content. Teachers should be involved in the wider social community and use an appropriate mix of newer and older technologies.

A WIRED CIVIL SOCIETY

Governments throughout the world are taking on new duties and responsibilities. They need better access to information and the ability to disseminate it to citizens affected by their decisions and policies.

ICTs open up enormous possibilities for improving dialogue between government authorities and the populations they serve. In industrialized countries, the trend is toward more open and transparent government. New forms of participation in government decisions can offset the costs of making information more available. The availability of the World Wide Web on the Internet is dramatically reducing the cost of

informing the public and soliciting responses to particular initiatives, at least in countries where citizens have access to the network at affordable cost.

ICTs also permit those undertaking community-based initiatives and local groups to coordinate their actions over greater distances, learn about initiatives elsewhere, broaden the involvement of citizens, and respond more quickly to development problems. ICT applications can facilitate democratic processes by helping individuals to locate information, identify like-minded people, deliberate about their choices, and voice their opinions.

The same technologies and services that enable more broadly based participation in civil society also carry the risk of being used to monitor, control, and stifle initiatives. For example, ICTs are being used to automate surveillance and to intrude into people's private lives.

Policymakers need to devise ways to avoid the risks of intrusion while building a foundation for a wired civil society in which debate is encouraged. Governments operate most effectively if they can interact with citizens and respond to development problems. ICTs offer the potential for widespread citizen participation in governance. The issues at stake may affect their businesses, their prospects for education and health, and their opportunities for social and cultural activities.

NEW FORMS OF COMMERCE

The majority of commercial transactions are still being made through direct face-to-face or telephone contact and depend on the proximity and accessibility of key participants. The global economy concentrates commercial activity in a limited number of regions, which presents a major problem for many developing countries.

A growing number of transactions, though, are taking place on advanced communication networks, including the Internet. Electronic commerce is emerging as a way to reduce the costs of business transactions. In theory, electronic commerce will eventually make it possible to conduct even highly complex business transactions without any direct human intervention.

As new forms of electronic commerce are used more widely, they can reduce the importance of firm size, as the competitiveness of firms becomes much less a function of the scale of their capital or tangible assets. Market access and competitiveness in both local and global

markets depend much more on a firm's capacity to manage information supply chains, including links with suppliers, customers, service providers, and government authorities.

Electronic commerce is becoming a prerequisite of conducting business in innovative knowledge societies. If developing countries do not adopt electronic business networks, businesses in these countries will be disadvantaged in trade and in finance.

Electronic commerce requires more than the presence of a telecommunication infrastructure and the relevant software applications. Experience shows that electronic commerce is effective only when parties to business transactions develop trust in each other and in the commercial security of information. Standards for the protection and exchange of information are a concern accompanying the growing use of global networks.

The new electronic business networks can open up new commercial opportunities, but they can also exclude firms from taking advantage of them. Business groups and policymakers in developing countries need to take initiatives to enable firms to benefit from the access to information and markets that electronic commerce provides.

OPPORTUNITIES FOR TRADE

Innovation in the ICT sector is radically affecting global trading patterns. The semiconductor industry in South Korea is just one example of how building a production capability in ICTs can generate significant rewards for developing countries. Emulating this success will be extremely difficult for many other developing countries, but lessons learned from the dynamics of public- and private-sector governance and partnerships in South Korea can be applied elsewhere.

In India and several other developing countries, the software industry is benefiting from new partnerships that are providing new opportunities for trade in software and related software-development activities.

Similarly, ICTs are contributing to dramatic changes in the cost structure and the basis for delivering services in the public and private sectors. ICTs are radically altering the nature of these services. For example, airlines, banks, tour operations, and other similar service providers can establish customer-service centres in different time zones, thereby providing cost-effective 24-hour service. Teleworking may shift certain jobs away from industrialized countries to lower-cost, high-skilled developing countries, but the pattern of activity may also go in the opposite direction.

The key issue for developing countries is to foster new electronic-trading relationships that depend on more than relative labour costs. Developing countries may no longer be able to lower labour costs to ensure their competitive advantage in higher value-added trade in goods and services. Competitiveness in global markets will increasingly depend on the capacity to create new jobs and to compete on the basis of excellence in the application of knowledge. If measures are not put in place to develop the skills base, training, and commercial practices favourable to global trading, the wider diffusion of ICTs could accentuate, rather than reduce, existing disparities in income, wealth, and opportunity. Many of the potential benefits of ICTs would be lost to all sectors of the societies and economies of developing countries.

POTENTIAL USES OF ICTs

New technologies and services are facilitating public- and private-sector activities. ICTs can be used for the reorganization of internal administration and alternative provision of services, thus cutting administration costs. ICT applications support development programs in many urban and rural areas. Databases, drawing facilities, and simulation and modeling tools are integral supports for decisions in planning, management, and development. In the transport sector, advanced telematics improve road safety, maximize road-transport efficiency, and contribute to solving the environmental problems of congestion, pollution, and resource consumption.

ICT applications can improve the quality of life for citizens in developing countries. In health care, ICTs support more efficient exchanges of information between health professionals, saving both time and money. They enable the transfer of patient records between sites and help to improve the responses of medical staff. Tools such as the World Wide Web are used to educate health-care and government workers, overcome the isolation of health workers in rural areas, and provide information to the public. ICTs can help the disabled and elderly achieve independent lifestyles, with greater autonomy and improved social integration. ICTs offer people with disabilities and learning difficulties access to education curricula and informal learning. ICTs can enable visually impaired or blind people to record their work.

ICTs can facilitate access to environmental information for citizens; local, regional, and national authorities; and businesses. Examples

of applications include multimedia public-information kiosks; air- and water-quality monitoring and warning systems; local air-quality prediction systems for improved traffic control; emergency-management systems for flooding, forest fires, and industrial hazards; home-based teleworking; and public-information services for cities and regions. In agriculture, information systems collate information on soils, hydrology, and rainfall and provide socioeconomic information on value ratings, communication, and utilities to support decision-making and planning activities at various administrative levels.

ICT applications provide new tools to improve access to information and for sharing knowledge. The competitiveness of industrial sectors in developing countries depends on the quality of their science and technology (S&T) research and the ability of their firms to transform the results of research into marketable products. Researchers in developing countries require easier access to up-to-date S&T information, as well as opportunities to communicate with other researchers. Network services, including e-mail and multimedia conferencing, are essential lifelines for many researchers in the industrialized countries, and those in developing countries must be included in these networks.

The manufacturing sector is adopting ICTs for planning and control, factory automation, and general business management. Rather than accelerating single steps in the production process, ICTs are enabling manufacturers to speed up whole process chains or target them for elimination. Apart from automating the manufacturing process, ICTs facilitate the systematic capture of information at all stages of design and marketing. The design stages of both machine tools and manufactured parts benefit from computer-aided design and interactive graphics. The range of skills required for these advanced manufacturing technologies includes electronic, mechanical, and software engineering; mathematics and physics; robotics; hydraulics and pneumatics; programing; and process control. Also required is knowledge of organizational processes.

ICTS AND EMPLOYMENT

The impact of ICTs on employment and on the distribution of different kinds of low- and high-skilled jobs in the knowledge societies of the future is the subject of widespread and inconclusive debate and research. The growing use of ICTs in developing countries will bring the need for structural adjustment as the patterns of employment change. Employment will

be affected by growth in productivity and output, particularly in the new information-service sectors. Direct and indirect employment effects are likely to be substantial and undoubtedly will intensify with the structural transformation of newly emerging knowledge societies.

ICTs contribute to economic transparency insofar as they bring to light the cost advantages of alternative locations, international capital mobility, and international outsourcing of particular activities. For example, North American companies' outsourcing of such activities as software, processing of health-insurance claims, and maintenance of customer databases has generated 3000 jobs in the Barbados – the same number of people as employed in growing sugar cane.

Research on the impacts of ICTs on employment falls mainly into two categories. One sort emphasizes the long-term structural adjustment of the labour force to productivity-enhancing technological change. The other focuses on the likelihood of technology-induced unemployment and on the high costs of labour adjustment to technological change.

Essential to ICTs' generation of employment, as well as to the scale and pervasiveness of job losses, are the training, retraining, and lifelong learning opportunities for all workers. Employment policies need to be integrated closely with policies in other areas, and increasing emphasis should be given to the organizational, political, and cultural aspects of the work force and the gender implications of changing employment opportunities.

NEW TECHNICAL INFRASTRUCTURES

Most of the new ICT-based opportunities require an adequate communication infrastructure. Although some require an advanced high-speed network capacity, others only require the simple extension of telephone services or television reception. Still others need computer equipment matched to software applications.

To date, wireless telephony has been based on fixed terrestrial transmitters. This overcomes some of the constraints but remains unattractive in regions with thinly dispersed populations and areas with very low telephone penetration rates. Over the next 10 years, competing satellite-based mobile telephone services will become commercially available (Table 2).

These new networks and services could help to extend the reach of the global information infrastructure and allow many of the poorest

Table 2 – LOW-ORBITING SATELLITES APPROVED AS OF JANUARY 1995.

NAME	HOLDING COMPANY	NUMBER OF SATELLITES	ALTITUDE (km)	START-UP DATE	ESTIMATED COST TO BUILD AND LAUNCH (MILLION USD)
STARSYS	General Electric-CLS (France)	6*	1 000	1998	200
ORBCOMM	Orbital Science Corp.	36	775	1998	100
VITA	Nonprofit	1	1 000	1990	—
	Modification	3	800-1 000	1998	—
TELEDESIC	McCaw-Gates-AT&T	840	695-700	2001	9 000

Note: AT&T, American Telephone & Telegraph Co.; CLS, Collecte, Localisation, Satellites; USD, United States dollars.

*Initial number.

developing countries to join the global information society. Although technological leap-frogging is feasible with instant infrastructure, many issues are unresolved.

At least initially, wireless telephony services may be priced beyond the reach of the most disadvantaged people in developing countries. Without new policy and regulatory measures, moreover, the new services may reduce the revenues of national public telecommunication operators and their ability to invest in the extension of their existing terrestrial networks.

ICTs afford opportunities to increase network connectivity. However, this entails negotiations and the coordination of national-, regional-, and global-market development, as well as informed participation in key institutions, such as the International Telecommunication Union (ITU), the United Nations, and other development agencies.

This page intentionally left blank



Chapter 2

BUILDING THE CAPABILITIES

Innovative knowledge societies depend on education and an S&T base. The particular mix of capabilities needed to take advantage of ICTs will be different in each developing country. This is a major area for policy action and the involvement of all stakeholders in society. The balance of capabilities that will enable production, maintenance, or use of ICT systems and applications is unique to each country. Nevertheless, all countries need to build a broad base of technological and social capabilities.

ICTs offer new opportunities for social and economic transformation. In the industrialized countries, these transformations are evident in the ways new forms of learning give rise to innovative knowledge networks for the creation and exchange of information. Although ICTs offer new techniques for acquiring digital information, this information is of little use in developing countries if it cannot be transformed into knowledge relevant to development.

New modes of producing and exchanging knowledge, with knowledge produced in the context of its application, have profound implications for developing countries. The new modes are creating potential problems for existing educational and scientific-research institutions. Without changes in these institutions' approaches, many developing countries risk finding themselves locked into a mode of knowledge production that is increasingly less relevant to their specific technical, scientific, and economic needs.

Evidence from both industrialized and developing countries suggests that success in building new capabilities depends on continuous investment in the technical and social infrastructure, organizational change,

flexibility conducive to new methods of learning, and strengthened capabilities to generate and use tacit knowledge (or local experience).

ILLITERACY, SKILLS, AND KNOWLEDGE-BASED DEVELOPMENT

Building capabilities for knowledge-based development has an important human dimension. New skills and capabilities are needed to fully integrate ICTs into commercial and social life. One of the principal barriers to accumulating new capabilities is the high level of illiteracy in many developing countries (Table 3).

Table 3 - ILLITERACY IN THE DEVELOPING WORLD, 1995.

	ILLITERACY RATE (% OF TOTAL POPULATION)	NUMBER OF MEN (MILLIONS)	NUMBER OF WOMEN (MILLIONS)
Sub-Saharan Africa	45.3	83.8	139.4
West Asia	26.6	16.5	34.8
China	18.9	60.1	169.1
Latin America	13.3	26.6	33.0
Eastern Europe	5.8	0.2	0.7
Central Asia	2.5	0.4	1.3

Based on data collected by the United Nations Educational, Scientific and Cultural Organization (UNESCO), 1.35 billion men and women, more than one-third of the world's population, lack basic literacy. Women are much more likely to lack the skills to read and write in their own language than men. Across a wide range of different cultures, for every illiterate male there are two illiterate females.

The availability of the scientific and professional skills needed to design ICTs and to adapt them to new uses in support of development varies widely between the industrialized and developing countries. UNESCO data show large variations in the numbers of graduates in engineering, computer science, and mathematics per million people in a population. Russia has the highest, with 2 266. The figure is 748 for Europe, 851 for North America, and 1735 for the newly industrializing economies of Hong Kong, South Korea, and Singapore. At the other end of the scale are Latin America and sub-Saharan Africa, where the numbers are only 227 and 18, respectively.

Sustaining innovative knowledge societies requires both generic and specialized professional and technical skills. The creation of such skills is one of the most important prerequisites for knowledge-based development and effective use of ICTs.

NEW SOCIAL CAPABILITIES

A few Asian countries have exhibited a dynamic rate of economic growth over the past two decades. Like the Latin American countries, considered miracle economies in the 1960s, these Asian countries have performed extremely well, at least until very recently.

What was the basis for this success? Is it likely to be duplicated in other developing countries in the 1990s? The World Bank's assessment of the East Asian miracle identifies a number of factors, including market liberalization, an export orientation, and, in particular, high levels of investment in education. Equally significant has been the practical, intangible knowledge accumulated as a result of promoting ICT industries, which now collectively account for more than 25% of all exports from these East Asian countries.

Social capability refers to the levels of general education and technical competence in a country, as well as to the broader, socially defined institutional structures that guide economic and social activity. The past decade of experience in East Asia highlights the importance of achieving threshold levels of social capability to produce ICTs. Such capabilities are also essential to the effective use of ICTs.

Social capability develops through learning, which takes place at all levels of formal education, as well as taking place informally. It develops within firms, policy-making bodies, S&T research institutes, other public-and private-sector organizations, and NGOs.

Policymakers and the business community can contribute to the learning processes by filling gaps in the institutional framework for learning. They can encourage the use of ICTs in areas where they help to generate information relevant to development.

TACIT KNOWLEDGE AND THE LEARNING ECONOMY

The capacity for learning in a society is linked to making global stocks of electronic information more accessible, but such use of ICTs cannot substitute for various kinds of tacit knowledge. ICTs can complement

and enhance learning in a knowledge-based economy but cannot replace it. In the learning economy, individuals, firms, and countries can be expected to create wealth and obtain access to wealth in proportion to their capacity to learn.

To create wealth and improve the quality of life, developing countries need a broad range of knowledge and learning. Useful knowledge has to be seen to include practical skills gained through learning by doing, as well as through formal education and training that may incorporate ICT applications.

In the learning economy, tacit knowledge is as valuable as the formal

WHAT IS TACIT KNOWLEDGE?

Should firm A take over firm B, or should it leave things as they are? To make such a decision, one needs to process an enormous amount of information and attempt to analyze a multitude of relationships between ill-defined variables. Simple arithmetic will not suffice. The decision is unique, rather than being one in a series of similarly structured problems. Attempts to design formal decision models to cope with this kind of problem will not be meaningful, and the knowledge remains tacit and local. The competence of business leaders can be learned, but the learning will typically take place in a kind of apprenticeship relationship in which the apprentice or the young business administrator learns by operating in close cooperation with more experienced colleagues.

knowledge that can be conveyed in a codified or structured electronic form by ICT networks. The learning processes for acquiring tacit knowledge occur within all economic and social activities, including research and development (R&D), production, product development, marketing, and the application of innovative technologies such as ICTs.

ICTs often can be used most effectively to reinforce human interaction and interactive learning. They help to repersonalize data and electronic information. E-mail systems can connect people with common local knowledge and give them a tool for developing a consensus on ways to address their development needs and objectives.

Developing countries need initiatives to ensure that the ICT-assisted learning processes they introduce are appropriate for their specific social, cultural, and organizational circumstances. Every effort should be made to avoid simple replication of the ICT-based learning processes used in industrialized countries.

ACQUIRING NEW SKILLS

New skills are needed to make creative use of ICTs. English remains the predominant language in ICT applications. It is also the dominant language of the Internet, reflecting the strong North American presence and the Anglo-Saxon bias of this medium. Fluency in English is becoming an important skill in the use of ICTs.

Three other types of skills are particularly relevant to effective use of ICTs. First, participatory skills can help in networked communication and information sharing. Second, facilitating skills are needed to support the design, implementation, and maintenance of new communication networks and ICTs requiring technical skills for installation, user training, and maintenance. Third, control skills are needed to manage increasingly sophisticated communication networks and information services and applications.

The least-developed countries face many pressures when they seek to accumulate these new skills. Even when facilities exist to support the acquisition of formal skills, these countries need informal-learning opportunities to upgrade the skills base. Trainers with the necessary skills are often in short supply because of the high demand. Furthermore, highly qualified technical personnel are attracted by offers of employment in the industrialized countries.

Informal and formal training is essential to the development of the skills base for future innovative knowledge societies. In view of the growth in the world's population, providing the necessary skills training and learning opportunities is a tremendous challenge. The high proportion of young people in developing countries means a rising demand for qualified teachers. Developing countries need to adopt measures to retain students in the educational system or in the types of employment that offer them effective learning, and the new ICTs can support these measures.

LIFELONG LEARNING

The training provided at formal institutions of higher education in developing countries is becoming less relevant to the requirements of emerging knowledge societies. As policymakers and other stakeholders develop new, more flexible approaches to training, it is important to assess the benefits of ICTs and to introduce them in ways that help countries achieve their unique development objectives.

Ardent supporters of the ICT revolution insist that electronic conferences, small discussion groups around computers, and surfing on the Internet will prepare students for the knowledge societies of the future. In their view, scientific and corporate teams in many different parts of the world will be addressing most problems. Students will prepare papers collectively and log on to networks to confer with others in foreign countries. Others caution that the most basic applications of ICTs, including conventional television and radio broadcasts, will continue to play an important role in ICT-assisted learning. They also point to the very real scarcity of funding to support initiatives to incorporate ICTs into mass education. Nevertheless, the range of ICT applications in the education sector is substantial, and many have relevance to the needs of developing countries. Computer-aided instruction is used in a growing number of public- and private-sector training programs to support self-learning, not only in the classroom but also at a distance from the formal classroom.

ICTs can be used to help overcome teacher shortages, and they are used to develop and upgrade teaching skills. The evidence suggests that electronic communication between teachers can enhance the benefits of these applications, enabling teachers to exchange experiences and teaching materials. ICTs and network access can be used to create repositories of study materials to be accessed, transmitted, and reproduced at low costs if the appropriate facilities are in place.

The main danger is that ICTs will be incorporated into inflexible education programs and that available resources will support training for already-advantaged people in developing countries. The challenge for an ICT strategy is to ensure that resources are also available to support lifelong learning opportunities for marginalized people.

TOOLS FOR BUILDING INNOVATIVE KNOWLEDGE SOCIETIES

ICTs offer a variety of tools to strengthen the social and technological capabilities in developing countries and build innovative knowledge societies. Both types of capabilities accumulate through formal and informal learning, and these capabilities can be combined in ways to facilitate knowledge-based development.

These capabilities are essential if digital information is to be transformed into useful knowledge for development. This is the case on the shop floor, in schools, in agriculture, in health, in nonprofit community

organizations, in commercial settings, and in government initiatives to protect the environment. To make this transformation, developing countries will need to invest in generic and specialized education and training, including selected areas of ICT-related R&D. Even if these technologies are available off the shelf, little can be accomplished unless the capabilities are in place to use the tools effectively.

Investment in ICTs may compete with other claims on scarce resources needed to address development priorities. Sometimes there is a reluctance to invest in building capabilities for effective ICT use until other pressing problems have been alleviated. However, although the evidence from experience in developing countries is still limited, it suggests that creating strategies that support the use of ICTs as an enabler of development is a worthwhile endeavour.

The potential benefits of investment in ICTs and related capabilities are unlikely to become available if this investment is not coordinated with strategies for investment in development in high-priority sectors. Policymakers operate in a world in which established practices and urgent development problems constrain their capacity for action. Private-sector investors, quite appropriately, seek a reasonable return on their investment. Coordinated ICT investment strategies can produce economic returns and social benefits.

This page intentionally left blank



Chapter 3

CONSTRUCTING THE INFRASTRUCTURE

Many of the most beneficial applications of ICTs for social and economic development do not require a highly sophisticated telecommunication infrastructure. ICTs can be used with stand-alone computers, televisions, and radios. They can be embedded in devices to automate manufacturing processes and to control and monitor natural-resource extraction and environmental pollution. As knowledge-based development becomes a more important aspect of the global economic and social order, advanced communication networks will become more central to the acquisition and exchange of information. If developing countries have no communication infrastructure or it is unreliable, limited in capacity, or simply too expensive to use, they will be unable to exploit the new opportunities these networks provide.

Constructing an ICT infrastructure tailored to the particular needs of a developing country is a major task. This infrastructure includes the communication network, but it may also include computer hardware and software, as well as information content. The task is especially great for countries with low national incomes that need to invest large sums to extend and upgrade existing networks.

Developing countries can no longer expect to base their development on the comparative advantage of low labour costs. Development will increasingly depend on excellence in the use of knowledge. Without the appropriate communication infrastructure, ICTs might accentuate, rather than ameliorate, existing disparities in income, wealth, and opportunity.

A small group of Asian countries has invested heavily in communication infrastructure in recent years. The experience in these countries

differs from that in most Latin American countries. In 1965, Brazil had more telephone lines per 100 inhabitants than either Taiwan or South Korea. After 20 years, their positions have been dramatically reversed. Both Taiwan and South Korea now have telephone networks that are four to five times more extensive than Brazil's on a per capita basis. Similar comparisons can be made in other ICTs.

A lack of infrastructure is not the principal and only barrier to be overcome. Infrastructure must also be seen in dynamic terms. Its availability ultimately depends on access to investment that, in turn, is a function of the existence of a broader set of capabilities. These include the effective management of business and public-sector partnerships, as well as the involvement of NGOs and user communities.

THE MISSING LINK REVISITED

In 1984, ITU published its Missing Link report, which revealed major differences in the provision of basic telephone services throughout the world. People generally agreed that these disparities were unacceptable. However, after more than a decade, many developing countries still lack the most basic telecommunication infrastructure. Meanwhile, applications of ICTs have blossomed, both in variety and in complexity. Major global and national information infrastructures are being constructed to link some countries and people, but others are excluded. Multilateral institutions such as the World Bank emphasize the important connection between harnessing a growing stock of global electronic knowledge and achieving development goals. This requires ever-more sophisticated communication networks for accessing voice and data services, and, increasingly, the Internet.

Tokyo still has more telephones today than the whole of southern Africa. But some of the economies in transition in Eastern Europe—particularly the Czech Republic, Hungary, and Poland—as well as many countries in Asia, have achieved major advances.

Lack of a widely accessible communication infrastructure is not an insurmountable obstacle. India has one of the lowest levels of telephone provision in the world but has established a significant export-oriented computer software industry, centred in Mumbai and Bangalore. Revenues from software exports are estimated at more than 500 million United States dollars (USD) per year and have captured a growing share of the United States market.

Despite a range of new policy initiatives, wide disparities persist in the provision of infrastructure. Narrowing the gap between well-endowed nations and those with minimal facilities remains a major investment problem.

COMMUNICATION-NETWORK DEVELOPMENT

ITU gathers comprehensive statistics on communication networks in its member countries. These data confirm huge disparities in basic telephone services. Teledensity (defined in terms of the number of main telephone lines per 100 inhabitants) ranges dramatically, from more than 53 in some industrialized countries like Sweden to less than 2 for those with the lowest income and with predominately rural populations, such as Bangladesh and Nigeria (Table 4). For many of the least-developed, low-income countries, catching up to the countries with the highest per capita gross domestic product remains a distant prospect.

Table 4 - GROWTH OF TELEPHONE MAIN LINES BY ITU-COUNTRY INCOME GROUP, 1990-95.

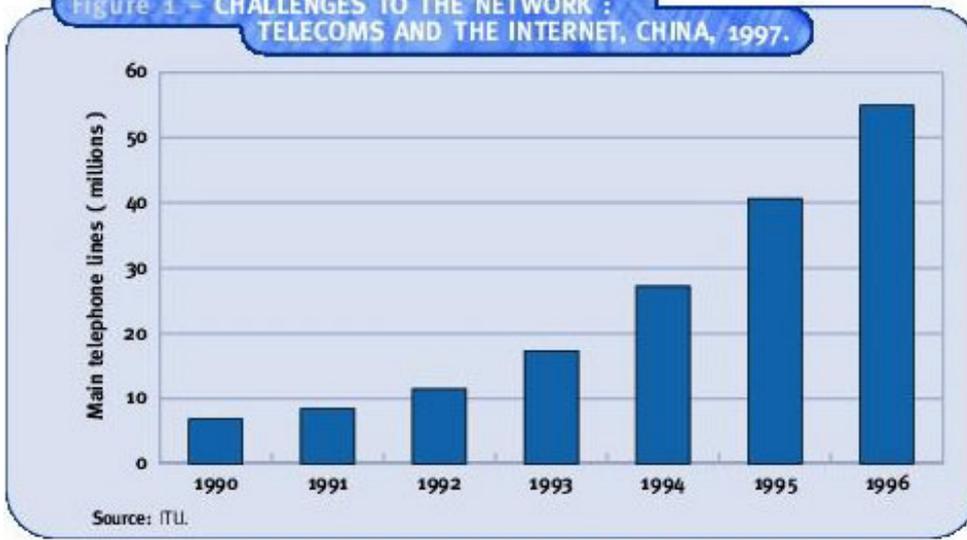
INCOME GROUP	CAGR		SHARE OF GLOBAL TOTAL OF MAIN LINES, 1995 (%)	MAIN LINES PER 100 INHABITANTS, 1995
	MAIN LINES, 1990-95 (%)	MAIN LINES PER 100 INHABITANTS, 1990-95 (%)		
Low income	27.4	24.9	9.3	1.98
Lower middle income	8.2	6.6	14.9	9.09
Upper middle income	8.2	6.4	10.1	14.51
High income	3.5	2.8	65.8	53.16

Note: CAGR, compound annual growth rate; ITU, International Telecommunication Union.

Over the past 5 years, investment in telecommunication infrastructure has increased dramatically in a number of countries. Several have managed to expand their networks by 20% or more each year. However, the experience among countries with similar income levels has been highly varied.

Expansion of the telephone network in China, which has the world's largest population, has been particularly striking (Figure 1). In the period 1990-95, China added nearly 34 million main telephone lines. This is equivalent to a compound annual growth rate (CAGR) of 40% and had the effect of increasing teledensity during this period by nearly

Figure 1 - CHALLENGES TO THE NETWORK :
TELECOMS AND THE INTERNET, CHINA, 1997.



500%, from 0.6 to 3.4. The creation of ITU, more than 130 years ago, marked the beginning of the modern telecommunication age. But 130 years later, a major proportion of the world's population continues to have very limited access to this technology and to its most recent applications, such as the Internet, e-mail, and the World Wide Web.

EXPANSION OF THE INTERNET

The Internet powerfully illustrates the potential of innovations in ICTs and the convergence of telecommunication, computing, and software technologies. On the Internet, one can now find multimedia services combining interactive applications with exciting text and audiovisual presentations.

The growing availability of low-cost personal computers, common communication protocols, and standardized multimedia interfaces has created phenomenal global growth in use of the Internet. Over the past 2 or 3 years, the number of computers with Internet access is estimated to have increased to more than 16 million; the number of users, to more than 50 million. Despite this torrid rate of expansion, the size of the Internet is modest compared with that of the global telecommunication network. Total revenue derived from the provision of Internet-related services was less than 5 billion USD in 1996. This figure is growing rapidly, but in the same year, the value of the market for public telecommunication services was estimated at 670 billion USD.

Access to the Internet tends to mirror the uneven global provision of telecommunication infrastructure and is strongly correlated with levels of per capita national income. However, a number of countries, including Finland and parts of Central and Eastern Europe, have disproportionately high levels of access. Similarly, some of the highest annual growth rates in Internet access have been in Asia. Despite strict government regulation, Asia has a CAGR of Internet users that is among the highest in the world.

The future of information access is shaped by the growing accessibility of predominantly English information; new patterns of communication and information distribution within scientific communities; and the introduction of intranets and extranets, which are available to companies. We jeopardize the prospects for developing countries if access is not provided beyond its current geographic concentration.

BENEFITS OF NETWORK EXPANSION

Communication networks have what economists call network externalities, meaning that the value of a network increases disproportionately as it is extended. The opportunity to make calls in a telephone network is determined by the combination of people who can initiate calls and those who can receive them. If the network is limited, both are disadvantaged. Table 5 shows that a 10% level of coverage limits calling opportunities to only 1% of its potential total. This is because 90% of the population can call neither one another nor the 10% already connected. If the connection rate is increased to 20%, the calling opportunities increase more than fourfold, from 1% to 4% of the population. As population coverage is extended, the benefits of the network (measured in terms of increased calling opportunities) increase twice as fast as the rate of network expansion.

Table 5 - MULTIPLE BENEFITS OF NETWORK EXPANSION.

POPULATION (% COVERAGE)	CALLING OPPORTUNITIES (% OF TOTAL)	CHANGE WITH GROWTH		
		POPULATION COVERAGE (% INCREASE)	CALLING OPPORTUNITIES (% INCREASE)	CALLING- OPPORTUNITY MULTIPLE
10	1	—	—	—
20	4	100	400	4.0
30	9	50	125	2.5
40	16	33	78	2.3
50	25	25	56	2.3

Such network effects are present for many types of ICTs. As use of advanced networked ICTs expands, the benefits of network externalities will become evident in the complex interconnection of data communication networks, computer systems, and information services. Increased investment in public communication infrastructure is needed to achieve the initial, critical level of network coverage required for network externalities to come into effect. This is beneficial because it allows more of the business population and citizens to share information.

ICT PRODUCTION CAPACITY

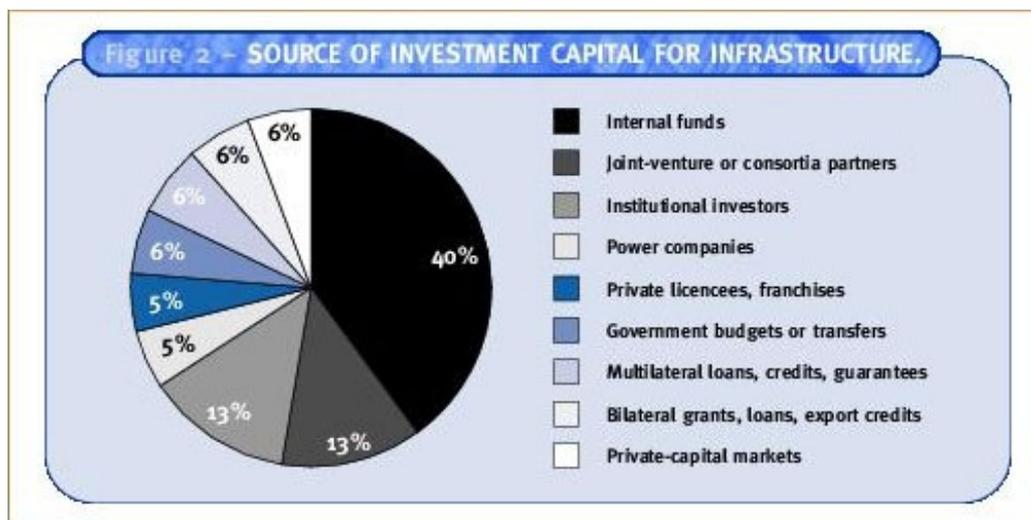
The estimated production of the global electronics industry was more than 1 trillion USD in 1996. This rapidly growing industry comprises several sectors, principally electronic data processing, control and instrumentation, and telecommunication and office equipment. Although production capacity has been expanding in developing countries, facilities in the high-income industrialized countries continue to dominate the electronics industry. In 1996, 53% of production took place in the United States and Japan, and only around 25% of capacity was in either newly industrialized or industrializing countries. The location of production capacity for ICTs affects access to vital telecommunication and other computer-based equipment. In the least-developed countries, such applications have to compete for finite foreign-exchange reserves with other pressing requirements, such as imports of pharmaceuticals and agricultural equipment. A number of the Asian economies have successfully built indigenous ICT-production capacity. South Korea is home to some of the largest multinational producers of computer memory chips. Malaysia, Singapore, Taiwan, and Thailand have become major suppliers of key electronic goods, such as mobile telephones, personal computers, computer disk drives, and computer monitors. The global electronics sector is likely to continue to enjoy strong growth. But excessive concentration of the industry could exacerbate existing imbalances in trade. In addition, countries without facilities to produce this equipment nevertheless need a certain level of capability to maintain and use the equipment effectively.

BUILDING NEW COALITIONS OF RESOURCES

The telecommunication industry is one of the most important economic sectors. In 1996, it had worldwide revenues of 670 billion USD related exclusively to the provision of public telecommunication services.

The last decade has seen a transformation in the old model for the construction, financing, and operation of communication infrastructure. For a long time, this was the responsibility of local or national monopolies. International trade in telecommunication services was managed under a series of international agreements that established accounting rates and division of revenues among national operators. When new international facilities, such as undersea cables, were required, the monopolies constructed and financed them cooperatively, making long-term precommitments to use the new capacity on a fixed basis.

Globalization has resulted in a massive expansion in international communication services. These include new mobile services and data services, as well as a reconfiguration of international voice, data, and conferencing services for multinational companies to permit streamlined communication. This sector has had a range of new entrants previously involved in other sectors.



Building new transmission infrastructure increasingly requires the mobilization of complex, global coalitions (Figure 2). This is a function of the creation of globally operating communication and information service companies, the requirement to supply equipment on a global basis, and the need to access finance from the world's major financial centres.

The challenge is to bring together key partners in these coalitions, including service and equipment suppliers, institutional investors, banks, major companies in the communication sector, governments, and local telephone operators. Policies and regulations favourable to the ICT sector are needed to encourage such coalitions.

This page intentionally left blank



Chapter 4

ADDRESSING KEY GOVERNANCE ISSUES

Governance issues for ICTs concern the ways national and international agreements influence opportunities for building new social and technological capabilities. Governance issues need to be addressed effectively if the full benefits of ICTs are to be realized. Some countries, especially the newly industrializing economies of Southeast Asia, stand to benefit from international agreements shaping global information flows. For other countries in the developing world, the evidence is ambiguous or nonexistent or suggests that the new governance arrangements embody the seeds of social and economic exclusion.

In today's international governance system, any country that tries to strengthen its national information infrastructure must take account of the global environment. The representatives of governments and the private sector from developing countries are finding it necessary to negotiate with a wide range of influential international institutions, which influence ICT investment and the accumulation of producer and user capabilities. These institutions include private and public banks, regional satellite-service suppliers, regulatory and standards organizations, and private-sector trading associations. By providing or withholding resources, they can make it easier or more difficult for a country to pursue its national goals. Decision-makers must become aware of international governance issues and the implications for their own countries.

As communication networks become interconnected throughout the world, it is increasingly feasible to market and distribute information and software to the world. The major producers of information products are very actively seeking strong intellectual-property protection. They are

calling on governments to update and enforce international conventions and national legislation.

The cost of reproducing a digital-information product is very low. However, the cost of the first copy of a film, broadcast program, book, multimedia application, on-line database, or other information product can be very high. The majority of these products are produced in the industrialized countries, although some developing companies have an interest in increasing intellectual-property protection for their local firms. Firms and governments have been changing the rules for intellectual-property protection in response to pressure from firms that will gain economically from stronger enforcement. Decision-makers in developing countries need to create governance frameworks to encourage, support, and release peoples' capacities to use the new technologies and digital-information products to produce useful knowledge.

INTERNATIONAL INSTITUTIONS GOVERNING ICTs

Some developing countries want to strengthen their national information infrastructures, and they must do so to play by the new international rules of the game. National decision-makers must become familiar with a complex maze of international regulations in the communication sector, agreements on technical standards, conventions on intellectual-property rights and protection, labour-practice standards, and a host of other issues.

ITU provided early international governance relating to infrastructure networks in the telecommunication sector. WorldTel, one of several entities closely associated with ITU, was established to raise private-sector finance in countries with very low levels of infrastructure.

The World Intellectual Property Organization helps develop conventions and agreements for trademarks and the protection of intellectual property (including literary, musical, dramatic, pictorial, photographic, and cinematographic works). It has been very active in negotiating new standards for the protection of computer software and rules concerning downloading of protected information from the Internet.

The agencies of the United Nations system promote ICTs in key sectors. A number are providing advisory services aimed to strengthen the national information infrastructures in developing countries. The United Nations is in a unique position to identify the institutional, legal, regulatory, and policy issues that need to be addressed to enable developing countries to benefit from ICTs.

The World Bank has increasingly promoted a transition to knowledge-based development. Similarly, with the expansion of trade in services, the World Trade Organization (WTO) has established international agreements on trade liberalization that include many of the developing countries.

Negotiations in these international forums and in private consortia are producing new pressures to open markets to global competitors and to protect the property rights of the producers of equipment and information. The risk is that developing countries might find their local initiatives to build the foundations for innovative knowledge societies stifled.

OPENING UP BUT KEEPING CONTROL

International governance forces are very strong, both in the direction of opening markets up and in the direction of keeping them sufficiently closed to enable domestic control over ICT strategies and development priorities. Historically, countries found it advantageous to push for openness and linkages between national communication systems while keeping control of conditions within their borders.

The pressures for open markets have been building very quickly in the communication sector. ITU has drawn attention to the need for major structural adjustment. It has stressed the need for restructuring to gain operational efficiencies and to stimulate new service development in national and international markets. Management has to change its practices, and the work force must acquire new skills. Large amounts of capital are also vital to this transformation.

Between 1997 and 2010, the cumulative gains in cost savings and other benefits for the low-income developing countries from the liberalization of the telecommunication-service market will be equal to about 177 billion USD; those for the high-income industrialized countries, about 523 billion USD. These estimates assume effective competition and an enforceable governance regime for policy and national regulation. In the face of pressures to liberalize markets, developing countries must find innovative ways to extend their infrastructures. Their legislative and regulatory arrangements must encourage the kind of competition that is responsive to development priorities.

The opening of telecommunication-service markets to global players means that more governments and development agencies are working in concert with larger pools of private capital to shape the investment environment in developing countries. The right balance needs to be achieved

between creating a conducive environment for large direct investment and ensuring that the benefits accrue without excluding people. People may be excluded if the new facilities fail to extend to remote or high-cost areas, are unaffordable, or are inappropriate to the needs and practices of the local community and businesses.

GOVERNING TRADE IN SERVICES AND EQUIPMENT

An agreement on liberalization of market access for basic telecommunication services, effective from February 1998, was achieved under the auspices of WTO. Although the agreement has some exemptions for developing countries, it will open markets for foreign investment. The European Union, the United States, and Japan, participants in these negotiations, had a 74% share of world telecommunication revenues in 1995 (Table 6).

	SHARE (%)		
	EUROPEAN UNION	UNITED STATES	JAPAN
Revenue	28.3	29.7	15.6
Main lines	26.1	23.8	8.8
Investment	27.1	15.6	22.0
International traffic	35.2	25.3	2.7

This is not the only major trade agreement to set the parameters for a new international ICT governance regime. The Information Technology Agreement, again under the auspices of the WTO, includes 28 governments and provides for the elimination of customs duties and other import charges on information-technology products, to be achieved through annual reductions to 2000.

These two agreements demonstrate the commitment of the industrialized countries and companies to rapid advance in the global information infrastructure. The rate at which access to a global infrastructure becomes a reality for many developing countries depends on liberalization of their own national markets. It also depends on the capacities of these countries to put new regulations in place to better reflect the new rules of the game, as well as their own infrastructure-development priorities.

PROTECTING INTELLECTUAL PROPERTY

Because of the rapid innovations in ICTs and the shift toward knowledge-based development, the law governing intellectual property is changing very quickly. Creating, distributing, and using digital information are important activities. Intellectual-property protection attempts to balance interests in the disclosure and dissemination of ideas with the exclusive rights of the owners of the property to control and profit from the invention or the authorship.

The degree to which existing intellectual-property rights will be strengthened and enforced in any given developing country depends on that country's social and economic circumstances. Social and economic costs, as well as benefits, arise from greater protection of the intellectual property of both foreign and local producers.

Many developing countries depend heavily on access to information from external sources for business, culture, and S&T research. This includes financial and market information, interactive games, music, films, and television programs. It also includes on-line databases with information important to medicine, health-care treatment, the environment, agriculture, and the natural-resource, chemical, and pharmaceutical industries.

Table 7 shows the estimated losses to US software, entertainment, and publishing industries resulting from violations of intellectual-property

Table 7 – LOSSES TO US SOFTWARE, ENTERTAINMENT, AND PUBLISHING INDUSTRIES FROM VIOLATIONS OF INTELLECTUAL-PROPERTY RIGHTS, 1995.

	LOSS (MILLION USD)				
	MOTION PICTURES	RECORDS AND MUSIC	BUSINESS SOFTWARE	ENTERTAINMENT SOFTWARE	BOOKS
Asia	514	349	2 756	2 002	377
Middle East and Mediterranean	248	54	180	100	104
Latin America and Caribbean	289	226	836	359	129
Canada	22	18	270	NA	NA
Africa	11	25	171	NA	60
Eastern Europe and Russia	464	363	534	396	73
Western Europe	710	245	2 451	286	41

Note: NA, not available; USD, United States dollars.

rights. Although much of the impetus for better protection of intellectual property comes from the industrialized countries, many developing countries are also interested in providing improved protection to local producers. Most countries are signatories to international conventions for intellectual-property protection, but some developing countries do not have institutions in place to effectively enforce these conventions.

Enforcement requires public resources, and many developing countries have competing claims on such resources. The technical means of protecting digital information can be costly, and in many cases, these safeguards can be circumvented. Policymakers in developing countries are in a difficult position because empirical evidence on the economic costs and benefits of changes in existing measures for intellectual-property protection is either ambiguous or suggests that some developing countries will be disadvantaged.

The goals of achieving the widest possible use of electronic-information services and of enforcing strong intellectual-property protection often seem in conflict. Developing countries need to achieve the right balance between too little protection and too much as they become involved in building national information infrastructures.

PRIVACY AND INFORMATION SECURITY

Cultural and social considerations are very significant for developing countries addressing the implications of citizen access to the Internet, business use of electronic commerce, and the growing amounts of electronically held information on the everyday activities of people. Important governance issues for developing countries include the protection of individual privacy and the security of commercial information. The rules and standards governing cyberspace will be given different nuances, depending on the country or region.

Changes in ICTs and the extension of global networks may compromise the privacy of home and working environments. Governments, public-service providers in the health and education sectors, and the police services will hold increasing amounts of personal information. The national or local responses to these developments are often culturally defined. Religion, cultural tradition, political organization, economic practices and the intermingling of these aspects of societies with new experiences inform the capabilities to beneficially use the new electronic services. Cultural norms associated with confidentiality and personal

privacy need to be translated into effective legislation and enforcement measures, without imposing overly elaborate technical solutions unlikely to be workable in the longer term.

If electronic commerce is to expand in the business sector, parties involved in transactions must establish trust. Buyers and sellers need to be able to agree that the content of electronic information has not been altered and that the owner, originator, and recipient can be linked to that information. New methods are needed to establish the integrity, authenticity, and endorsement of information (in the same way that company letterheads, written signatures, and seals do on paper documents). This involves the development of a governance system to protect the integrity of data. To protect the confidentiality of digital information, new technical and organizational measures are needed to ensure that only those authorized to read certain kinds of information can do so.

GOVERNANCE AND THE NETWORKED ECONOMY

The governance system for ICTs emerging in the wake of recent developments in international markets is not likely to bring equal benefits to all developing countries, especially to the least-developed countries. Some developing countries stand to benefit and, in some cases, very considerably. Evidence of the rapid diffusion of infrastructure and services is clear, especially in the newly industrializing economies. Other developing countries, particularly the least-developed and smaller island nations, need to establish more effective ways to ensure that their voices are heard in negotiations on international governance regimes for ICTs. Their development priorities and specific circumstances need to be reflected in the new rules of the game.

Ideally, the principles of equity, open access, and fair competition would be features of emerging global markets for ICTs and services and the new global system of governance for the networked world of the future. In practice, oligopolistic competition is the norm in global markets. With the existing uneven distribution of capabilities, the investment in people and technologies will not automatically include marginalized people.

Stakeholders in developing countries and their national governments will need to put ICT strategies in place with measures to address key governance issues. Action is urgently needed to set priorities for ICT development and application.

This page intentionally left blank



Chapter 5

FORMULATING ICT STRATEGIES

National and regional ICT strategies and policies in developing countries and regions will determine whether the growing availability of ICTs and their applications brings social and economic improvement or leads to new forms of exclusion. An effective strategy must include the accumulation of capabilities to assess the strengths and weaknesses of various hardware and software alternatives and to select specific applications in line with development priorities.

As developing countries join the global information infrastructure, they will need to establish effective ways to maximize the benefits and control the risks of ICTs. This means coordinated action, encompassing the technologies and services, as well as many aspects of the institutional environment. Strategies are needed to establish the necessary S&T, engineering knowledge, and management techniques and to build the social and economic institutions needed to reap the potential social and economic benefit of ICTs.

Priority should be given to policies, regulations, education, training, and technology-assessment programs to enhance the capacities to creatively produce or use ICTs. The balance between producing and using the new applications will differ from country to country. New coalitions of resources and partnerships among stakeholders, including the business sector, will need to be encouraged, in line with each country's development priorities.

No simple recipes can be given for developing such strategies. No hard and fast rules govern the design of such strategies, and each developing country will follow a distinct path. ICT strategies need to establish priorities across business sectors and the responsibilities of government

departments and ministries. Coordination will be needed, together with clear implementation plans and targets. Strategies will need to be flexible and open to the requirements of a wide variety of stakeholders. ICT strategies for building up the national information infrastructure, including its technological and social components, must be more than statements of what might be done. They must be action plans with appropriate funding.

The UNCSTD Working Group on Information Technology and Development found evidence that the positive impacts of ICTs on developing countries are not as deep or as pervasive as they are sometimes made to appear in the debate about the benefits of a global information society. The lives of many people, especially in the least-developed countries, are barely touched by ICTs. Others have been negatively affected by their exclusion from the global information society or by the social or economic dislocations stemming from these new technologies, services, manufacturing practices, and ways of organizing work. The problem is not simply a lag in the diffusion of these technologies or in accessing ICTs. There are substantial problems in ensuring that the capabilities for creatively using these technologies are embedded in new policy measures and firm strategies.

Given the potential of ICTs, all governments and other stakeholders need to build new capabilities to produce, access, and use these technologies. To build these capabilities, ICT strategies must be responsive to sustainable-development goals and involve all social and economic stakeholders. The government has a very important role to play: supporting new forms of market facilitation, introducing effective regulation, promoting stakeholder dialogues, and providing public services appropriate to local conditions.

TECHNOLOGY CHOICES AND CAPACITY-BUILDING

The national information infrastructure in developing countries will depend to some extent on the strength of their firms' R&D capabilities and their propensity to invest in the R&D that will enable them to help construct and use this infrastructure. Other equally important elements will be the R&D capabilities of public-sector institutions, the links between these institutions and the private sector, and the relationships between domestic organizations and those located in distant places around the world. The production, maintenance, and use of ICT systems almost always leads to

new forms of organization. These organizational changes need to be identified and implemented by informed managers. People are needed who can act as intermediaries between system suppliers and users to coordinate, integrate, and disseminate relevant information about new technical developments and applications. If S&T research results and practical experience with the production and use of ICTs are shared, replication of problems can be avoided and risks can be minimized.

Competition in domestic and international markets is forcing firms in industrialized countries to reduce costs and improve quality. Firms in developing countries are also affected. This requires increased investment in R&D activities.

Some developing countries are already giving a high priority to R&D activities in the ICT sector and to building up a broad range of related capabilities. Bermuda, Brazil, Indonesia, Jamaica, Malaysia, Malta, Mexico, Singapore, South Africa, South Korea, and Vietnam are among the countries that have put considerable effort into developing ICT strategies. Many regional initiatives are in place to strengthen stakeholder roles for the African Information Society and the Association of Southeast Asian Nations. In these initiatives, ICT strategies are informed by medium- to long-term visions. Indigenous capabilities are needed to complement these visions. In the hardware and software components, a skills base must be either built up internally or attracted from other countries. Failure to define national strengths and weaknesses in ICT production, maintenance, and development can make a country's growth overly import dependent. It can lead to lost opportunities for economic growth, export earnings, and jobs.

STRATEGIES FOR MARKET LIBERALIZATION

Profiles of market reform show a common movement to greater reliance on market instruments to encourage the ICT sector. However, because developing countries are at very different stages in acquiring ICTs and have their own development priorities, they articulate their market reforms differently.

The models of privatization and competitive entry in the telecommunication sector, for example, differ considerably between countries. Monopoly supply in domestic markets is retained in some countries, whereas in others, this is abandoned in favour of competitive entry by domestic or international companies.

The WTO agreement on basic telecommunication services commits many developing countries to opening their national telecommunication markets to foreign suppliers and to introducing competition in the provision of all services. The inward-investment implications of privatization and market liberalization are considerable for the least-developed countries, which in many cases have not joined the agreement. They must attract both new competencies and investors while attempting to extend the reach of their networks. The major global investors are likely to concentrate on their home markets and on opportunities in countries covered by the agreement. The danger for the least-developed countries is that less experienced foreign companies will seek to invest there. Decision-makers in these countries will need to accumulate skills in negotiating terms and conditions attractive to these investors and responsive to their own domestic needs.

Even after an initial flurry of privatization and market liberalization, problems remain in responding to escalating demand and ensuring that competition is effective. Service-supply incentives must be created to respond effectively to all stakeholder needs, and innovative regulatory policies will always be needed. Pacific Rim countries are investing in a telecommunication-infrastructure framework to link such investment to strategies for education and training, and they are strengthening their business sectors to participate in global markets.

With market liberalization and competitive entry, the prices for the use of international communication services are expected to fall dramatically, although near-zero prices may be unrealistic. This decline in prices will happen as competitive entry into national markets and oligopolistic competition in the international market take hold.

These developments may also produce major reductions in the revenues available for reinvestment in the national infrastructures of some developing countries. Social-policy and equity issues related to the extension and upgrading of the infrastructure will become pressing for policymakers trying to promote access to new information services.

PROMOTING IMPROVED ACCESS

Discussions about promoting universal access to reduce the gap between the information rich and the information poor can obscure as much as they illuminate. Least-developed countries, for instance, still have a low teledensity (Table 8). Access to networks is only part of the story – it does not always lead to greater or more effective use of ICTs and services.

Table 8 - LDC INDICATORS RANKED BY TELEDENSITY, 1992 AND 1995.

	GDP PER CAPITA, 1995 (USD)	INFANT MORTALITY PER 1 000 LIVE BIRTHS, 1992	MAIN LINES PER 100 INHABITANTS, 1995
Yemen	1 217	107	1.24
Lesotho	447	108	0.90
Haiti	257	87	0.84
Zambia	323	113	0.82
Congo	594	170	0.81
Lao People's Democratic Republic	281	98	0.37
Nepal	175	90	0.36
Malawi	133	143	0.35
Mozambique	80	167	0.33
Myanmar	1 319	83	0.32
Sudan	160	100	0.27
Ethiopia	81	123	0.25
Bangladesh	215	97	0.22
Somalia	101	125	0.17
Afghanistan	133	165	0.12
Zaire	195	121	0.08

Note: GDP, gross domestic product; LDC, least-developed country; USD, United States dollars.

People must be able to obtain benefits from their use of the new network technologies, and these provide only the initial basis for accessing these benefits. The full benefits depend on the types of technologies selected and the model of access for individuals in their homes, work-places, or communities. They also depend on the capabilities of users and whether they have the resources to purchase or otherwise gain access to appropriate equipment and training.

Developing countries need to ask themselves what they expect to gain from access to the communication network and its services. Communication network technologies and services have been moulded in most cases by economically and politically powerful actors in the industrialized countries.

Access by less powerful people in developing countries is limited by cultural and economic factors. These factors shape user needs for network access to global and local sources of information. Cultural and economic factors influence patterns of communication with family members and businesses locally, in the next village or city, and in distant countries. These patterns differ enormously, and there is no uniform prescription for closing the access gap.

Policymakers and regulators can emphasize particular measures to reduce the access gap at different stages of network development. In the early stages, for example, when teledensity is less than 10, an emphasis on creating the conditions for effective competition and network expansion is often needed. Potential users need to be brought into the network planning and design processes to help tailor service packages to their needs. As network penetration increases, customer education may need to be more strongly emphasized.

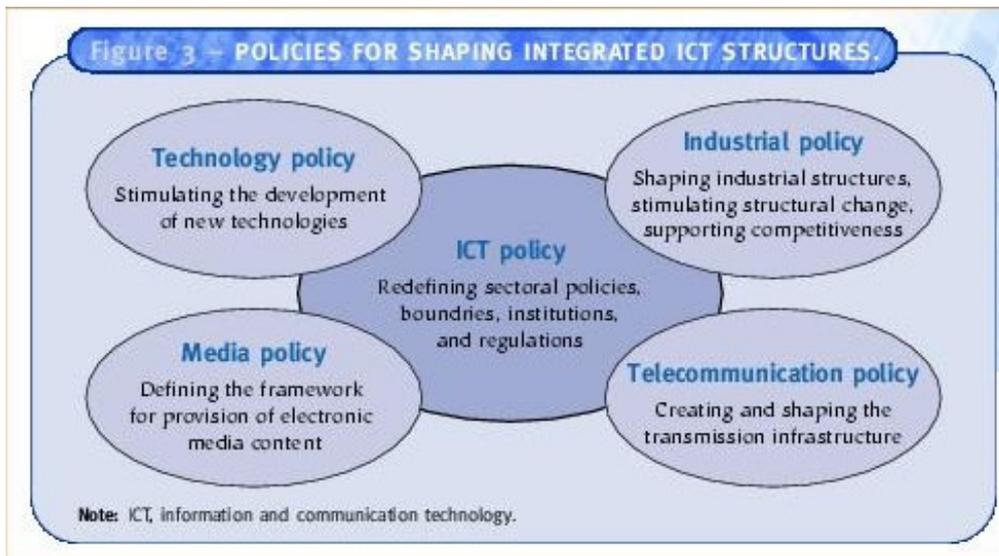
In some instances, much greater priority may be given to using ICTs on a stand-alone basis. Non-network applications may be appropriate to facilitate access to information resources or to provide training in innovative processes or manufacturing techniques. The ability to develop ICT applications that are meaningful for people in the least-developed countries is crucially important. In education, for example, the initial focus is often on side-stepping the inadequacies of existing institutions by experimenting with distance learning and using networks to access external professional competence. However, major progress is not possible until the new information is absorbed into local education systems, with extensive programs for training and support.

The main issue is to ensure that access to the technological infrastructure and to information resources is as inclusive as possible and is responsive to as wide as possible a variety of the cultural, social, political, and economic factors influencing the achievement of development goals.

HARNESSING ICTs FOR DEVELOPMENT

Two conditions enable developing countries to exploit the potential of ICTs for social and economic development. The first is the availability of a national information infrastructure tailored to the new applications. The second is the capability to create and administer an enabling environment. This means developing the applications to exploit the infrastructure in ways that meet the needs in the local environment.

Several aspects of policy are important (Figure 3). Technology policy tries to stimulate the economy by fostering innovation through R&D initiatives. Industrial policy is about economic growth and employment. It tries to stimulate the emergence of new industries to secure future growth and jobs. Telecommunication policy attempts to secure the provision of the communication infrastructure and services, and media policy provides the framework for the development of the audiovisual sector.



With the convergence of ICTs, these separate policy domains are proving inadequate. It is not unusual for turf wars to hamper the formulation and implementation of new policies that cut across existing policy domains.

This is complicated by the fact that attitudes toward social and economic development involving the diffusion and use of ICTs can become entrenched and resistant to change, even though change would improve opportunities to gain the benefits of new services and applications. Opportunities are available to shape the direction of ICT diffusion and use in developing countries. However, the longer decision-makers delay the introduction of ICT strategies, the more likely it is that particular systems and applications will be difficult to tailor to the specific needs of people in developing countries. Both public and private ICT-using sectors play important roles in knowledge-based development. ICT strategies will need to encompass policies for businesses and the public sectors, such as health, education, and the environment.

INTEGRATING ICT STRATEGIES

Integrating national and regional ICT strategies involves a process of participatory and interactive learning and planning. This process is emerging as an alternative to both state intervention and unconstrained market solutions. ICT systems and applications will facilitate, as well as limit, the development of new knowledge societies for many decades to come. Opportunities to shape these systems in the developing countries

can be created by involving a wide array of actors, especially representatives of civil society.

Using innovative legislative and regulatory instruments to create new coalitions of resources is preferable to leaving ICT diffusion to the market or attempting to use a heavily centralized public-sector structure to direct the path of development.

Learning how to configure existing technological and social capabilities and to restructure institutional arrangements to create incentives for continuous learning is central to this process. Some developing countries are successfully combining indigenous and external capabilities to strengthen the contribution of ICTs to their development. Knowledge-based development involves an intricate weave of many social and technological threads. It involves combinations of tacit knowledge, electronic information, access to networks, and other social, cultural, and economic resources. Some combinations work well, and others do not. Policymakers, business managers, workers, and citizens all have important roles to play in establishing the most innovative and productive combination of social and technological capabilities.

Harnessing ICTs for development means giving consideration to people's expectations for service delivery, the plans and architectures of networks, and the appropriate training. It involves decisions about whether to develop or reconfigure hardware and software in the national market or to buy products and systems from external sources. Ongoing assessment of people's information needs and their changing capacities to use electronic information and ICT applications is fundamentally important to successful outcomes. ICT strategies can promote or impede the critical learning processes needed to develop new social and technological capabilities.

The ICT revolution presents the least-developed countries with a double challenge. One is to assign qualified and able people to keep abreast of the latest developments in the ICT field. The other is to ensure that scarce human, organizational, and financial resources are used to meet the needs of rural and marginalized people. Although these problems have no simple solutions, improved coordination of activities through ICT strategies can help.

We always need to improve our understanding of the roles and impacts of ICTs in specific development contexts. Major ingredients in this are mechanisms for ongoing policy review, assessment, and monitoring. To design and implement a national or regional ICT strategy means giving unified, rather than fragmented, consideration to several major issues.

GUIDELINES FOR ICT STRATEGIES

The UNCSTD Working Group on Information Technology and Development concluded that ICTs can offer huge economic and social benefits to all people if the appropriate ICT strategies are implemented. Key considerations in the design and implementation of an ICT strategy include producing and using ICTs for social and economic advantage, developing the human resources to effectively implement the strategy, managing S&T innovation in the ICT sector for sustainable development, improving access to ICT networks, promoting and financing investment in ICTs, creating and accessing S&T knowledge, and monitoring and influencing the international rules of the game.

To build a capability in ICTs and develop a national information infrastructure, developing countries will have to mobilize and pool large amounts of investment and expertise. Action is required in three closely interrelated areas. First, developing countries should seek to create a market-friendly environment and formulate an explicit national or regional ICT strategy. Second, developing countries need to ensure that their ICT strategies explicitly address the question of financing. Third, because of the complexity of linking the question of financing to the process of planning and implementing the national information infrastructure, developing countries need to review and adjust their existing governance processes.

The mobilization and attraction of domestic and external financial resources to ensure that ICT projects are financially sustainable can be approached in a number of ways: focusing on self-funded programs or projects, targeting commercial users, accommodating commercial users in remote areas, accommodating noncommercial users, refocusing existing expenditure, building ICTs into existing programs and projects, or coping with high initial investment costs and foreign-exchange constraints.

In operational terms, the management of new coalitions to pursue elements of an ICT strategy may require the establishment of an advisory council or a national or regional committee to oversee the strategy. Mission-oriented task forces in fields such as telecommunication infrastructure, computer literacy, human-resource development, and the application of ICTs may also be needed for advice or advocacy, guidance, and coordination. Vision, leadership, and promotion of organizational change are critical to the use of ICTs for sustainable development.

This page intentionally left blank



Chapter 6

ICTs FOR SUSTAINABLE DEVELOPMENT

The coming decades will not see the eradication of the gap between the rich and the poor. Nevertheless, if governments and other stakeholders design and implement effective ICT strategies, the new technologies and services may help to reduce the gap for some disadvantaged or marginalized people. These strategies need to focus on capabilities for using ICTs in ways relevant to development priorities.

Special attention needs to be given to providing the least-developed countries, especially in sub-Saharan Africa, and the rural areas of lower-income countries with the financial resources, physical infrastructure, and knowledge base to achieve sustainable-development goals.

Innovative knowledge-based development strategies based on new models of governance and market development are being formulated. When ICT strategies and policies are in place, a limited investment in human and technological capabilities can have an enduring, catalytic effect on development concerns, including poverty, gender inequalities, and the environment. Special attention also needs to be given to modifying the technologies and applications to support these priorities.

Significant barriers will need to be overcome if the world's population, particularly in the least-developed countries, is to realize the full benefits of ICTs. As new ICTs are developed, the need to put ICT strategies in place will become even more pressing. Although there is a risk that further diffusion and use of ICTs will exclude some people, coherent ICT strategies need to be developed to unleash the unrealized potential of these revolutionary technologies for the future prosperity of developing countries.

The changing social and economic fortunes of developing countries necessitate strategies and policies specifically for the ICT sector. Policies for

education, employment, trade, industries, and markets need to be informed by developments in the ICT sector. Innovative knowledge societies in the developing world will become more dependent on their capital base of knowledge and software, and services will represent a larger and larger share of world trade; meanwhile, it will be necessary to maintain the tax base. If new ways to generate public-sector revenues are introduced in the wake of electronic commerce and global flows of data and information, the impact on developing countries could be substantial.

Decision-makers need to gear their deliberations in all these areas toward the everyday needs of people in developing countries, as well as toward business concerns. Attention to the needs of consumers and citizens, alongside those of industrialists, is needed to create sustainable knowledge societies.

Appendix 1

ACRONYMS AND ABBREVIATIONS

CAGR	compound annual growth rate
ICT	information and communication technology
ITU	International Telecommunication Union
NGO	nongovernmental organization
R&D	research and development
S&T	science and technology
SPRU	Science Policy Research Unit
UNCSTD	United Nations Commission on Science and Technology for Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
WTO	World Trade Organization

Authors

ABOUT THE AUTHORS

Andreas Credé is a Visiting Fellow at the Science Policy Research Unit (SPRU), University of Sussex, East Sussex, UK. He is also a Project Finance Consultant with Babcock & Brown in London, UK. Dr Credé's research interests focus on the nature of information and knowledge production in financial institutions and the way it is mediated by the new developments in information and communication technology. To this research he brings experience gained while working as a senior manager for The Mitsubishi Bank, the Amsterdam Rotterdam Bank, and the European Banking Company.

Robin Mansell is Professor of Information and Communication Technology Policy at SPRU, University of Sussex, and a Director of the SPRU Information, Networks and Knowledge research centre. Dr Mansell also serves on the Advisory Board of the Swedish Transport and Communication Research Council; on the Information Engineering Committee of the Institution of Electrical Engineers (London); as a director and founding member of the European Network for Communication and Information Perspectives (Montpellier); and as a member of the Economic and Social Research Council's Invisible College for Geography, Economics, and Politics.

Institutions

ABOUT THE INSTITUTIONS

The International Development Research Centre (IDRC) is committed to building a sustainable and equitable world. IDRC funds developing-world researchers, thus enabling the people of the South to find their own solutions to their own problems. IDRC also maintains information networks and forges linkages that allow Canadians and their developing-world partners to benefit equally from a global sharing of knowledge. Through its actions, IDRC is helping others to help themselves.

The United Nations Commission on Science and Technology for Development (UNCSTD) was established in 1992 by the General Assembly of the United Nations and, since 1993, has been serviced by the UNCTAD secretariat. Through assembled panels of experts, the Commission examines and provides advice on current issues in science and technology, with a focus on the developing world. UNCSTD's Working Group on Information Technology and Development was convened to explore the ramifications of the Information Revolution for the countries of the developing world.

Publisher

ABOUT THE PUBLISHER

IDRC Books publishes research results and scholarly studies on global and regional issues related to sustainable and equitable development. As a specialist in development literature, IDRC Books contributes to the body of knowledge on these issues to further the cause of global understanding and equity. IDRC publications are sold through its head office in Ottawa, Canada, as well as by IDRC's agents and distributors around the world.