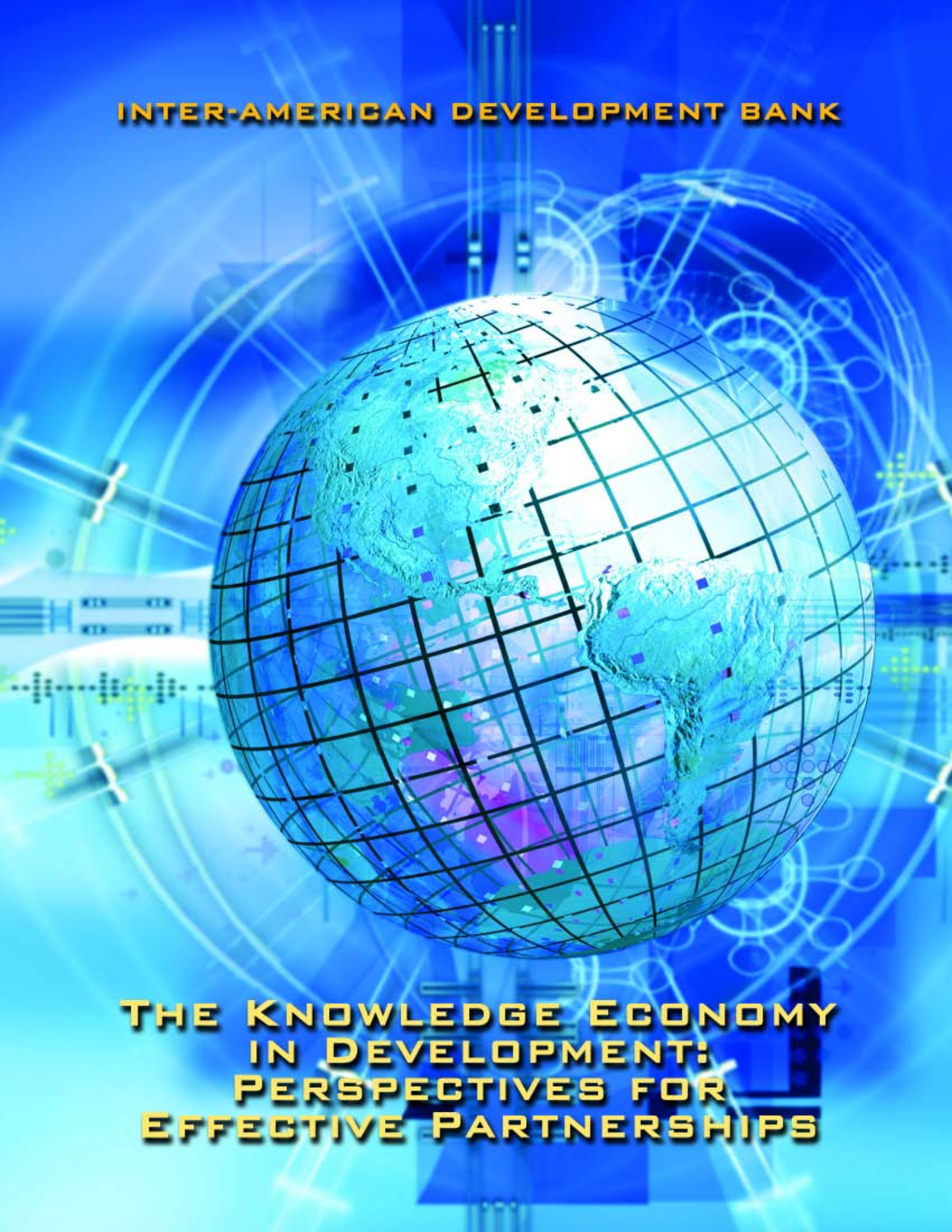
INTER-AMERICAN DEVELOPMENT BANK



The Knowledge Economy in Development: Perspectives for Effective Partnerships

INTER-AMERICAN DEVELOPMENT BANK

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Robert A. Vitro, Editor

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Contents

Foreword

In numerous forums during the past 10 years, the countries of Latin America and the Caribbean have expressed their political will to hasten their transition to a more knowledge-intensive economy as a means for achieving their development objectives and the Millennium Development Goals. As part of its strategy to meet this demand, the Inter-American Development Bank has adapted its programming, institutional arrangements, and funding instruments to meet this increasing and varied demand to foster a wider diffusion and application of information and communication technology (ICT) in development. This publication examines the importance of information and communication technology in sustainable economic growth, human capital formation, governance, and institutional strengthening, as well as the Bank's efforts to forge more effective partnerships in this area.

While much has been accomplished in efforts to promote ICT for development and expand the knowledge intensity of the economy in the region, much more needs to be done. Conditions in the region and the Bank are ripe for a renewal of IDB efforts to increase development effectiveness. At the core of this renewal is the growing understanding that expansion of the Knowledge Economy is a conceptual and programmatic "bridge" between the Bank's two overarching objectives: fostering sustainable economic growth and reducing poverty while promoting equity. Specifically, access to information and knowledge are crucial to increased productivity and competitiveness, which, in turn, are essential to achieve the rates of economic growth needed to generate the resources to address social problems. Similarly, enhancing the capacity of individuals to access information and knowledge is at the core of human development.

In addition to its support for ICT in sectoral programs, the Bank has embarked on intersectoral programming that includes support for ICT in sustainable economic growth, social development, and governance. Crucial to this entire process is the dialogue between the Bank and the countries of the region to build a consensus on outcomes and indicators to measure, monitor, and manage the contributions of ICT to productivity and sustainable development. The recent creation of a new subdepartment within the Sustainable Development Department that incorporates the three major pillars of the Knowledge Economy—learning, ICT, and science and technology—highlights the will of the Bank to adapt its organization and strengthen its capacity to better address the policy challenges faced by the region's countries in their transition to a knowledge economy.

This book opens a window into the dynamic partnership among the countries of Latin America and the Caribbean as they work with the Bank to create an enabling environment to ensure that development reflects the values, needs, conditions, resources, and aspirations of all citizens.

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Preface

The partnership between the Inter-American Development Bank and the countries of Latin America and the Caribbean to integrate the requirements of an emerging knowledge-based global economy into development planning is a work in progress. It is a multidimensional and multilevel effort involving public, private, and civil society organizations to spur sustainable economic growth and reduce poverty while promoting equity. This publication is part of an ongoing commitment to improve the effectiveness of that partnership. It is designed to stimulate further discussion and promote consensus in the formulation of outcomes, outputs, and indicators to measure, monitor, and evaluate the contribution of Knowledge Economy expansion to increasing the rate of sustainable economic growth and reduce poverty while promoting equity.

The partnership has deep roots. The latest phase coalesced during 2000 as the countries began to express their political will in terms of accelerating Knowledge Economy expansion to achieve their development objectives. The catalyst was the regional preparation for the July 2000 United Nations Economic and Social Council (ECOSOC) Special High-Level Segment on "Development and International Cooperation in the 21st Century: The Role of Information and Communication Technology in the Context of the Knowledge-Based Global Economy." A declaration emerging from a regional meeting that took place in Florianópolis, Brazil, in June 2000, reflected a consensus for the ECOSOC event in acknowledging that ICTs are "fundamental for the construction of a knowledge economy [since] they represent the foundation for new forms of organization and production at the global level."

Two high-level regional meetings after the ECOSOC event reinforced the countries' commitment. At the conclusion of the Summit of South American Presidents during August/September 2000 in Brasilia, Brazil, the heads of state and governments released a declaration with a section on "Knowledge, Information, and Technology." In it they acknowledged the importance of the Florianópolis Declaration, urged accelerated access to the information and knowledge society, and proposed the creation of a South American Fund to stimulate this process. A few months later, at the Third Summit of the Americas held in Quebec City, Canada, in April 2001, the leaders declared, "we are convinced that the promotion of an agenda on connectivity for the Americas will facilitate integration of the hemisphere in the knowledge society."

Within this context, other regional events facilitated dialogue among public, private, and civil society leaders involved in guiding ICT deployment and shaping the character of the Knowledge Economy in the region. The First Latin American and Caribbean Workshop on Information and Communication Technology (LACTIC) took place in Porlamar, Venezuela. A Latin American and Caribbean Forum on the Information Society was organized by the Government of Brazil and held in Rio de Janeiro in September 2002. In addition, Latin American and Caribbean leaders in ICT for development participated in interregional dialogues such as the Summit of the Latin American Heads of State and Government and the European Union, the Latin American and European Union Forum on the Alliance for the Information Society, as well as various Ibero-American Meetings on the Information Society and with G-8 countries involved in the Digital Opportunity Task Force (dot.force).

This process helped shape the political framework and energize national efforts for Latin America and the Caribbean country involvement in the three major, interrelated global activities. The ECOSOC meeting led to the creation of the United Nations Information and Communication Technology Task Force that included regional participation through its Latin

American and Caribbean Regional Network. During September 2000, the United Nations General Assembly approved the Millennium Development Declaration. Millennium Development Goal No. 8, Develop a Global Partnership for Development, includes the pledge to, "in cooperation with the private sector, make available the benefit of new technologies—especially information and communication technologies." Phase one of the World Summit on the Information Society (WSIS), in Geneva, Switzerland (2003), and phase two in Tunis, Tunisia (2005), along with the respective Latin American and Caribbean Regional Preparatory Meetings in Bavaro, the Dominican Republic, in January 2003 and, Rio de Janeiro, Brazil, in June 2005 have provided additional opportunities for the region to participate in influencing the global agenda.

The IDB has accompanied the countries of Latin America and the Caribbean, individually and collectively, throughout this process. The expanded discussion stimulated by the contents of this publication should help move the partnership between the Bank and the countries to a new phase that will be characterized by the appropriate application of development effectiveness methodologies to assess the contribution of Knowledge Economy expansion to development in the region.

Before moving on, it is important to acknowledge that this book has been made possible through the insights, hard work and commitment of the authors whose chapters are published herein. In addition to speaking during individual sessions of the IDB Discussion Series on "The Knowledge Economy in Development: Towards Definition of Outcomes, Outputs and Indicators in Bank-funded Projects", they kindly agreed to contribute a chapter for this publication. These distinguished individuals have greatly extended our understanding of how information access and the application of knowledge can contribute to a democratic process of efficient, equitable and sustainable development. Their innovative thinking—and their generosity in sharing it—is the heart of this collection. We are much in their debt. .

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Introduction

Development Effectiveness and Knowledge Economy Expansion

Danilo Piaggesi

National and international development organizations are striving to make their operational methodologies with the countries more effective. An important part of that effort will depend on how well the role of information and knowledge is understood and integrated into the development process. The Inter-American Development Bank is committed to working with beneficiary countries to refine processes and instruments for formulating outcomes, outputs, and indicators to measure, monitor, and evaluate development effectiveness. The key is making sure that what is being measured is relevant and contributes to achieving strategic objectives.

Accurately measuring the impact of Knowledge Economy expansion on development is important for a variety of reasons. First, the capacity to manage change is vital since there are no simple solutions to the challenges of development. A dynamic Knowledge Economy can ensure that accurate, complete and timely information is available to manage change.

Second, information and knowledge are essential to formulate strategies and design projects that effectively deploy information and communication technology for development. Mechanisms need to evolve to match the demand for information and communication goods and services with supply. In the process, legal, technological, and regulatory safeguards must be established to ensure that all citizens participate in and benefit from a democratic process of equitable, efficient, and sustainable development.

Managing change depends on access to information and the application of knowledge. Ensuring this access, therefore, depends on applying development effectiveness methodologies to ICT deployment and Knowledge Economy expansion.

Once the idea of applying development effectiveness methodologies to Knowledge Economy expansion is understood, the questions that emerge relate to what should be measured and how. At the IDB, the Information Technology for Development Division of the Education, Science and Technology SubDepartment in the Sustainable Development Department, is promoting the application of the new development effectiveness processes, tools, and funding instruments to measure the *contribution* of Knowledge Economy expansion as a conceptual and programmatic "bridge" for achieving the two strategic objectives of the Bank: increasing the rate of sustainable economic growth and reducing poverty while promoting equity. Consequently, our primary focus is on the process of building consensus about outcomes, outputs, and indicators to ensure the effective construction of that bridge. Toward these ends, the Division works closely with the regional and central departments of the Bank. The adjustment to the new conditions of development created by the widespread deployment of ICT and Knowledge Economy expansion is a Bank-wide collaborative process.

In order to stimulate consensus on outcomes, outputs, and indicators, the Division invited some of the leading thinkers and practitioners in the field to share their ideas and experiences with IDB management and staff. The essays that form the chapters of this book reflect some of the ideas that were aired during their presentations at the Bank and the discussions that followed. Publication will help expand the discussion throughout the region and the Bank about how to design the most effective bridge. Each article, in its own way, pushes the

envelope of how we understand and measure the *contribution* of ICT and the Knowledge Economy to development objectives. Each of the book's four parts is introduced with a brief description highlighting the chapters and linking them to the larger context of the book.

Our overriding goal in this book, and in all our work, is to strengthen the individual and collective capacity of organizations and countries to manage change so that the expanding Knowledge Economy responds to the specific values, needs, conditions, resources, and aspirations of the countries of Latin America and the Caribbean. We strive to improve the ability of countries and the Bank, individually and collectively, to generate complete, relevant, and accurate measures of the contribution to development objectives made by ICT and expansion of the Knowledge Economy. The goal is to create conditions for more effective decision making by development policy makers and planners, ensuring that they have the information they need when they need it.

The Bank's commitment to development effectiveness is shaping four substantive intersectorial programmatic areas: ICT in sustainable economic growth, ICT in human capital formation, ICT in governance and ICT institutional arrangements.

ICT in Sustainable Economic Growth. Historically, expansion of the Knowledge Economy has helped to increase productivity and competitiveness, which, in turn, spur economic growth and the diversification of the labor force and result in higher incomes and changes in the character and volume of international trade.

ICT in Human Capital Formation. Lifelong learning is the fuel of Knowledge Economy expansion. The scope of learning activities taking place throughout the region is being expanded beyond primary, secondary, and tertiary education to include a variety of innovative learning environments being created by public, private, and civil society organizations.

ICT in Governance. This refers to the character of the relationship between citizens and their public sector representatives, which changes as ICT applications improve access to public services, improve public administration and contribute to greater openness and transparency.

ICT Institutional Arrangements. In order for countries to manage change effectively on an ongoing basis, organizational arrangements must ensure stakeholder participation, the use of appropriate instruments to measure, monitor and evaluate effectiveness, and access to needed information for making decisions and evaluating results.

Recognizing that there are no simple solutions to complex development challenges, the partnership between the IDB and its member countries seeks to create an enabling environment for innovation and learning about what works and what does not in ICT deployment in each programmatic area. The Information Technology for Development Division is a catalyst for this approach. Success depends on making countries and the Bank more successful and more effective as they adjust to the new conditions and insights in development emerging from the widespread deployment of ICT and an expanding Knowledge Economy. In tandem with countries in the region, we at the Bank understand that creating an enabling environment for managing change is the key to development effectiveness. This approach is crucial to carrying out our task of matching the changing and expanding needs of the countries in the region with our own mix of human and capital resources.

While it is impossible for a book to adequately cover all the issues, we believe that the ideas in this publication reflect an evolving approach to development in an emerging knowledge-based global economy that could contribute to refining and achieving strategic outcomes. As such this book is a work in progress, as is the evolving partnership in this area between the Bank and the countries of Latin America and the Caribbean. It is offered as a catalyst for further discussion in which feedback about each article, as well as the overall approach, is welcomed.

Part I

Information and Communication Technology in Sustainable Economic Growth

Economic growth is symbiotic with advances in information and communication technology. How they work together changes the relationships between people and what is known and knowable.

Institutional transformation, organizational change, and realignments of business processes can be crucial for realizing the potential of ICT. These key factors contribute to increased competitiveness, productivity, and growth. Whether or not ICT innovations actually realize their potential depends on many things, but most importantly on whether the incentives for a fair, open, and competitive market are in place and enforced.

Information and communication technology change over time. Yet as Joel Mokyr points out (Chapter 1), access to information for creating and applying knowledge has historical roots, and understanding those roots can contribute to economic growth. To better address the uncertainty of the information technology environment, Graham Mitchell (Chapter 2) calls for a shift in approaches, tools, and strategic orientation. Arlindo Villaschi (Chapter 3) underscores why development organizations must link innovation, technology, and knowledge with commitment to build social capabilities.

Chapter 1

Historical Origins of the Knowledge Society: Implications for Development

Joel Mokyr

One way to begin to comprehend the nature of a *knowledge society* is to ask what it means to reverse the elements of the term—in other words, what is useful *social knowledge*? What does it mean to say that a society "knows" something?

A sensible way to define knowledge at a social level is *the union of all the sets of individual knowledge of the members of that society*. This definition is consistent with our intuitive notion of the concept of an invention or a discovery—at first only one person has it; but once that happens, society as a whole feels it has been acquired.

This notion requires some simplifying assumptions—for instance, that we agree as to who does and doesn't belong to society. It also means that individual "knowledge" can be defined by abstracting from the degree of certainty that the individual has in the correctness of this knowledge. An immediate corollary of the definition is that the set of knowledge contains contradictory elements: it usually contains elements inconsistent with one another.

Another obvious characteristic of social knowledge is that its "truth" is irrelevant (by "truth" we can only mean something that conforms to the consensus view of our own time). In other words, "knowledge" pertains to what an individual *believes* to be true. Knowledge differs from information in that it exists only in the human mind. It can be stored in external storage devices such as books, drawings, and artifacts; but such knowledge is meaningless unless an actual person can transfer and acquire it.

A definition of this sort immediately requires a further elaboration: if one person possesses certain knowledge, how costly is it for others to acquire it? I shall refer to these costs as *access costs*. Such costs are central to any understanding of the process of knowledge accumulation.

This concept—access cost—lies at the heart of the idea of a "technological society." Knowledge is shared and distributed, and its transmission through learning is essential if a society is to use it effectively. At one extreme is a society in which all knowledge acquired by one member is "episodic" and not communicated to any other member. At the other extreme is a society in which all knowledge is shared through some monstrous super network (as envisaged by Robert Wright, 2000). Between the extremes is a reality—sharing and access of knowledge that is partial and costly.

These access costs were not historically invariant, and their development is one of the keys to technological change. Basically, these costs depended on two types of factors, technological and cultural. The technological factors determined the physical costs of disseminating information, including communications, transportation, printing, and the technology of organizing information. The cultural factors determined the extent to which the people who possessed the knowledge were willing to share and place it in the social domain.

The term "useful knowledge" was used by Simon Kuznets (1965: 85–87) to mean the source of modern economic growth. One could debate at length what "useful" means; and though I will

defer that here, in what follows, I am motivated by the centrality of technology. Because technology in its widest sense is the manipulation of nature for human material gain, I confine myself to knowledge of natural phenomena and regularities that exclude the human mind and social institutions. To be sure, a great deal of important knowledge, including economic knowledge, involves people and social phenomena: knowledge about prices, laws, relationships, personalities, the arts, literature, and so on. I must also immediately qualify that some "technologies" are based on the regularities of human behavior—for example, management science and marketing that use psychology—and thus they might be considered part of this definition. Moreover, some segments of useful knowledge defined in this way are rather unlikely to be applied to any technical purpose—for example, astronomical knowledge about remote galaxies. Yet despite such gray and ambiguous areas, I shall maintain my definition.

Propositional and Prescriptive Knowledge

The set of useful knowledge defined above can be partitioned into two subsets. The first is the knowledge that catalogs natural phenomena and regularities ("knowledge of what"). I will call that *propositional knowledge*. The second is the knowledge that prescribes certain actions to manipulate natural phenomena for human material needs ("production"). I will call that *prescriptive knowledge*.

Propositional knowledge contains what we call "science" (formal and consensual propositional knowledge) as a subset, but it contains a great deal more than science. Through most of human history, indeed, science was a negligible subset; and it is one of the hallmarks of technological modernity that the relative size of the scientific component of propositional knowledge has grown in relative importance. Propositional knowledge also contains practical informal knowledge about nature—for example, the properties of materials, heat, motion, plants, and animals. It contains an intuitive grasp of basic mechanics, including the six "basic machines" of classical antiquity—the lever, pulley, screw, balance, wedge, and wheel. It contains regularities of ocean currents and the weather, as well as folk wisdom, such as, "An apple a day keeps the doctor away."

Geography is very much part of it. Knowing where things are logically precedes the set of instructions on how to go from here to there. It also includes what Edwin Layton (1974) has termed "technological science" or "engineering science," and what Walter Vincenti (1990) has termed "engineering knowledge"—which is more formal than folk wisdom and the mundane knowledge of the artisan, but less formal than science. Engineering knowledge concerns not so much the general "laws of nature" as the formulation of quantitative empirical relations between measurable properties and variables. It considers abstract structures that make sense only in the context of engineering or chemistry—for example, the friction-reducing properties of lubricants or simple chemical reactions (Ferguson, 1992: 11).

Prescriptive knowledge has the form of techniques or instructions. The archetypical technique is the recipe, which instructs on how to prepare a certain dish. In principle, all techniques are such sets, although they are vastly more complex and often filled with nested do-loops, if-then statements, and so on. The technique, not the artifact, is the fundamental unit of analysis in evolutionary accounts of technology. They are sets of executable instructions—just recipes of a different sort—on how to manipulate nature, much like Richard Nelson and Sidney Winter's (1982) "routines." When these instructions are carried out in practice, we call the result *production*. The sets of techniques are no longer knowledge then, but action. This is comparable to DNA instructions being "expressed."

The instructions in the set that I call prescriptive knowledge, like all knowledge, reside either in people's brains or in storage devices. They consist of designs and directions for how to

adapt means to a well-defined end, much like a piece of software. They can all be taught, imitated, communicated, and improved upon. A "how-to" manual is a codified set of techniques. An addition to the prescriptive knowledge set of a society would be regarded as an "invention" (although the vast majority of inventions were and are small incremental changes unrecorded by patent offices and history books).

One feature of any technique is that it cannot wholly be written down. There is always an irreducible "tacit" component that cannot be eliminated, requiring those who execute it to possess some knowledge. Not all techniques are explicit, codified, or even verbalized. But even those that are codified in some way are rarely written down in complete form, and much is left to be interpreted by the user. Thus, riding a bicycle or playing a musical instrument consists of neuromuscular movements that cannot be made entirely explicit. It should be obvious that in order to read such a set of instructions, readers need a "codebook" that explains the terms used in the technique (Cowan and Foray, 1997). Even when the techniques are wholly explicit, the codebook may be lacking; and thus a second codebook is needed to decipher the first, and on and on. Eventually some knowledge must be tacit. Sometimes instructions are tacit even when they could be made explicit but it is not cost-effective to do so. Each society has access to some metaset of feasible techniques, a monstrous compilation of blueprints and instruction manuals that describe what a society can do.

What did these techniques look like in the more remote past? That may be hard to pin down; yet all the same, they existed. From that set, economic decision makers—whether households, peasants, small-scale craftsmen, or large corporations—selected the techniques actually used. This choice is the technological analog of natural selection; and since enunciated by Nelson and Winter (1982), it has remained the best way to describe and analyze technology and technological change. Naturally, only a small subset of feasible techniques is in use at any point in time.

Why society selects some techniques and rejects others is an important question needing discussion (Mokyr, 2005). In addition, techniques need to be passed from generation to generation because of wear and tear on their carriers. Much learning happens within families or in master-apprentice relationships. Despite the codifiability of many techniques, direct contact between teacher and pupil seemed, at least until recently, indispensable. We need to distinguish between the knowledge needed to write down a set of instructions for the first time ("invent") and carry them out ("produce"). In order to write this paragraph, I learned to use WordPerfect, but I did not need to know very much about the programming language and technique of those who created it. The kind and amount of knowledge necessary to play the *Hammerklavier* sonata is very different from the knowledge needed to write it.

The Role of Technology in Economic Growth

An increase in the set of prescriptive knowledge, allowing society to produce cheaper and better products, is at the heart of the economic growth process. Economists associate long-term economic growth with technological progress; it is deeply embedded in the main message of Solow-inspired growth models, which treated technological change as exogenous, and even more so in the endogenous growth models. Whether technology is an exogenous deus ex machina that somehow descends like manna from heaven and makes productivity grow a little each year, or produced within the system by the rational and purposeful application of research and development—technology is central to the dynamic of the economy in the past two centuries. The growth of human and physical capital is complementary with growth in useful knowledge, and even the simple computations that equate total factor productivity with technological progress demonstrate its importance beyond doubt. Many scholars believe that people are

inherently innovative, so that technological change is almost guaranteed if circumstances are right (the exact nature of right circumstances differs from scholar to scholar).

All the same, economic historians studying earlier periods have come to realize that technology was less important than institutional change in explaining premodern (say, before 1750) episodes of economic growth. It is easy to point to the many virtues of "Smithian growth," the increase in economic output caused by commercial progress (as opposed to technological progress). Better markets in which agents specialize by comparative advantage and take full advantage of economies of scale, and in which enhanced competition stimulates efficiency and best-practice technology, could generate growth sustainable for decades or even centuries. Even with no changes in technology, economies could and did grow in the presence of peace, law and order, improved communications and trust, the introduction of money and credit, enforceable and secure property rights, and similar institutional improvements (Greif, 2005). Better institutions could lead to improved allocation of labor and land, encouraged productive investment, reduced the waste of talent on rentseeking and the manipulation of power for the purposes of redistribution (North, 1990; Baumol, 2002). Pre-1750 growth was primarily based on Smithian and Northian effects: gains from trade and more efficient allocations through institutional changes. The Industrial Revolution, then, can be regarded not as the beginnings of growth altogether but as the time at which technology assumed an ever-increasing weight and eventually dominant role in the generation of growth.

The main reason why technological progress was at best an also-ran in the explanation of economic growth before 1750 is that even the best and brightest mechanics, farmers, and chemists knew relatively little of what could be known about the fields of knowledge that they sought to apply. The pre-1750 world produced, sometimes very well. Many pathbreaking inventions were made. But it was a world of engineering without mechanics, iron making without metallurgy, farming without soil science, mining without geology, water power without hydraulics, dye making without organic chemistry, and medical practice without microbiology and immunology. Not enough was known to generate sustained economic growth based on technological change.

Around 1750, all this began to change. Economic historians refer to the phenomenon as the Industrial Revolution, which they locate in key industries such as cotton and iron in certain regions of Britain. Yet as I have argued elsewhere (Mokyr, 2002), the so-called Industrial Revolution relates to deeper changes that were taking place across much of the Western world. In any event, this moment of change marks the beginning of modern economic growth, the kind of continuing expansion that can be sustained decade after decade without hitting the blocks and ceilings that previous societies had run into. The vast literature on the Industrial Revolution is still growing, with scholars placing differing emphases on its economic and social components. The consensus is, however, that it could not have happened without its technological component. From then on, technological change played an increasingly pivotal role in economic change. While there can be no dispute that it started in the West, the underlying changes were soon to affect the entire world.

What, really, changed? To understand this profound historical question, we need to make some use of concepts introduced earlier. The main idea is that in order to manipulate nature, something has to be known about its phenomena and regularities. Each technique in the set of prescriptive knowledge has a support or base in the set of propositional knowledge. I shall call that concept the *epistemic base* of the technique. To be succinct, I shall summarize the logical and historical relationships between the different kinds of knowledge in ten propositions.

First, every technique has a *minimum* epistemic base contained in the set of propositional knowledge, which contains the least knowledge that society needs to possess for this technique to be invented. This base can, for some techniques, contain no more than the trivial statement, "this technique works," in which case I shall refer to it as a singleton technique.

Second, many techniques require a minimum epistemic base larger than a singleton for a working technique to emerge, that is, they require some understanding of the underlying natural processes.

Third, the *actual* epistemic base is equal to or larger than the minimum epistemic base.

Fourth, there is no requirement that the epistemic base be true or correct in any sense.

Fifth, the wider the actual epistemic base supporting a technique relative to the minimum one, the more likely an invention is to occur, ceteris paribus.

Sixth, the wider the epistemic base and the lower the access costs to it, the more likely an existing technique is to be improved, adapted, and refined.

Seventh, the epistemic bases in existence during the early stages of an invention are historically usually quite narrow at first, but are often enlarged following the appearance of the invention, and sometimes directly on account of the invention.

Eighth, both propositional and prescriptive knowledge can be "tight" or "untight." Tightness measures the degree of confidence and consensualness of a piece of knowledge: how sure are people that the knowledge is true or that the technique works?

Ninth, it is not essential that the inventor, that is, the person writing the instructions, actually knows him or herself everything that is in the epistemic base. It is enough for the inventor to consult someone who does know—hence the importance of access costs.

Tenth, the existence of a minimum epistemic base is a necessary but insufficient condition for a technique to emerge. A society may well accumulate a great deal of propositional knowledge that is never translated into new and improved techniques. Knowledge opens but does not force society to walk through doors. It is here where the centrality of institutions and their interaction with useful knowledge is paramount.

Given these propositions, we can sharpen our understanding of modern economic growth. Before 1800, most techniques were either singleton or supported by quite narrow epistemic bases. In the absence of concomitant growth in propositional knowledge, the technological breakthroughs we associate with the early stages of the Industrial Revolution (1760–90) could have crystallized into a new, more-or-less static world as had happened repeatedly in the past. The Industrial Revolution would still have taken place in some sense, but it would have fizzled by 1800; and a new stationary state would have emerged, as most observers at the time expected. This did not happen largely because the epistemic bases of the new techniques were wider, and more importantly, because they were growing.

The growth of propositional knowledge after 1750 was no accident. Technology and science coevolved in many ways, reinforcing and strengthening each other. The traditional linear model, in which advances in science led to technological progress, has long since been abandoned. Technology affected science as much as the other way around. As noted, moreover, propositional knowledge contains a great deal more than science; and while the hallmark of technological modernity is a large and growing scientific component, it was still

quite small in the period of the Industrial Revolution. The artisanal and descriptive forms of propositional knowledge were, however, growing rapidly. Clever mechanics dexterously designed machines based on principles that came to be better understood more slowly, even if the science behind them was still quite murky.

Had the set of propositional knowledge remained more or less static, and had access costs remained the same, the expansion of techniques in the early Industrial Revolution would have run into diminishing returns. We might well imagine a counterfactual technological steady state—throstles, wrought iron, canals, and stationary steam engines in which there was a one-off shift from wool to cotton, animate power to stationary engines, and cheap wrought iron with no further progress. Fortunately, the first wave of innovations was followed by a secondary ripple of inventions after 1820. These may have been less spectacular, but they were the microinventions that gave muscle to the downward trend in production costs.

The second stage of the Industrial Revolution adapted novel ideas and tricks that were applied in more industries and sectors. The earlier innovations were improved and refined, which eventually was reflected in the productivity statistics. The techniques applied first in cotton were adapted to wool and linen. Iron became progressively better and cheaper. Railroads reduced transport costs, encouraging local specialization and labor mobility. Iron ships equipped with modified high-pressure boilers began shipping ever-cheaper food and raw materials from other continents. Chemists learned why the old processes worked, then tinkered to make the old ones cheaper and created entirely new ones.

By 1870, we can speak of a second Industrial Revolution. While income growth in Britain during the "classical" Industrial Revolution had been modest, per capita growth after 1830 accelerated to around 1.1 percent, modest perhaps by modern standards but unprecedented in the 19th century. In the ensuing years, the role of technology in economic growth has steadily expanded. The second Industrial Revolution added many new ingredients to the ever-expanding horizons of production in the West—cheap steel, electrical power, synthetic chemicals, pharmaceutics, food processing, and interchangeable parts manufacturing, to mention a few. By 1914, the technological gap between the West and the rest of the world had reached unimaginable proportions, resulting not just in a large difference in income per capita so far as we can measure it, but also in the ease with which Europe controlled much of the underdeveloped world.

The economic history of the 20th century provides the best testimony to the enormous force that growing useful knowledge had acquired as an agent of historical change by 1914. After all, while Europe had been relatively peaceful and subject to only short-lived minor fluctuations during the 19th century (actually between 1815 and 1914), the 20th century saw two devastating world wars, the collapse of the international economy after 1914, violent inflations and a great depression vastly more serious than any previous experience, and the rise of totalitarian and collectivist governments that imposed policies almost always detrimental to economic growth. To top things off, Europe lost its colonies after 1945, and population growth slowed to a trickle with the decline of fertility in the closing decades of the century.

Had an informed observer in 1914 been told of what was to come, sharp, unavoidable economic decline would almost certainly have been predicted. Yet, despite the obstacles of the 20th century, the West actually experienced much faster growth than before. We can only speculate how much faster this growth might have been had the fateful events of July 1914 taken a different turn and the world been spared the horrors of world wars, Leninism, and Hitlerism. Even more remarkable were the few dramatic technological breakthroughs in

the decades immediately following 1914. Many of the technological advances of the 20th century were in place in 1914. They just needed continued development and improvement to make their mark on daily life. Internal combustion engines, aviation, telephony, electricity, synthetics, and even electronics had their beginnings in the years before World War I. The following three decades witnessed continuing expansion of these techniques, with dramatic consequences for the standard of living of those lucky enough to survive.

After 1945, dramatic new developments again occurred—the advances in microprocessors, unorthodox energy sources and uses, antibiotics, satellites, and a plethora of new materials, to name just a few. Yet here too, what's striking is the importance of development rather than invention alone. The invention of the laser, to pick just one example, is a dramatic application of quantum physics that would probably have been impossible in the 19th century. But its rapid application to areas as diverse as music playing, bar codes, eye surgery, and smart bombs testifies to the wide epistemic base of the underlying knowledge and the much lower access costs that 20th century engineers and inventors faced. Not all new techniques were equally successful, and some have been abused. Yet the overall picture is undeniable: the growth of useful knowledge and the concomitant technological progress have turned from relatively small contributors to economic change, to the engine that drives economies to ever-higher plateaus.

Institutions, Politics, and the Conditions for Knowledge

Technology may have been the engine of economic growth in modern times, but as any driver knows, cars do not move by engines alone. Many scholars feel that *institutions*—formal and informal—matter more. So does the trustworthiness of government, the functionality of the family as the basic unit, security and the rule of law, a reliable system of contract enforcement, and the attitudes of the elite in power toward individual initiative and innovation. Some societies are simply better organized and their incentive systems work better than others. In this view, best expressed by North (1990) and Eric Jones (2002), hard work, initiative, and frugality will bring about growth only if properly rewarded, and such rewards are determined by the institutional structure.

The main institution accounting for economic success was the market, yet I would argue that markets on their own could not have generated the levels of growth after 1914. The juxtaposition of institutions and useful knowledge as alternative explanations of economic growth is, to a large extent, artificial. Differences in institutions better explain differences in a cross section of income levels at a given moment. Knowledge can and does flow across national boundaries, if not always with the frictionless ease that some economists imagine. If the only reason why Germany is richer than Zimbabwe today were that Germany possesses more useful knowledge, the difference might be eliminated in a relatively short time. If we were to ask, however, why Germany is richer today than it was in 1815, the importance of technology becomes unassailable—though better institutions also would still be important. Yet such decompositions of the sources of growth are of limited use.

Institutions and knowledge interact, and the interaction term may be larger than the individual components on their own. Institutions play a central role in the rate and direction of the growth of useful knowledge itself. Science and technology, as the constructivist school insists, are social processes. This approach is not as remote from the thinking of economists as they believe: everyone agrees that incentives matter. It is also understood that the supply of talent in the economy is finite, and that it should be regarded as another scarce resource.

Institutions help determine on which margins the efforts and time of the most resourceful and ambitious men and women will be applied. Potential entrepreneurs, innovators, and inventors

will try to make their fortune and fame wherever they perceive the rewards to be most promising. There are many possible avenues—industry, commerce, innovation, the arts, and finance, or plunder, extortion, and corruption (Murphy, Shleifer, and Vishny; 1991). From the point of view of the economic agent, a dollar made in any activity is the same. From the point of view of the economy, however, entrepreneurial activity is enriching, rentseeking is impoverishing (Baumol, 1993). The institutions of society determine when these efforts will be most rewarding and remunerative.

Institutional factors mattered first and foremost because they determined economic efficiency by affecting the exchange relations among people, resource allocation, and savings and investment behavior. Useful knowledge is different. The fundamental nature of production is an attempt to tease out of the environment something that is desirable by humans but that nature is not willing to give up voluntarily. By abandoning passive activities such as hunting and gathering and by exploiting the regularities they detected in nature, people invented farming and created what we might call a production society. By formalizing these regularities into something that eventually became science and allowing them to interact with the techniques they implied, the Baconian program reached a critical mass in late-18th-century Western Europe. There was nothing inevitable about this. It is far from obvious that had Western Europe never existed, or had it been wiped out by Genghis Khan, or been taken over in its entirety by the Spanish Inquisition, that some other society would have eventually developed X-rays, solar-powered desk calculators, and freeze-dried coffee.

The search for new knowledge can take many avenues, some of which are more useful than others. Knowledge that may have seemed rather abstract initially, such as pure mathematical knowledge, eventually can find unexpected uses. And yet the accumulation of useful knowledge is not like other entrepreneurial activities. The drive for understanding nature and recognition by one's peers for successfully having done so transcend purely material motives. In all human societies, curiosity and the thirst for knowledge for its own sake have been a driving motive in the accumulation of propositional knowledge. People do not expect to be paid for solving crossword puzzles; they enjoy the challenge. Scientific and technological puzzles are no different. One way of describing the modern age is that the relative importance of knowledge for its own sake has declined relative to useful knowledge that may be mapped fruitfully into better techniques. Whereas some part of the growth of propositional knowledge in a society of market-driven capitalist institutions is still motivated by pure epistemic motives, economic interests, no matter how remote, have become increasingly important in driving and directing the growth of useful knowledge in the past century and a half. The Baconian dream is increasingly becoming a reality.

Conclusion

The 20th century has been astonishingly successful in its improvements of the human lot. We are not individually better people. We are certainly not smarter, wiser, more judicious, nor more moral than our ancestors were three centuries ago. Yet collectively, humankind in 2005 knows more than ever before and is still learning rapidly. Such knowledge has enormous potential to make life better on this planet, as well as the potential to extinguish it. It seems to me that by knowing more rather than less, the likelihood of disaster can be limited and the costs of knowledge that misfires can be reduced. Useful knowledge based on wide epistemic bases has the miraculous ability to continuously adjust, improve, and self-correct. A wise historian of technology once formulated what has become known as Krantzberg's Law: Technology is neither good nor bad. Nor is it neutral. The same might be said of useful knowledge in general.

References

Baumol, W. J. 1993. *Entrepreneurship, Management, and the Structure of Payoffs*. Cambridge, Massachusetts: MIT Press.

———. 2002. *The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism*. Princeton: Princeton University Press.

Cowan, R., and D. Foray. 1997. "The Economics of Codification and the Diffusion of Knowledge." *Industrial and Corporate Change* 6 (3): 595–622.

———. 1994. *Science and the Secrets of Nature*. Princeton, N.J.: Princeton University Press.

Ferguson, E. S. 1992. *Engineering and the Mind's Eye*. Cambridge, Massachusetts: MIT Press.

Greif, A. 2005. *Institutions: Theory and History*. Cambridge: Cambridge University Press. Forthcoming

Jones, E. L. 2002. *The Record of Global Economic Development*. Cheltenham, Great Britain; Northampton, Massachusetts: Edward Elgar.

Kuznets, S. 1965. *Economic Growth and Structure*. New York: W. W. Norton.

Layton, E. T. 1974. "Technology as Knowledge." *Technology and Culture* 15: 31–41.

———. 2001. "Knowledge, Consumption, and Endogenous Growth." In U. Witt, editor, *Escaping Satiation: The Demand Side of Economic Growth*. Berlin: Springer Verlag.

Mokyr, J. 2002. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton: Princeton University Press.

———. 2003. "Mercantilism, the Enlightenment, and the Industrial Revolution." Paper presented to the Conference in Honor of Eli F. Heckscher, Stockholm, Sweden (May 2003). Forthcoming in Ronald Findlay, Rolf Henriksson, Hdkan Lindgren and Mats Lundahl (editors), *Eli F Heckscher (1879-1952): A Celebratory Symposium*, Cambridge, MA: MIT Press, 2005.

———. 2005. "Useful Knowledge as an Evolving System: The View from Economic History." In L. Blume and S. N. Durlauf, editors. *The Economy as an Evolving Complex System*. Vol. III. New York: Oxford University Press.

Murphy, K. M., A. Shleifer, and R. W. Vishny. 1991. "The Allocation of Talent: Implications for Growth." *Quarterly Journal of Economics* 106 (2): 503–30.

Nelson, R. and S. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge: The Belknap Press of Harvard University Press.

North, D. C. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge, United Kingdom: Cambridge University Press.

Vincenti, W. 1990. *What Engineers Know and How They Know It*. Baltimore: Johns Hopkins University Press.

Wright, R. 2000. *Nonzero: The Logic of Human Destiny*. New York: Pantheon Books.

Chapter 2

Visions and Revisions: Information Technology and the Future of Development

Graham R. Mitchell

For more than 30 years, private sector investment in a bewildering array of ICT products, services, systems, and processes has transformed consumer and business markets throughout the world. The information industry has introduced a continuous stream of new approaches and novel ways of doing business, challenging many of our most firmly held beliefs about managing business and technology. This has been true not only in implementation and operation but at a conceptual level.

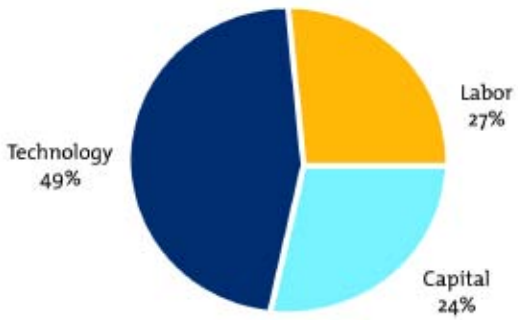
The information technology challenge has manifested itself in two related areas. First, continuous exponential improvements in information technology performance and the increased market and business volatility that creates are leading us to rethink many traditional approaches to business and financial investment. To the extent that business decisions in IT are necessarily based on uncertain assumptions rather than on facts, the tools, techniques, and approaches of entrepreneurship are finding ever-wider applications in mainstream IT investments (McGrath and MacMillan, 2000; Mitchell and Hamilton, 1988). Second, the global proliferation of transnational information networks, operating largely outside government control, suggests that nothing short of a new economic vision of the firm can capture the Net-centric, extended supply-chain operations of today's globally outsourced enterprises (Kleindorfer, 2005).

The fundamental case for *public* investment in IT stems from recognition that technological advance is a principal driver behind sustained economic growth. Governments generally accept that the public good will be well served by policies that encourage technical education, R&D, and infrastructure while also building a business climate for innovation and private investment in technology (National Science and Technology Council, 1996). Yet for the development organization interested in information technology, it may be appropriate to ask how far investment priorities should extend beyond the traditional public sector concerns for education, R&D, and infrastructure. How should the new, rapidly evolving, private sector perspective also be taken into account?

The Canonical Case for Public IT Investment: National Policy

Studies of the United States and other developed countries show that technological advance is responsible for nearly half of long-term economic growth; and as shown in Figure 2.1, it is responsible for more than 80 percent of the growth in total factor productivity (National Science and Technology Council, 1996).

Figure 2.1. Relative Contributions to Long-Term Economic Growth



Source: Boskin and Lau, 1992.

In addition, as shown in Figure 2.2, many of the most important measures of performance in the field of information technology—such as processing power, storage and memory capacity, fiber-optic transmission capacity, and other measures of performance per dollar or unit volume—expanded exponentially during the past four decades.

Figure 2.2. Progress in Information Technology

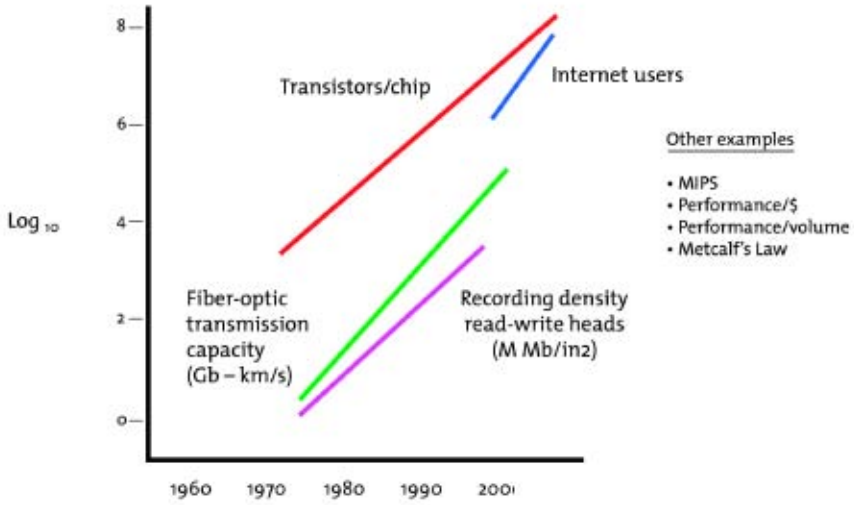
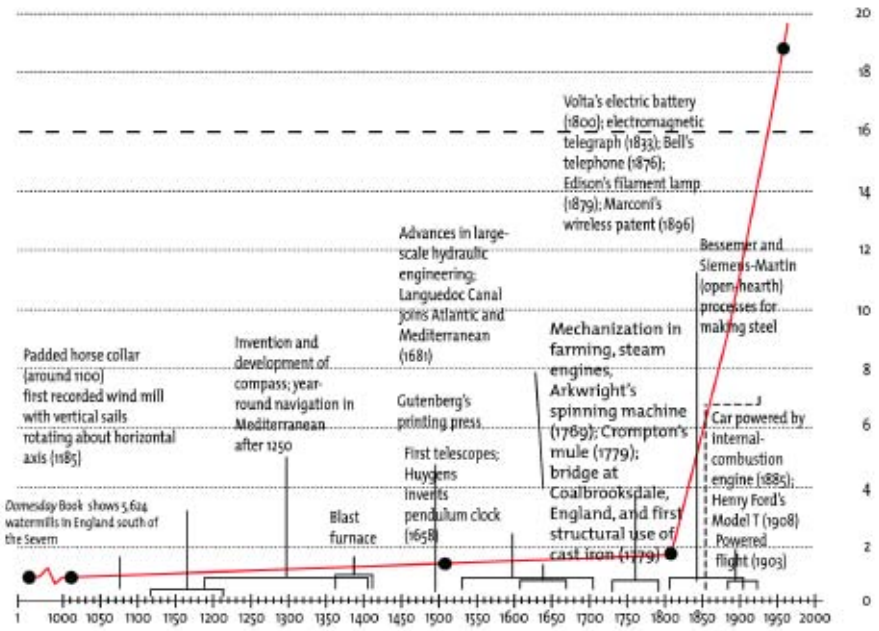


Figure 2.3 shows growth in per capita income in Europe over the past millennium, dramatically illustrating the rapid economic growth that is principally associated with the Industrial Revolution and the technical advances of our own era.

Figure 2.3. GDP per Capita in Western Europe



Sources: Angus Maddison; IMF – The *Economist*, 2000.
Note: GDP is measured in thousands of 1990-valued dollars.

When taken together, these trends suggest that the recent advances in information technologies are likely to continue to drive economic growth for some time to come—barring, that is, major political and economic disruptions or insurmountable resource limitations.

U.S. administrations have clearly recognized the importance of technological advance in underpinning growth. Bill Clinton put it this way:

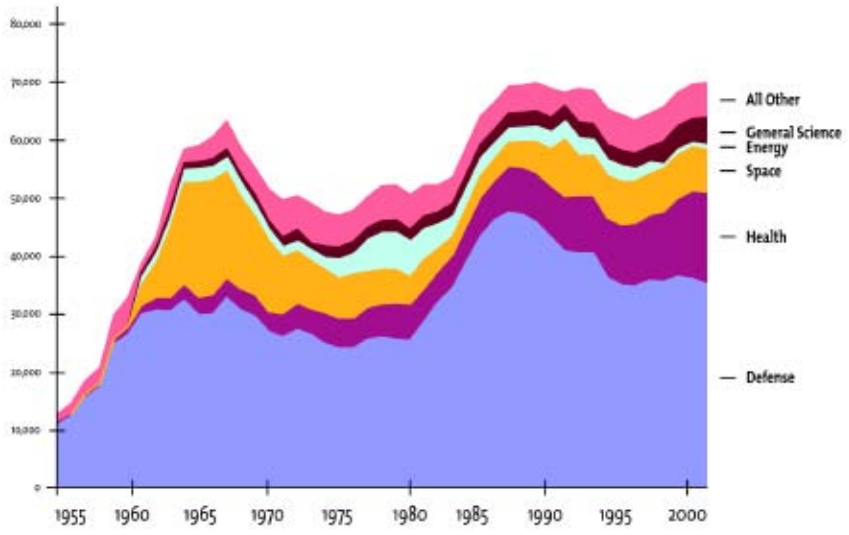
> Since the dawn of the Industrial Revolution, alarmists have argued that technology and automation threaten jobs. Such claims are still heard today. But history shows that they are wrong again. Time after time, in epoch after epoch and country after country, technological advance has produced higher wages and living standards, not mass unemployment. This is exactly what we expect to happen again in the 21st century. And the government should be helping this process along—facilitating growth and change, not impeding it (Clinton, 1993).

Clinton's vision is hardly unique to the United States. Countries around the world are focusing on policies that promote sustained economic growth and technological advance. Though avoiding overtly direct subsidies to domestic industries (or at least trying to), most developed economies pursue growth through technological advance on several fronts. First, they invest in people—education, R&D, and a national science and technology agenda. Second, they invest in infrastructure, including IT infrastructure. Third, they try to create business climates that encourage innovation, growth, and the commercialization and deployment of new technology. Finally, they supplement the other measures through policies and programs that facilitate technology transfer (Mitchell, 1999). Development organizations, I believe, should be expected to adopt a similar investment agenda in support of the public good.

U.S. National Investment in R&D

Within the United States, direct government investment in R&D is only a part of the picture. As shown in Figure 2.4, U.S. federal investments in R&D have been dominated by defense spending over the past 50 years, peaking as a percent of GDP at the height of the space race in the 1960s.

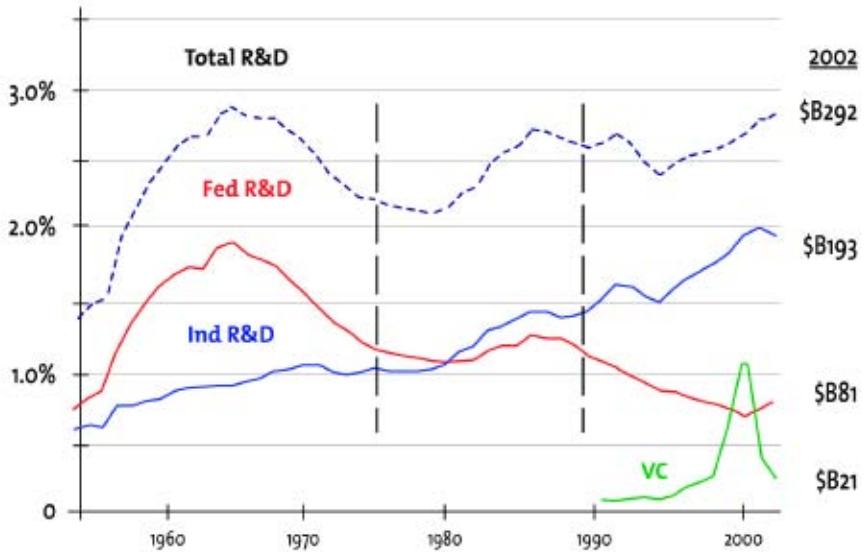
Figure 2.4. U.S. Federal Funding of R&D, 1955-2001



Sources: NSF.

When viewed together with industrially funded R&D, U.S. national R&D funding patterns fall into three distinct periods. As shown in Figure 2.5, U.S. national spending in R&D was dominated by federal funding from 1950 to the mid-1970s. Federal and industrial funding were at comparable levels from the mid-1970s to the late 1980s. Industrial R&D funding surged significantly to approximately twice the federal level from the late 1980s to the present. Figure 2.5 also shows national venture capital spending which peaked at $10 billion, compared with $60 billion in federal R&D for that year. Much of this investment, though not strictly R&D, was targeted to the creation of new businesses based on technological advances.

Figure 2.5. Federal R&D, Industrial R&D, and Venture Capital as Percents of GDP



Sources: NSF/NVCA.

Table 2.1 shows the approximate share of total U.S. industrial R&D from information, pharmaceuticals and biotechnology, and other sectors. Much of the growth shown in industrial R&D was funded by increased corporate spending in information after 1980. Spending in pharmaceuticals and the biotechnology sector increased sharply after 1995.

Table 2.1 Share of U.S. Industrial R&D by Sectors, 1981–98 (in percent)

Sector	1981	1988	1995	1998
Information/Electronics R&D	32	42	44	48
Drugs/Medicines R&D	7	9	16	17
Other Industrial Sectors' R&D	61	49	40	35

Sources: U.S. DOC; Standard & Poor's Compustat (Nov.1999).
Note: Sample includes all listed U.S. publicly traded companies that conduct at least $1,000 in R&D.

Table 2.2 shows the dominance of these two sectors in R&D. For 2003, 8 of the top 18 R&D spenders in the United States were information-based companies. Seven were pharmaceutical and health companies.

Table 2.2 Top U.S. Corporate R&D Spenders, 2003

Company	$Billion	Share of Sales (%)
Top 1,000	160.850	4.6
Microsoft*	7.779	21.1
Ford Motor Co.	7.500	4.6
Pfizer**	7.131	15.8
General Motors	5.700	3.1
IBM*	5.068	5.7
Johnson & Johnson**	4.684	11.2
Intel Corp*	4.360	14.5
Motorola Inc*	3.771	13.9
Hewlett-Packard*	3.652	5.0
Merck & Co**	3.178	14.1
Cisco Systems Inc*	3.131	16.6
Lilly & Co**	2.350	18.7
Bristol Myers Squib**	2.279	10.9
General Electric	2.103	1.6
Wyeth**	2.093	13.2
Delphi Corp*	2.000	7.1
Sun Microsystems*	1.926	17.2
Abbott Labs**	1.733	8.8

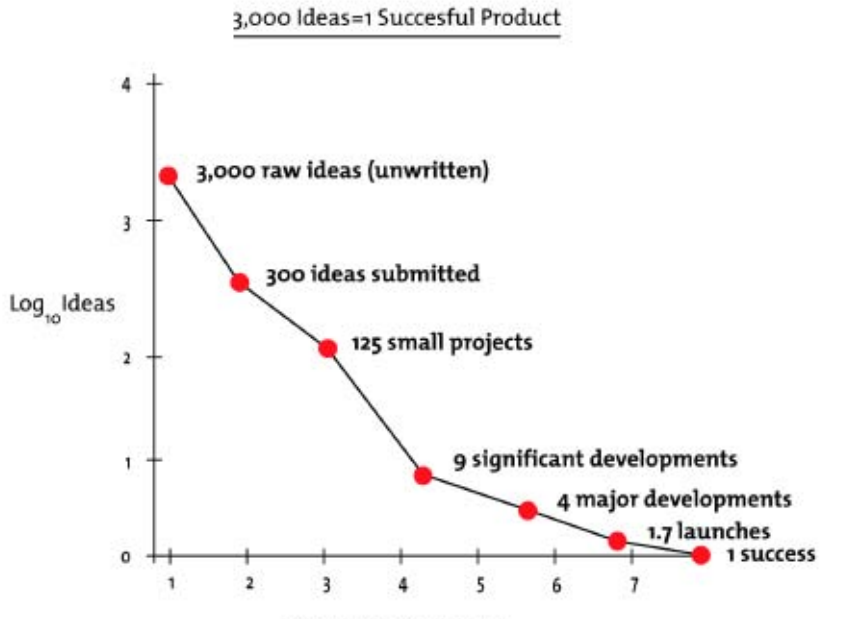
* Information companies.
** Pharmaceutical/health companies

Managing R&D Investments under Various Levels of Uncertainty

The path to a new product—from initial concept to successful product launch—is shown graphically in Figure 2.6. On average, it takes over 3,000 unwritten raw ideas to produce a single successful product launch (Stevens and Burley, 1997). As raw ideas pass from the initial concept, they are transformed through evolving stages of project management. Step by step, uncertainties are resolved; confidence in success builds; and more expenditures are committed. Eventually, the raw idea is commercialized.

Figure 2.7 illustrates approaches to managing R&D at different levels of uncertainty. Implicitly, the appropriateness of management tools and decision-making criteria varies greatly as ideas evolve through the process into commercial products.

Figure 2.6. Universal Product Development Curve



"Universal Industrial Success Curve" Between each stage of the new product development (NPD) process.

Sources: Stevens, Burley Research Technology Management, May-June 1997

Figure 2.7. Three Ways of Managing R&D at Different Levels of Uncertainty

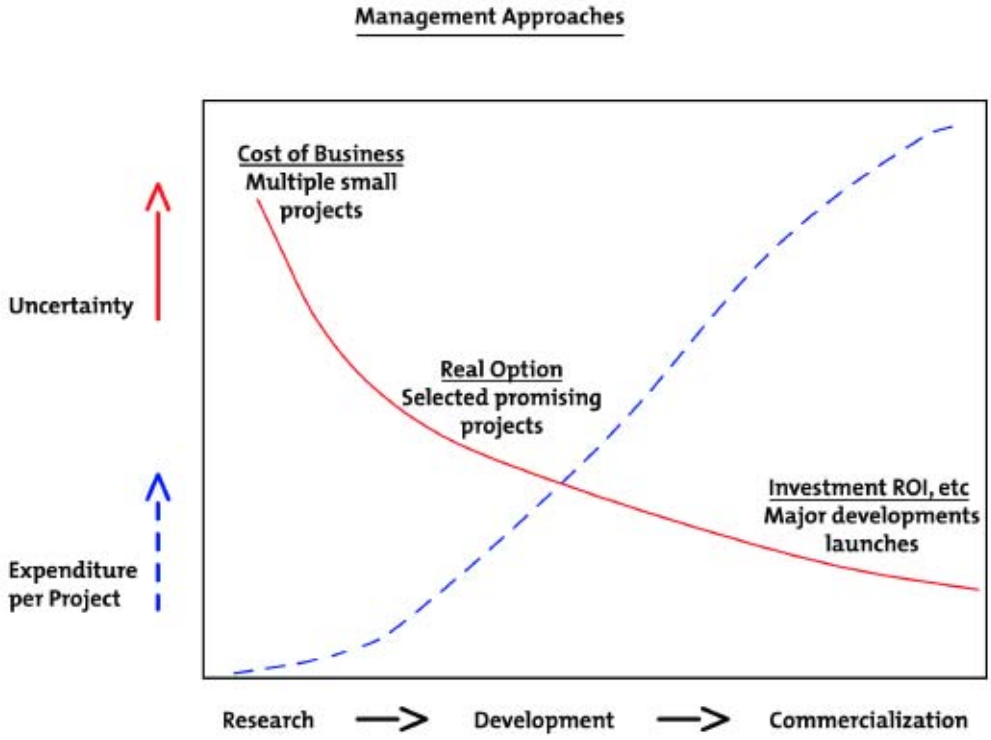
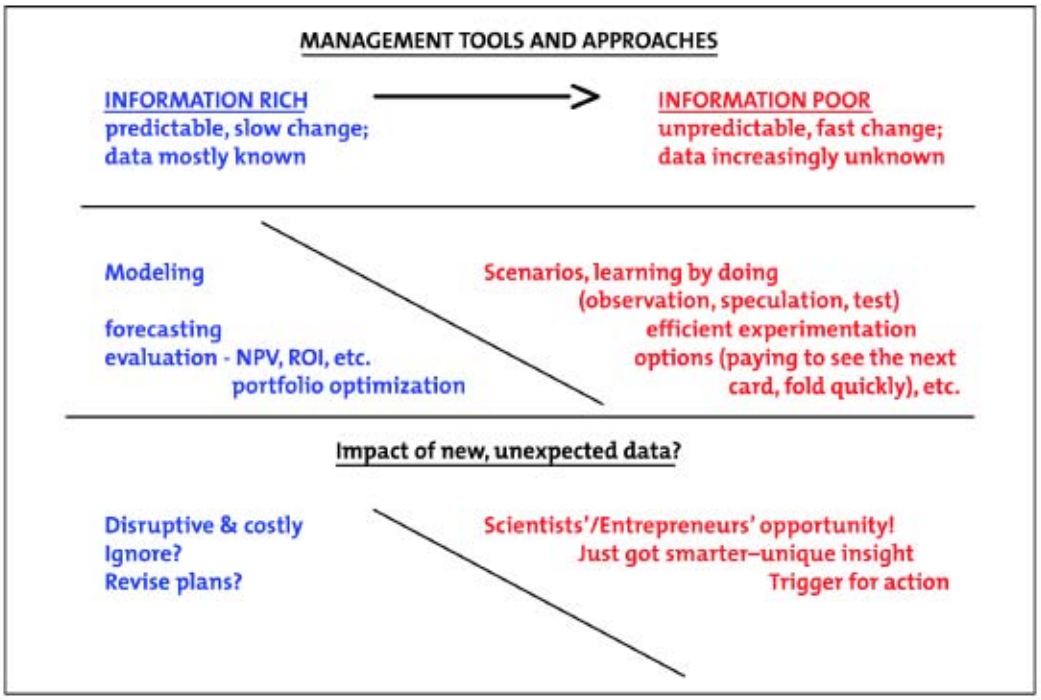


Figure 2.8 contrasts management tools that are appropriate for information-rich versus information-poor environments. As the figure illustrates, we are relatively "richer" in business and

Figure 2.8. Management Tools for Information-Rich vs. Information-Poor Environments



financial tools that are applicable toward the end of the process, that is, at the product/service-launch and major-investment stage. Typically, some form of return on investment (or comparably explicit and consistent criteria) will be used toward the end of the process in order to justify the major investments—for example, investing in the launch of a new product.

At the other end—that is, at the start of the process—most sophisticated companies recognize the need to invest in the early conceptual or idea-generation phases. This is when potential for future returns is speculative, if not impossible to determine. The costs of doing business are uncertain. Many companies develop a level of comfort by allocating a modest proportion of their R&D budget to exploratory research, which is justified as "knowledge building."

In reality, ideas seldom make a single jump from the exploratory stage to full-bore corporate investment to bring a major new commercial venture to market. Once ideas progress beyond the exploratory stage, the required investments are generally significant and require strategic commitments. Decisions cannot be left to the discretion of the technical community nor treated as routine business costs. The idea usually is still too undeveloped and its prospects too uncertain to be accepted as a major business investment. At this stage, an idea frequently fails to meet the corporation's well-accepted guidelines for investment.

Decisions at this critical stage can more accurately be modeled as *real options* (McGrath and MacMillan, 2000; Mitchell and Hamilton, 1988). Rather than being thought of as hard authorization to follow through to full commercial investment, decisions at this point imply relatively modest commitments toward intermediate goals—essentially, to pursue the idea to the next milestone. Thus, the *option* to continue extends only as far as the next step.

Interestingly, the overall decision-making logic of this process most closely resembles a three-step poker game. First, the player commits a small up-front charge to be in the game. Second, the player pays a relatively small amount to see the next card. Finally, a decision is made to make the final bet or fold. That will depend on the next card or cards and on the estimated position of the other players—or in the case of a business decision, competitors.

Why treat this stage of the investment process as a *real option*? Although they may hold out great hope and future promise, projects under development are inevitably too uncertain at this stage to pass the standard return on investment test (ROI), and thus they are likely to be rejected. By treating them as real options, though, they may advance to the next stage. (Technically, the value of the option to invest at some future date increases with both the time for which the option is available and the uncertainty (or upside potential) of the project. Both conclusions are often counterintuitive from the perspective of ROI analysis.)

Entrepreneurial Strategy

As Dorf and Byers (2005) point out, "the average life span of a company in the S&P 500 has declined from 35 years in 1975 to less than 20 years today." In general, as business conditions become volatile, business decisions must be taken with limited information. This includes many decisions involving IT investments. Figure 2.8 implies that many of the most familiar decision-making tools for investment—such as return on investment, discounted cash flow, forecasting, and other common due-diligence techniques—assume (or at least are more effective in) an information-rich environment. As uncertainty grows—that is, as the ratio increases in assumptions to facts (McGrath and MacMillan, 2000)—other decision-making techniques become relatively more important. These include scenario-building, learning by doing, and experimentation methods involving repeated "vision-hypothesis-test-revision" (Stephenson, 1983).

In the current volatile IT environment, danger is constant of overreliance on decision-making frameworks and techniques that are best suited to information-rich environments—only to find that confidence in the concreteness of the data is misplaced. In attempting to make their best case for project funding, project advocates all too often overstate what they actually know. They are easily engrossed in projecting scenarios with the help of schedules, milestones, financial projections, and tools that are in reality more appropriate to information-rich settings.

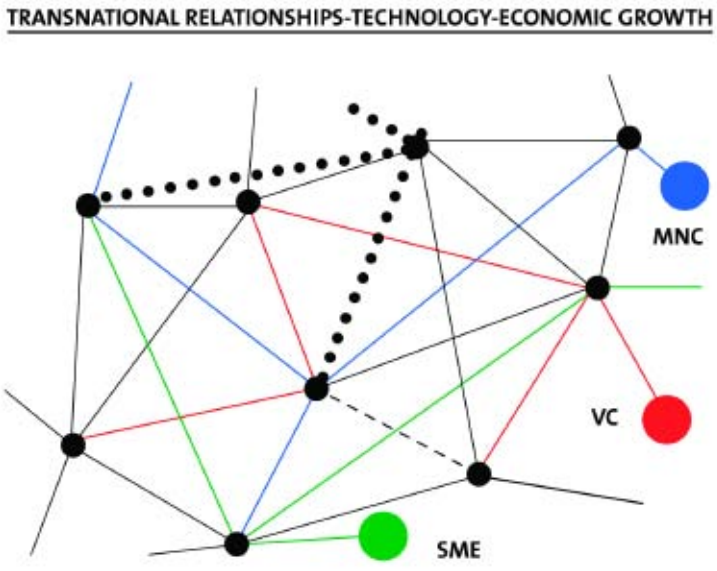
What typically happens when prospects are framed prematurely (if elegantly) in this fashion? When faced with new facts that seem to contradict the starting projections, an instinctive reaction is either to discount the new findings or to ruthlessly refit them to the existing model. In fact, it is more sensible to reframe the process, accepting that decision-making is taking place in an information-poor environment. This alternative allows the product development team to accept and work with the new data. Rather than thinking that the team was "wrong," a better approach is that "they just got smart." If maximum learning is the goal, progress is best measured by the distance between their initial guess and their new understanding.

What is illustrated here, more generally, is the need to give more weight to the tools and perspectives that constitute an entrepreneurial strategy. A shift is needed in approaches, tools, and strategic orientation to better accommodate the inherent uncertainty of the IT environment. This requires, first, a strategic perspective that is driven by the perception of opportunity rather than the need to manage currently controlled resources. Second, a multistage process is needed with minimum exposure at each stage, rather than a one-time, all-or-nothing commitment. Third, the strategy must assume episodic rent of required resources rather than complete ownership or employment of required resources.

Networks: Politics—Supply Chains—The Firm

The explosive growth and extensive application of transnational information networks over the past 15 years are other features of the IT revolution that require conventional business wisdom to be revised. In Figure 2.9, these networks are illustrated as connections among multinational corporations, small- and medium-size enterprises, and even venture capital organizations. These networks vastly expanded during the period of deregulation and privatization. More often than not, they did not come about as a result of government action.

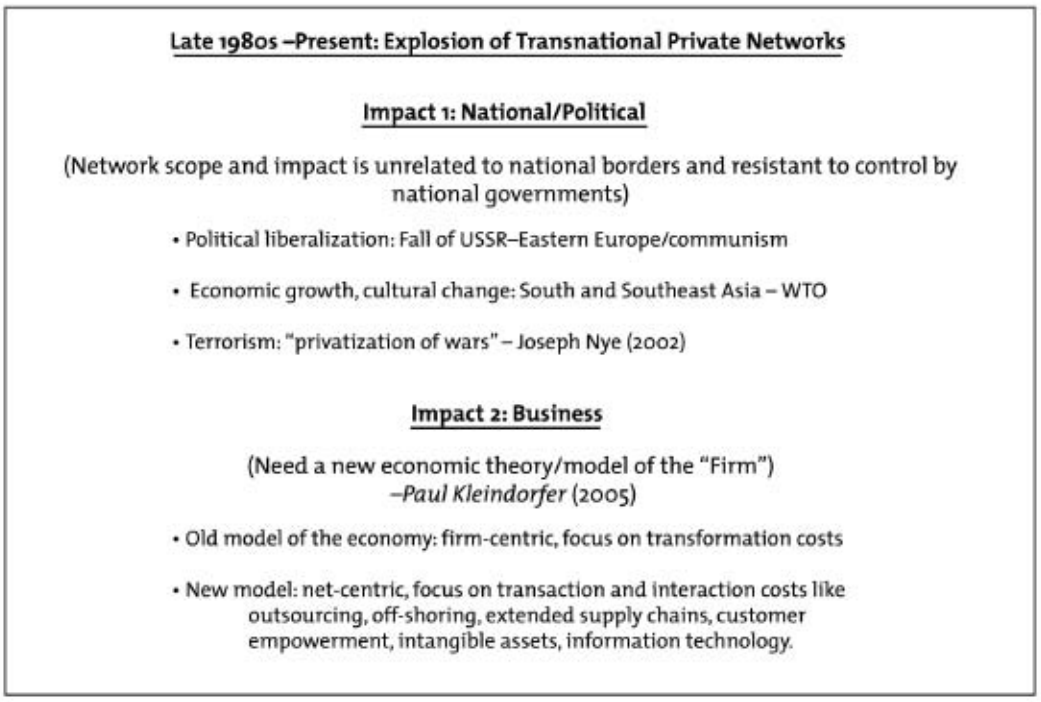
Figure 2.9. Rapid Growth in Private Transnational Networks



Note: *SME* signifies "small-and medium-size enterprises"; *VC* signifies "venture capital organizations"; *MNC* signifies "multinational corporations."

As shown in Figure 2.10, the explosion in transnational private networks has brought political changes that have not always been welcomed by host governments. The role of information, communication, and business networks in the demise of the Soviet Union is one among many examples. Similarly, there is the case of political and economic liberalization in South and Southeast Asia. In the developed world, these networks raise numerous interstate tax issues and widespread concerns related to national security. Some observers have even pointed to their role in facilitating terrorism and the privatization of war (Nye, 2002).

Figure 2.10. Political and Economic Impact of Private Information Network Growth



These networks also transform business. They enable corporations to search for global suppliers through a combination of outsourcing and offshore activities. An extended supply chain sometimes means coordination involving thousands of members of the chain. Beyond this, the Web empowers individual customers to a degree hitherto unknown, and these empowered customers are beginning to insert themselves directly into the process.

To manage this unbundling and rebundling, successful transnational corporations will need new skills above and beyond their traditional competencies. For example, they must learn to manage the logistics of extended supply chains so that they can compete by reducing their risks and transaction costs (National Science and Technology Council, 1996). Not surprisingly, this unfolding process has produced considerable angst over business prospects in light of the need to change. Understandable concerns are frequently mirrored in the statements of elected representatives.

Issues for Development Organizations

Development organizations have a clear mandate to advance information technology in the public interest because IT has shown its powerful potential as an engine for sustainable economic growth. However, recent private sector experience has taught us that development

organizations may need to foster a more entrepreneurial mindset if they are to manage IT investments effectively. The techniques, tools, and lessons to be learned from entrepreneurial strategy could well play a greater role in how development organizations make their decisions.

In a related area, our traditional model of the firm as a discrete entity is rapidly being superseded by something new—ubiquitous, Net-centric organizations that are operating now through supply chains that extend from globally outsourced suppliers to increasingly empowered and networked customers. Development organizations must recognize that future private sector investment priorities will inevitably require lower transactional costs, greater reliability, and improved effectiveness of this new generation of globally networked operations.

References

Clinton, W.J. 1994 Economic Report of the President. Washington, D.C.: U.S. Government Printing Office

Dorf, R. C., and T. Byers. 2005. Chapter One. In *Technology Ventures: From Idea to Opportunity*. Boston, Massachusetts: New Press.

Kleindorfer, P. 2005. Private communication. Wharton School, University of Pennsylvania, Philadelphia (May).

McGrath, R. G., and I. MacMillan. 2000. *The Entrepreneurial Mindset: Strategies for Continuously Creating Opportunity in an Age of Uncertainty*. Boston, Massachusetts: Harvard Business School Press.

Mitchell, G. R. 1999. "Global Technology Policies for Economic Growth." *Technological Forecasting and Social Change* 60: 205–14.

Mitchell, G. R., and W. Hamilton. 1988. "Managing R&D as a Strategic Option." *Research Technology Management* (May –June): 256–62.

Nye, J. 2002. "The New Rome and the New Centurions." *The Economist* (March).

National Science and Technology Council. 1996. "Technology in the National Interest." Washington, D. C.: Executive Office of the President of the United States. http://www.ostp.gov/NSTC/html/NSTC_Home.html.

Shoemaker, P. J. H., and R. Gunther. 2002. *Profiting from Uncertainty: Strategies for Succeeding No Matter What the Future Brings*. New York: Free Press.

Stephenson, H. H. 1983. "A Perspective on Entrepreneurship." Harvard Business School Case 384-131. Cambridge, MA.

Stevens, G., and J. Burley. 1997. "3,000 New Ideas = 1 Commercial Success." *Research Technology Management* (May–June).

Chapter 3

Building Innovative Capabilities Toward Competitiveness and Social Development

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This chapter examines the questions that multilateral economic and social development agencies such as the Inter-American Development Bank must consider in promoting policies to enhance their engagement in the knowledge economy. Such engagement *must* occur under a framework that considers the technological changes that are taking place in the technological base of world development.

The argument here derives from an understanding of competitiveness and social capabilities. *Competitiveness* is understood to mean the capacity of all economic players—including private, governmental, and NGO—to work cooperatively among themselves and with other organizations. Whether or not they are located in the same geographic area, cooperation must take place in formulating competitive strategies for the global marketplace of goods and services. Particular attention must be paid to goods and services that require intensive knowledge and learning. The term *social capabilities* refers to a human construct. It describes the specific socioeconomic formation that continuously improves quality of life in a particular geographic context. What are the economic, cultural, and political activities of which people there are capable?

The second root of this argument is the emergence of a new techno-economic paradigm. Ever since the seminal work of Freeman and Perez (1988), changes in the techno-economic paradigm increasingly are recognized as crucial to the economy. They create new demand complexes; they are substantially important for the renewal of existing productive capital; they affect the skill profile of the labor force; and they create chain reactions leading to new configurations for growth.[1]

Freeman and Perez also described the social and political acceptability of changes in the paradigm. Acceptability, they noted, can take longer than actual perception of the technical and economic advantages of an innovation because acceptance often must be expressed through legislative, educational, and regulatory changes.

Understanding competitiveness, social capabilities, and the new techno-economic paradigm leads us to the realm of public policy, which is not necessarily the exclusive bailiwick of government. Policy changes are often needed to remove technological, economic, and institutional constraints that hinder innovation. Policies need to be grounded in the systemic content of the processes that lead to competitiveness and social capabilities.

This chapter considers the inputs that are necessary for innovation to enhance competitiveness and social capabilities. It then looks briefly at key issues related to innovation and at the different dimensions of knowledge that must be considered for sustainability. The analysis then highlights the centrality of knowledge and learning. Concluding remarks focus on the institutional behavior needed for Latin America to open windows of opportunities created by the new ICT techno-economic paradigm. Such considerations are highly relevant to the mission of the Inter-American Development Bank.

[1] In Villaschi (1994), I used the concept of techno-economic paradigm to appraise the opportunities and constraints that were already present for a country such as Brazil in the late 1980s, given the emergent information and communication technologies and techno-economic paradign at the time.

These ideas draw upon the neo-Schumpeterian literature (with special emphasis on Freeman, Perez, Lundvall, and Johnson) and on my own empirical work in Brazil and my research in Finland and India.[2]

Necessary Inputs for Innovation

Following traditions beginning with Freeman (1987) and Andersen and Lundvall (1988), we can ask how economic, social, and political actors interact, and what is needed to enhance the development, diffusion, and use of innovations.

Despite increased relations at world scale, regional, national, subnational, and local dimensions are highlighted here. This focus captures the spatial and institutional dimensions of interactions geared toward learning processes, which are essential to sparking innovation, enhancing competitiveness, and building social capabilities. The idea is to capture interactions among agents within and beyond geographical boundaries (Villaschi, 1994). Despite the importance of the global view, the focus here is on countrywide systems of innovation encompassing "elements and relationships, either located within or rooted inside the borders of a nation state" (Lundvall, 1992: 2).[3] This perspective stresses the differences in the rates at which countries exploit the possibilities created by technological gaps. Such gaps are especially frequent at times such as our own that span two eras, a moment when the techno-economic paradigm is changing under the influence of new technological trajectories (Freeman and Perez, 1988). The difference in rates of response depends on each locality's ability to mobilize the political and financial resources for transformation of the technological, institutional, and economic structures that make up its system of innovation.[4]

As highlighted in the neo-Schumpeterian literature, the trajectories emerging from a techno-economic paradigm are seldom driven naturally by endogenous scientific and technological factors. Economic and sociopolitical factors critically shape the trajectories of technological change. Particular technological trajectories determine how particular countries experience the unfolding of world development. In other words, a selection process takes place that is mitigated through the interplay of broader economic, political, and social forces, as well as scientific, technological, and industrial capabilities playing out at the local level.

How can one capture the main characteristics of the interplay occurring at a particular regional, national, subnational, or local level? A system of innovation must be viewed from angles that are simultaneously interconnected and opposite. One view reveals the disequilibrium from the interacting forces. That is not surprising; the forces of change and transformation are disequilibrating by their nature. From the other angle, however, one sees a system of innovation in which the forces maintain relative order. The overall configuration acquires balance, as forces array to allow a broad consistency with conditions that will reproduce the system.

The economic, social, and political actors that make up a system of innovation do not respond to a single logic. The different "logics" to which the system responds do not necessarily converge. Their elements must be viewed from the multiple perspective of three self-regulated domains—the technological, economic, and institutional, which are hypothesized to operate according to the following four principles (Dosi, 1984).

First, each domain has its own dynamic and content despite the powerful interactions that connect all three. The specific character of each domain shapes and constrains that domain's impact, while the interactions determine the functional feedbacks creating either virtuous circles or mismatches.

[2] For which I give special thanks to ETLA and to IIIT-B for hosting me in Helsinki and in Bangalore, respectively.
[3] To further support the "localized argument" (be it at the national, regional, or local levels), it is worth emphasizing factors such as trust and the capacity to build extra-family collective loyalties. Such factors are important when characterizing a national business system.
[4] For a review of different aspects of the innovation systems approach, see Lundvall et al. (2001) and Edquista, ed. (1997). For critical comments on the approach, see Edquista (2001). Miettinen (2001) highlights criticisms of the concept, mainly with how it has been incorporated in the Finnish technological policy discourse.

Second, the number of "possible worlds" is limited by the number of configurations under which the three domains can operate in a relatively smooth, well-regulated way.

Third, imbalance or mismatch among the three domains does not necessarily lead to changes nor to more–balanced, smoother configurations.

Finally, the adaptability of a technological system to a given economic and social environment is limited. Conversely, a relatively fixed set of macroeconomic conditions and social relations are "given" at each stage of the technological domain.

In summary, the system of innovation is interpreted here as a function of how it responds to several basic features posed by Edquista (2001). First, it consists of two kinds of entities—components, and relationships between components. Second, the reason why an array of components (technological, economic, or institutional) and relationships (especially those not mediated by the market) are chosen is because they constitute a whole. Third, these components and relationships are chosen because they distinguish a particular system within the rest of the world—in other words, they confirm the possibility of identifying discernible boundaries. At least one modifiable factor of the learning, searching, innovating, and producing process must lie within the locality's geopolitical boundaries.

An Overview of Innovation

For the purposes of this chapter, innovation[5] will be considered from two perspectives—the characteristics of the innovative process and alternative taxonomies of innovation.

Orsenico (1989) highlights some characteristics of the former:

- Innovation is a ubiquitous phenomenon that combines gradual, cumulative changes (that is, the Schumpeterian "new combinations" content of innovation) and changes that represent radical breaks from the past (that is, the Marxian and Schumpeterian "creative destruction" content of technological development).

- The uncertainties that accompany the innovative process stretch well beyond not knowing what the technical and commercial outcome will be. This happens because innovative processes entail not only lack of knowledge of the exact cost and nature of the outcomes, but the cost and nature of the alternatives—and for that matter, what the alternatives are.[6]

- An innovation process has myriad possible sources. Although we usually think of innovation in terms of growth in scientific knowledge, it also involves innumerable bits of tacit and specific knowledge that are not and cannot be written down. There is no blueprint for innovation.[7]

- There is a cumulative character to technological capabilities, and the partial appropriability accompanying it creates permanent asymmetries in the innovative competencies separating firms and countries.

As for taxonomies of innovation, Edquista (2001: 6) points out, "In spite of the name—'the systems of innovation approach'—a lot of the writing within this 'tradition' was initially focused on *technological* change, and not on innovation in a more general sense." Thus, he suggests that the complex and heterogeneous category of innovation should distinguish between process and product *innovation*.[8]

[5] Innovation in an economy, to use Schumpeter's original terms, is "doing new things or old things in a new way." Perhaps this should be replaced by looking at innovation as a matter of creation and exchange of knowledge among relevant actors.
[6] As Nelson and Winter (1982: 132) state, there is, "[A] simple distinction between organizational activity directed to innovation (or problem solving more generally) and the results of such activity. The fundamental uncertainty surrounding innovative activity is uncertainty about its results."
[7] The existence of a global bank of blueprints from which anybody can get a copy for use in starting up production, is a simplifying assumption made by neoclassical theory of production and economic growth. As Johnson and Lundvall (1999) presented at the *DRUID Winter Conference*, 18-20 January, Aalborg, Denmark stress, this ignores the fact that most accessible knowledge can only be used by skilled agents and that skills differ and are not easily transformedd in blueprints.
[8] He also suggests that one can distinguish among development, diffusion, and use/production of new processes and products; as well as among innovations in low-,medium-, and hiigh-technology sectors of production.

Process innovation—that is, *how* goods and services are produced—can be either technological or organizational. Meanwhile product innovation—that is, *what* is being produced—can be either goods or services.[9] In this taxonomy, only goods and technological process innovations are considered material innovations. Organizational process innovations and services are considered intangible. Nevertheless, "It is crucial to take the intangible innovations into account also, since they are increasingly important for economic growth and employment" (Edquista, 2000: 7).[10]

Freeman and Perez (1988) put forward a different taxonomy of innovation[11] that, on the one hand, relates innovations to their impact on economic structure and, on the other, considers different combinations of demand pressures and sociocultural factors affecting innovative capacity. Whether speaking of firms, industries, or countries, innovations can be distinguished as follows:

- *Incremental innovations*. These are innovations whose main economic impact refers to the extension of demand and to increase in value added. They improve efficiency in how the factors of production are utilized, but they are not necessarily a result of deliberate R&D. They are characterized by "learning by doing" and "learning by using." Often they reflect inventions and improvements suggested by those directly involved in production processes.

- *Radical innovations*. These are new lines of production and partial modification of existing demand. They are characterized by substantial change within industries and by new kinds of demands. Increasingly, radical innovations are directly derived from R&D that takes place in enterprises, universities, and government laboratories. Isolated radical innovations—for example, nylon or "the pill"—can bring significant structural change, but more often than not, their aggregate economic and social impact is relatively small and localized. This situation can change if, as Freeman and Perez (1988: 46) put it, "a whole cluster of radical innovations are linked together in the rise of new industries and services, such as the synthetic materials industry or the semiconductor industry."

- *Changes of technology systems*. These are characterized by major modifications on the demand system and the creation of new industries. They go beyond the combination of radical and incremental innovations to encompass organizational and managerial innovations. Freeman and Perez cite the technically and economically interrelated "constellation of innovations" that occurred from the 1920s onward, including synthetic materials and petrochemicals as well as machinery for injection molding and extrusion.

- *Changes in the techno-economic paradigm*. These have critically altered the economy through new demand complexes, renewal of productive capital, impact on the skill profile of the labor force, and the chain reactions that further transmit the creation of new growth complexes.

All four levels of innovation are important. Yet the second category, the revolutionary innovation, is of greatest interest here. Three aspects of such "revolutions" are worth emphasizing. First, their application is often associated with drastic reductions in the costs of products and services. Apart from their technical significance in a particular area, these innovations typically imply major changes in cost structure.

Second, technological revolutions have implications related to their social and political acceptability. This is quite different than acceptance at a technical level or recognition that an innovation has economic benefits, because this kind of acceptance often must be expressed through legislative, educational, and regulatory reforms.

[9] Edquista (2001) points out that some product innovations are transformed into process innovations in a "second incarnation." That is mainly the case of investment products—such as an industrial robot—which are a product when they are produced and a process when they are used in the production process.

[10] The importance of intangibles increases each time that knowledge-intensive business services (KIBS) help to diffuse innovation to different-size firms.

[11] Archibugi and Michie (1995) propose a taxonomy that helps to explain the political economy of innovation during an era in which economic relations are being intensely changed through internationalization.

In this regard, Freeman's and Perez's (1988) concept of a techno-economic paradigm[12] approximates Kuhn's elaboration of a paradigm shift in science transcending disciplines because the technological paradigm relates not just to a particular branch of industry but to the economy as a whole. Analytically, they link the inadequacy of institutions to how a technological revolution develops—and the state of crisis that eventually emerges as a paradigm's revolutionary character gradually wanes. This gives real content to the notion of successive industrial revolutions. It interprets Kondratiev waves as increasing degrees of matches between the techno-economic system and the socio-institutional framework in the upswing, followed by increasing mismatches in the downswing.

Besides breaking with monocausal economic determinism, the techno-economic paradigm approach is important because it moves toward a unified theory of growth, crisis, and change. This heterodox approach serves more adequately than the vicious circles of the mainstream social sciences whereby sociologists and political scientists try to explain weak social motivations, political apathy, and political crisis in terms of economic trends on the one hand, while economists try to explain economic crises in terms of politicization, social motivations, and human incentives on the other.

The heterodox approach becomes even more important if one wants to address the continuous changes in techno-economic paradigm. Even if one goes as far back as its scientific and technological roots in the 17th century,[13] the so-called ICT techno-economic paradigm only entered the economic agenda after the 1970s. Its institutional implications only entered open public debate in the 1990s.

As Table 3.1 shows, it doesn't greatly matter when each of these three dimensions of the ICT techno-economic paradigm surfaced in the academic and public debate.[14] What's important

Table 3.1. Techno-Economic Paradigm Shifts—From "Cheap Energy" to Chips

"Fordist" (Old)	ICT (New)
Technology features	
	Knowledge and communication linked with human mind
Functionality and 'better' products	Person-to-person connectivity
Place-to-place connectivity	Personal, physical, and psychological sustainability
People as "users," "consumers," "workers"	
Economic features	
	Information intensive
	Computer-aided designs
Energy intensive	Concurrent engineering
Design and engineering in "drawing" offices	Systemization
	Networks
Sequential design and production	Services with product
Automation	Distributed intelligence
Single firm	Multiple skills
Product with service	
Centralization	
Specialized skills	
Institutional features	
Government control and sometimes ownership	Government information, coordination, and regulation
"Planning"	"Vision"
"Welfare state" and "warfare state"	"Regulation" of strategic ICT infrastructure
"Pax Americana": U.S. economic and military dominance	"Multipolarity": Regional blocs
U.S.-dominated international financial and trade regimes	Problems of developing int'l institutions capable of regulating global finance
(GATT, IMF, World Bank)	

Sources: Adapted from Freeman and Perez (1988), Freeman and Loucã (2001), and Tuomi (2001).

[12] In Villaschi (2004), I discuss this concept in greater depth.
[13] See, for example, Cortada (2000).
[14] Freeman and Loucã (2001: 301) remind us that even the chairman of the U.S. Federal Reserve, Alan Greenspan, frequently referred to the "new paradigm" of computers, telecommunications, and the Internet as the source of the remarkable growth spurt of the 1990s."

is to avoid the pitfall of single-factor determinism, whether the factor of choice happens to be cultural, economic, political, scientific, or technological (Freeman and Loucã, 2001).

Knowledge, Learning, and Systems of Innovation

Economists are more keenly aware than ever of the importance of knowledge and learning. Among those who study innovation and technological change, Nelson and Winter (1982) distinguish between tacit and codified knowledge. Arrow (1962), Rosenberg (1976), and Lundvall (1985) raise specific questions about learning and innovation. A major difference among these scholars is that the first two are more concerned with learning within the firm (by *doing* and by *using*, respectively), while Lundvall's l*earning by interacting* emphasizes innovation capabilities that emerge when users and producers search together for a new product or process.

Significant insights have emerged from historical and empirical research on institutional economics, evolutionary economics, socioeconomic research, and the economics of innovation.[15] Today, we know far more about how innovation takes place within different parts of the economy. Nevertheless, our understanding of knowledge and learning is far less developed. And our understanding of other aspects of knowledge production—for example, competence building, learning, and mediation of knowledge—can be said to be in its infancy at best. We are just beginning to raise fundamental questions on who learns what and on how learning takes place in the context of economic development (Johnson and Lundvall, 2001).

To better understand these issues, Johnson and Lundvall (2001) break individual[16] knowledge into four categories:

- *Know what*. Refers to knowledge of facts—for example, the number of people living in New York, the ingredients in pancakes, and the date of the Battle of Waterloo. This kind of knowledge is close to what we commonly call information. Above all, it can be broken down into bits, and it can be communicated as data.

- *Know why*. Refers to knowledge about principles and laws—for example, of motion in nature, in the human mind, and in society. This kind of knowledge has been extremely important for technological development in science-based areas such as the chemical and electronic industries. The access to "know why" will often make advances in technology more rapid and reduce the frequency of errors in procedures that involve trial and error.

- *Know-how*. Refers to skill, that is, the ability to do something. This may be the skills of an artisan or of production workers, and it is all-important in economic activities. A businessman assessing market prospects for a new product or a personnel manager selecting and training staff make use of know-how. It is misleading to characterize know-how as practical rather than theoretical. Apart from other kinds of knowledge, finding the solution to a complex problem may require a mathematician to use intuition and skills related to pattern recognition. These are rooted in experience-based learning, not simply a series of distinct logical operations.

- *Know who*. Refers to information about who knows what and who knows what to do. This includes the social ability to cooperate and communicate with different kinds of people as well as with experts. This kind of knowledge has become increasingly important because of the general trend toward a more composite knowledge base. New products typically combine many technologies rooted in distinct scientific disciplines. Access to many sources of knowledge becomes essential.

[15] It is important to bear in mind, however, that the core theories of standard economics assume that rational agents make choices on based on a given amount of information. The only kind of learning allowed for is agents' access to new bodies of information.

[16] According to these authors, on the organizational level the four categories correspond to "shared information (data bases)," "shared models of interpretation (including company stories)," "shared routines," and "shared networks." On the regional level these are identified as "people, culture, institutions, and networks."

Even orthodox economics recognizes that very little knowledge is perfectly public. Information of the *know-what* type can become unavailable to those not connected to the right communications and social networks.[17] Even if perfectly accessible, scientific and other types of complex knowledge may be of little use if the user has not invested in building absorptive capacity.[18] Johnson and Lundvall (2001) illustrate these points with the following considerations:

- Despite information technology greatly extending information to individual agents, *know what* increasingly depends on the capacity to select for relevance. Despite recent advances in this area, access to "what knowledge" remains far from perfect, and the most effective medium for obtaining *pertinent* facts may be the *know-who* channel.

- Scientific work aims at a theoretical model of the *know-why* type, and some of this work is placed in the public domain. But that still doesn't mean public access. To the contrary, enormous investments in learning are often necessary before information obtained from, say, the Internet takes on meaning. Once again, *know who*—which often points toward academia—can help the layman to translate something that might otherwise be totally incomprehensible.[19] That is why so many companies maintain a presence in academic environments or engage in basic research themselves. Sometimes large companies not only contribute to basic research, they take over as de facto technical universities. The close connection between science and the exploitation of new ideas by business is particularly pronounced in fields such as biotechnology, despite hazards that the open exchange key to academic knowledge production runs the risk of being undermined.[20]

- In fields characterized by intense technological competition, the production of technical solutions often outstrips the academic *know-why*. This especially happens when technology is able to solve problems or perform functions without a clear scientific understanding of the reason(s) something works.

Having considered these different forms of knowledge and their blurred public and private boundaries, Johnson and Lundvall (2001) address a fundamental problem that is especially vital to those who are concerned with the production and distribution of goods and services. How, they ask, can different aspects of knowledge be mediated? In this respect, they make two important observations. First, because tacit *know-how* knowledge cannot be separated from the person or organization that contains it, mediation often translates as the purchase of services, not the transfer of competence. The role of this sort of mediation, including the problems it entails, can be seen in the increasing importance of knowledge-intensive business services. Second, tacit knowledge can also be mediated[21] through interactive learning between those who have it and those who need it. This may be a conscious choice—for example, an apprentice who enters into a contract with a master. Or, it may be an unintended side effect when people and an organization work cooperatively on a shared problem.

Mediation of knowledge is not necessarily easier when its content can be made explicit and separated from its carrier. Similarly, it is not easy to determine the value and set the price of knowledge before the transaction actually occurs. The reason is obvious: the user wants to know something about the knowledge in advance, and the seller does not want to give away information for free.

On the other hand, a seller cannot easily restrict the use of information once it has been sold, and the buyer cannot easily restrict the seller from distributing it to other buyers. Lundvall (1988: 16) also points out:

[17] That should of great concern to those working on the prospect of a new international order in a time of ICT innovation. Since information and knowledge refer more than ever to power relationships, the "haves" and "have-nots" in both inter- and intracountry spheres cannot be side topics for those who are investigating opportunities and constraints in the new/next society/economy/paradigm.

[18] "Know-how is never fully transferable since how a person does things reflects that individual's personality (even organizations have a 'personality' in this sense)" [Johnson and Lundvall, 2001: 15].

[19] In this context, the Finnish Centre of Expertise Programme is a model in facilitating access to who knows, in which finding what is relevant and translating what is found is meaningful to business.

[20] Johnson and Lundvall (2001) also stress that access to scientific know why under all circumstances depends upon investment in R&D activities and in science. This is contrary to the assumption of free spillovers, as would be predicted by standard economics.

[21] Johnson and Lundvall (2001) point out that tacit knowledge can also be mediated by hiring experts or by taking over an organization that controls the knowledge.

Despite these difficulties, a large growing amount of knowledge is the object of transactions in something that looks like a market (there is a buyer, a seller, and a price). One reason why markets work is that formal and informal institutions—including legal protection in terms of patents, licences, and copyright—support transactions. Another, even more fundamental, reason is that many markets for knowledge transactions are not pure but rather organized markets. Long-term relationships with elements of experienced-based trust often play a major role in knowledge markets.

Greater R&D expenditure serves as another means to facilitate the mediation of knowledge. But even reverse engineering requires minimum scientific competence and investment in R&D. Because the rate of change and the complexity of knowledge have been growing so quickly, no single organization can master all the elements of the knowledge base. To engage in any kind of R&D collaboration, minimum scientific competence must still be available within any organization that wants to engage in this type of knowledge mediation.

Even when knowledge is embodied into products, some kind of mediation might be necessary so that tacit knowledge can be properly used. This is why suppliers of complex processing equipment generally offer training to the personnel of customer organizations.[22]

With the techno-economic paradigm changing so rapidly, any attempt to sharply distinguish between tacit and codified (or codifiable) knowledge is generally fruitless. It is therefore increasingly important to understand how each of these two forms of knowledge can establish its own virtuous circles of interaction.

The SECI (socialization, externalization, combination, internalization) model proposed by Nonaka and Takeuchi (1995) derives from the idea that knowledge is created through a continuous process in which the socialization of tacit and unarticulated knowledge transforms to knowledge that can be codified and transferred. The combination of different externalized knowledge increases the amount of tacit knowledge that is internalized by individuals and participating organizations. When this new tacit knowledge is socialized, a virtuous circle kicks in.

Virtuous circles are not limited to formal settings. They are often based on learning that is embedded in informal networks. For this reason, more attention must be paid to learning communities. The defining characteristics of learning communities are their shared knowledge management and logistical activities that result in adoption or production of innovations (Kuusi, 1999). Basically, learning communities are defined as a set of actors and interacting institutions. They are an excellent way to build new kinds of networks for learning.

Conclusion

This chapter has looked at the key role of innovation in the sustainability of competitiveness and social capabilities, as well as the social content of innovative processes. Its goal is to bring institutions center stage. As my earlier work points out (Villaschi, 1994), the concept of *institution* has been defined many ways. They are entities that regulate competition for power (political institutions); they are concerned with the production, circulation, and distribution of goods and services (economic institutions); they deal with religious, artistic, expressive activities, and the traditions of society (cultural institutions); and they deal with questions of marriage, the family, and rearing the young (kinship institutions). As North (1991: 97) points out, institutions in general terms are "humanly devised constraints that structure political, economic, and social interactions." Some of these constraints are formal rules, such as constitutions, laws, and property rights. Others are informal, such as taboos, sanctions, customs, traditions, and codes of conduct.

Given the centrality of institutions, it comes as no surprise that knowledge emerges in every approach as a central element to understanding the social, cultural, political, and economic

[22] In developing countries, transfer is essential except for complex processing equipment. If embodied knowledge is going to have any economic impact, a poorly educated labor force must be trained.

changes that we are experiencing. As highlighted by Freeman and Perez (1988), the old institutional framework is inevitably challenged as the techno-economic paradigm alters. The core resources, technologies, organizational arrangements, and market structures of the new paradigm are unable to achieve their full development potential within the old institutional framework.

Whether formally or informally, the old institutional setting evolved to meet the socioeconomic and technological needs of its day. The new setting must do the same; and if it does not, mismatches occur among the different domains described above.

One such mismatch becomes visible when we consider the various lenses through which individuals, groups, and organizations respectively perceive change. According to Hämäläinen (2004), there are those who develop a new attitude to better reflect the new techno-economic realities and who are typically dissatisfied with the slow adjustment of social norms, formal institutions, and collective behavior. Others, however, are satisfied with their old mental paradigm but dissatisfied with how the economy and technologies are changing around them. Still others feel dire loss from the rapid structural change around them and cannot understand what went wrong. And some understand that change is inevitable, but their interests are vested in the old paradigm, usually through human capital and physical assets. So they voice their protest against possible change.

In light of these differing perceptions and alternative behaviors, Perez (2003) says that the transition between the old and new tends to be turbulent. Social tensions rise; moral and religious fundamentalism emerges; new "clans" and extreme movements proliferate; strong leaders come forward with simplistic ideologies; and even wars and revolutions are waged.[23] The adjustment of society's[24] legal and regulatory framework can be slow because special interest groups tend to use the political process to resist change. Moreover, the institutional adjustment process influences collective behavior. Public sector organizations and entrenched special interest groups tend to join forces since they do not directly compete and both have a stake in perpetuating the old regime. So they tend to be the final stronghold for the old institutional arrangements.

Clearly, a system of innovation cannot rely solely on market-mediated economic relations in which governance takes place through hierarchies. Social capabilities are of fundamental importance if a system of innovation is to cope adequately with scientific, technological, economic, and institutional challenges, as well as benefit from the opportunities that emerge when the techno-economic paradigm changes (Perez and Soete, 1988).

Societies differ with respect to accumulated social capital, and this affects their ability to produce new intellectual capital and to innovate (Schienstock and Hämäläinen, 2001). Similarly, policies aimed at improving competitiveness and social capability through innovation need to be explicit in how they deal with the accumulated social capital in a particular place.

This chapter has stressed the importance of local specifics regarding policies that promote innovation. Several OECD countries seeking to innovate with ICT amid the changing techno-economic paradigm have used this approach quite successfully.[25]

Yet as Arocena and Sutz (2002) point out, the innovative systems approach cannot be seen as trivial, even while recognizing that it is a political concept.[26] Even as a political concept, it needs to embrace social attitudes concerning global transformations.

Social attitudes concerning global transformation are among the issues taken up by Albert Hirschman. He writes, "Our diagnosis is simply that countries fail to take advantage of their

[23] The events before and the reactions after September 11 well illustrate this interpretation.
[24] To be understood here as different scales of space (local, regional, national, supranational) and as other forms of social gathering (ethnic, religious, professional, and otherwise).
[25] For an overview on how this approach is used for looking at economic competitiveness in developing countries, such as Brazil, see Cassiolato et al. (2003).
[26] In Villaschi, 2005, I illustrate this point through analysis of the Brazilian system of innovation in the 1990s.

development potential because, for reasons largely related to their image of change, they find it difficult to take decisions needed for development in the required number and at the required speed" (cited in Arocena and Sutz, 2002: 15).

One implication is that development policy geared toward innovation, whatever the spatial level, must be well-tuned institutionally toward a vision (see table 3.1 above). According to Fransman (2002: 8), "A 'vision' or cognitive framework consists of an interrelated set of beliefs, embodied in assumptions and expectations, which serve the purpose of making the world seem intelligible and therefore orienting decision-making."

Indeed, what could be more central for a regional development than to pull together as many local actors as possible, building a contemporary vision of present challenges and the future's perspective?

References

Andersen, E., and B-Å Lundvall. 1988. "Small National Systems of Innovation Facing Technological Revolutions:
An Analytical Framework." In C. Freeman and B-Å Lundvall, editors. *Small Countries Facing the Technological Revolution*. London and New York: Pinter.

Archibugi, D., and J. Michie. 1995. *"The Globalisation of Technology: A New Taxonomy."* Cambridge Journal of Economics, 19:121-140.

Arocena and Sutz (2002) "Innovation systems in developing countries", DRUID Working Paper 2002-2005 (available at http://www.druid.dk).

Arrow, K. 1962. "The Economic Implications of Learning by Doing." *Review of Economic Studies* 29 (80): 155–73.

Cassiolato, J. E., H. M. Martin Lastres, and M. L. Maciel, editors. 2003. *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham, United Kingdom; Northampton, Massachusetts: Edward Elgar.

Cortada, J. 2000. "Progenitors of the Information Age: The Development of Chips and Computers." In A. D. Chandler and J. Cortada, editors. *A Nation Trasformed by Information: How Information Has Shaped the United States from Colonial Times to the Present*. Oxford, Great Britain; New York: Oxford University Press.

Dosi, G. 1984. "Technology and Conditions of Macroeconomic Development." In C. Freeman, editor. 1984. *Design, Innovation, and Long Cycles in Economic Development*. New York: St. Martin's Press.

Dosi, G, C. Freeman, R. Nelson, G. Silverberg, and L. Soete, editors. 1988. *Technical Change and Economic Theory*. London and New York: Pinter Publishers.

Edquista, C., editor. 1997. Systems of innovation: technologies, institutions, organizations. London: Pinter Publishers

——— 2001. "The Systems of Innovation Approach and Innovation Policy: An Account of the State of the Art." Paper presented at the Nelson and Winter DRUID Summer Conference, Aalborg, Denmark (June 12–15).

Fransman, M. 2002. *Telecoms in the Internet Age: From Boom to Bust to...?* Oxford, Great Britain; New York: Oxford University Press.

Freeman, C. 1987. *Technology Policy and Economic Performance: Lessons from Japan*. London and New York: Pinter Publishers.

Freeman, C., and F. Louçã. 2001. *As Time Goes By: From the Industrial Revolutions to the Information Revolution*. Oxford, Great Britain; New York: Oxford University Press.

Freeman, C., and C. Perez. 1988. "Structural Crises of Adjustment Business Cycles and Investment Behaviour." In G. Dosi et al., editors. *Technical Change and Economic Theory*. London and New York: Pinter Publishers.

Hämäläinen, T. 2003. *National Competitiveness and Economic Growth*. Cheltenham, United Kingdom: Edward Elgar.
Johnson, B. 1992. "Institutional Learning." In B-Å. Lundvall, editor. *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. London: Pinter Publishers.
Johnson, B., and B-Å Lundvall. 2001. "Why All This Fuss about Codified and Tacit Knowledge?" Paper presented at the DRUID Winter Conference, Aalborg, Denmark (January 18–20).
Kuhn, T. 1970. *The Structure of Scientific Revolutions*. 2nd. ed. Chicago: University of Chicago Press.
Kuusi, O. 1999. "Growing and Learning Entrepreneurial Networks and the Focus of the National Innovation Strategy." In Schienstock and Kuusi, editors. *Transformation Towards a Learning Economy. The Challenge for the Finnish Innovation System*. Helsinki: SITRA.
Lundvall, B. 1988. "Innovation as an Interactive Process from User-Producer Interaction to the National System of Innovation." In G. Dosi et al., editors. *Technical Change and Economic Theory*. London and New York: Pinter Publishers.
———. 1992. "Introduction." In B. Lundvall, editor. *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. London: Pinter Publishers.
Lundvall, B., B. Johnson, E. Andersen, and B. Dalum. 2001. "National Systems of Production, Innovation, and Competence Building." Paper presented at the Nelson and Winter DRUID Summer Conference, Aalborg, Denmark (June 12–15).
Lundvall, B-Å. 1998. "Why Study National Systems and National Styles of Innovation." *Technology Analysis & Strategic Management* 10: 407–21.
Miettinen, R. 2001. "Innovation Networks, Social Capital, and Technology Policy." Final report of the *Project Multidisciplinary Innovation Research and Technology Policy*. Helsinki: SITRA.
Nelson, R. 1988. "Preface to Part V." In G. Dosi et al., editors. *Technical Change and Economic Theory*. London and New York: Pinter Publishers.
Nelson, R., and S. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Massachusetts: Belknap Press.
Nonaka, I., and H. Takeuchi. 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford, Great Britain; New York: Oxford University Press.
North, D. 1991. "Institutions." *Journal of Economic Perspective* 5(1): 97–112.
Orsenico, L. 1989. *The Emergence of Biotechnology*. London: Pinter Publishers.
Perez, C. 2002. *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham, United Kingdom: Edward Elgar.
Perez, C., and L. Soete. 1988. "Catching up in Technology Entry Barriers and Window of Opportunities." In G. Dosi et al., editors. *Technical Change and Economic Theory*. London and New York: Pinter Publishers.
Schienstock, G., and T. Häamäläinen. 2001. *Transformation of the Finnish Innovation System*. Helsinki: SITRA.
Tuomi, I. 2001. *From Periphery to Center: Emerging Research Topics on Knowledge Society*. Helsinki: TEKES.
Villaschi, A. 1994. *The Newly Industrialized Countries and the Information Technology Revolution: The Brazilian Experience*. Aldershot, Hants, England; Brookfield, Vermont: Avebury.
———. 2004. "Paradigmas tecnológicos: Uma visão histórica para a transição presente." *Revista de Economia* (Curitiba, Brazil: UFPR) 30 (1): 65–106
———. Forthcoming. "Anos 90 — Uma década perdida para o sistema nacional de inovação brasileiro?" *Revista da Fundação SEADE* (São Paulo).

Part II

Information and Communication Technology in Human Capital Formation

Just as it can help to understand development as learning, as suggested by Soedjatmoko, a former rector of the United Nations University (UNU), frameworks such as learning force or human capital industry may well evolve from the focus on education. Such terms may well reflect the full extent of human development through learning that is actually taking place. In response for growing and diverse demand, a variety of public, private, and civil society as well as academic organizations are creating innovative learning environments and expanding the knowledge economy in the process.

The following two chapters offer some evidence for considering a framework of human development that transcends yet includes educational reform and labor force transformation. The research into adult skill levels being carried out by Scott Murray (Chapter 4) lays the foundation for formulating effective ways to reduce social inequalities. By focusing on the untapped centers of innovation and entrepreneurship among low-income people at the bottom of the pyramid, the work being done by Allen Hammond and his colleagues (Chapter 5) appears to validate the great potential for using ICT to leverage cognitive and technical skills to significantly improve economic growth.

Chapter 4

Human Capital, ICTs, and Literacy: Evidence from a Large-Scale Assessment

T. Scott Murray

Policy makers in nearly every country share three goals. First, they seek to maximize rates of economic growth. This is accomplished by removing barriers to the technical progress and organizational innovation that underlie productivity growth. Second, they seek to reduce, or at least limit, the magnitude of social inequality, particularly inequalities related to the economy. This is achieved through interventions in labor markets, including passive income support and active labor market measures such as minimum wage regimes; and it also includes active education policies aimed at workers obtaining the necessary skills for stable, well-paying jobs. Third, they actively try to reduce the cost of providing public goods and services, generally by increasing productivity in key sectors such as education and health.

How are these shared goals to be achieved? Many solutions exist. But policy makers are coming to recognize that information and communication technologies (ICTs) are critically important in nearly all of them.

Using data from the world's first large-scale comparative assessments of adult skill, this chapter explores the relationship between use of ICT, and skill and economic outcomes at the individual and macro levels. The results suggest that differences in literacy and numeracy explain individual employment and wage inequalities as well as significant differences in long-term economic growth. The data also suggest that ICT use tends to amplify these differences. If so, individuals, firms, and countries that achieve high rates of ICT adoption will compete more successfully in the global market for goods and services. On the other hand, the data also reveal strong dependency between ICT use and skill in literacy and numeracy. This implies the continuing centrality of these skills in economic and social development, a fundamental fact that should keep education policy at the top of national policy agendas. This data is drawn from OECD countries but the results are generally applicable because they reflect underlying universal economic processes. The following summary of findings offers evidence in support of that thesis.

The International Adult Literacy Survey (IALS) and the Adult Literacy and Life Skills Survey (ALL)

The International Adult Literacy Survey (IALS) and the Adult Literacy and Life Skills Survey (ALL) are large-scale, cooperative research studies undertaken by governments, national statistics agencies, research institutions, and multilateral agencies. Development and management of the studies was coordinated by Statistics Canada and the Educational Testing Service (ETS) in collaboration with the National Center for Education Statistics (NCES) of the U.S. Department of Education, the Organization for Economic Co-operation and Development (OECD), and UNESCO's Regional Office for Latin America and the Caribbean (OREALC) and its Institute for Statistics (UIS).

The IALS study was carried out in three phases of data collection between 1994 and 1998. It provides data for 25 distinct language or country groups. A first round of ALL data collection

was undertaken in 2003 in seven countries. Ten more countries will be added in 2006. The studies are the first to directly assess adult skill in a comparative global context. The objectives are to profile the level and distribution of skill in a range of economically and socially important domains; to identify groups whose skill levels put them at risk; to shed light on the factors that underlie differences in proficiency; and to understand the impact of particular skills on economic, social, educational, and health outcomes at both the individual and macro levels.

The IALS estimates skill in three domains:

- *Prose literacy*. The knowledge and skills needed to understand and use information from text, including editorials, news stories, brochures, and instruction manuals.

- *Document literacy*. The knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables, and charts.

- *Quantitative literacy*. The knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials—for example, balancing a checkbook, figuring out a tip, completing an order form, or calculating the interest on a loan from an advertisement.

The ALL assessment provides identical measures of prose literacy and document literacy as the IALS. The IALS quantitative literacy domain was replaced with a refined numeracy measure: the knowledge and skills to effectively manage diverse mathematical demands. In addition, the ALL assessment included a measure of analytic problem solving: goal-directed thinking and action in situations for which no routine solution procedure is available. (That is, the problem solver has a more or less well-defined goal but does not immediately know how to reach it. The incongruence of goals and admissible operators constitutes a problem. Understanding the problematic situation and its step-by-step transformation requires planning and reasoning, the process of problem solving.)

Both assessments conceptualize skill as a tool that helps individuals adapt to their changing environments and life circumstances. A basic premise is that such change is a defining characteristic of the emerging global information society and knowledge economy. The change is driven by evolving technology and continuous social reorganization, the twists and turns of any life, and the rethinking of individual goals and aspirations. Both assessments embody a notion of skill that is, at its core, about mastery of the unfamiliar.

Extensive background questionnaires for both studies include batteries of questions designed to profile skill use, including ICT use at work and at home. Results have been published in international comparative reports and monographs, including *Literacy, Economy and Society: First Results of the International Adult Literacy Survey* (Statistics Canada and OECD, 1995), *Literacy Skills for the Knowledge Society: Further Results of the International Adult Literacy Survey* (HRDC and OECD, 1998), *Literacy Skills for the Information Age: Final Results of the International Adult Literacy Survey* (Statistics Canada and OECD, 2000), and *Learning a Living: First Results of the Adult Literacy and Life Skills Survey* (Statistics Canada and OECD, 2005).

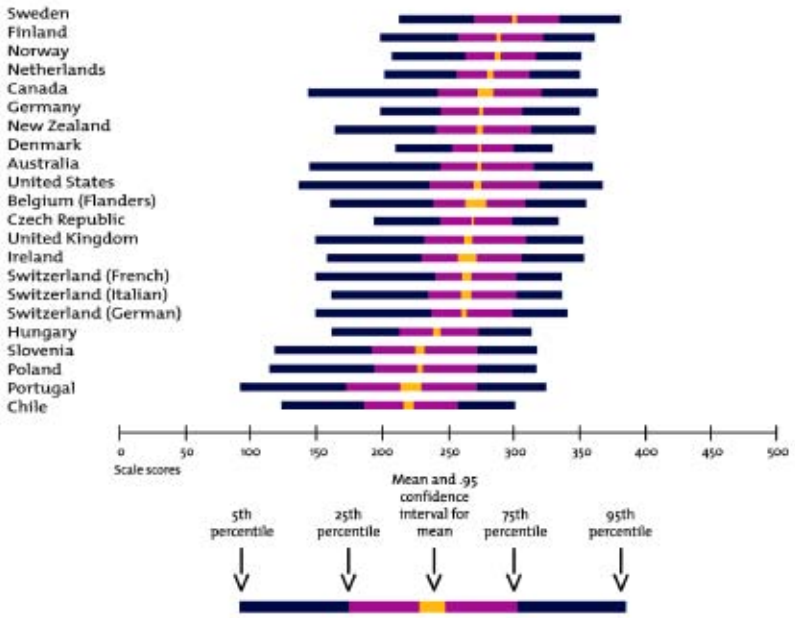
Readers interested in the theory and evidence for the validity and reliability of the measures that underlie the studies are referred to *The Adult Literacy and Life Skills Survey: New Frameworks for Assessment* (Statistics Canada, 2005). All reports cited in this chapter and the underlying data are available free at http://www.statcan.ca.

Why Skill Matters: Findings from IALS and ALL

The first and most striking result of these studies is illustrated in Figure 4.1. The figure shows mean scores with a 0.95 confidence interval and scores at 5th, 25th, 75th, and 95th percentiles on a prose literacy scale for the population aged 16 to 65 (1994–98). Countries are ranked on mean scores. The figure shows that differences in the level and distribution of adult literacy and numeracy skill are far greater than implied by mere difference in educational attainment. These differences are too large to be attributed solely to differences in the quality of initial education; they thus reflect differences in gain and loss of skills in adulthood. The figure also reveals that the performance of countries has shifted relatively over time, a trend that underscores the importance of national policies related to skills.

Figure 4.1. Distribution of Literacy Scores

Mean scores with .95 confidence interval and scores a 5th, 25th, 75th, and 95th percentiles on the prose literacy scale, population aged 16-65, 1994-1998

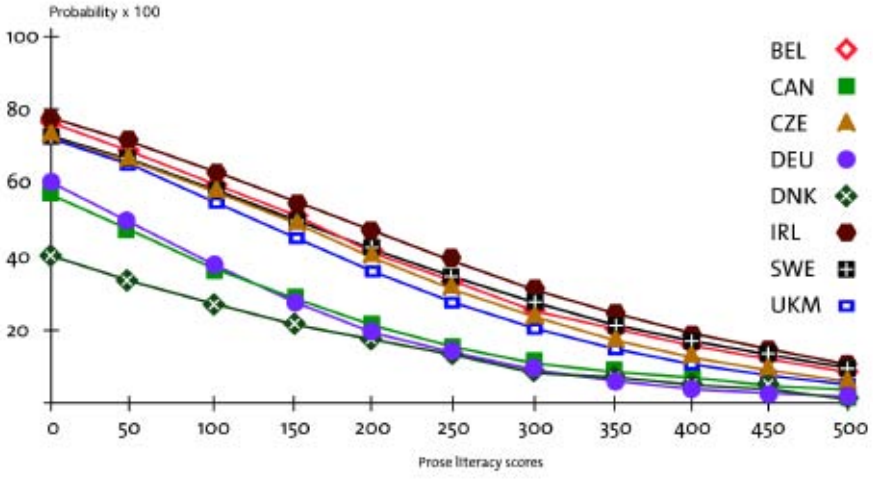


Source: International Adult Literacy Survey, 1994-98.

These data raise two questions: First, are the observed differences economically meaningful; and second, what social and economic processes underlie skill gain and loss in adulthood?

The answer to the first question is unequivocal at the individual level. Figure 4.2 shows the probability of being unemployed according to prose literacy score for 16-to-25-year-old men who have less than an upper-level secondary education (1994–98). As would be predicted by theory, labor markets identify and reward skill. Figure 4.3 shows the probability of unemployed adults aged 16 to 65 exiting from unemployment over a 52-week period. Their skill levels are ranked as "low" (levels 1 and 2), "medium" (level 3), or "high" (levels 4 and 5) during 2003. The figure attests that skill level exerts a profound influence on the probability that someone will experience or exit unemployment.

Figure 4.2. Probability of Unemployment and Literacy Proficiency

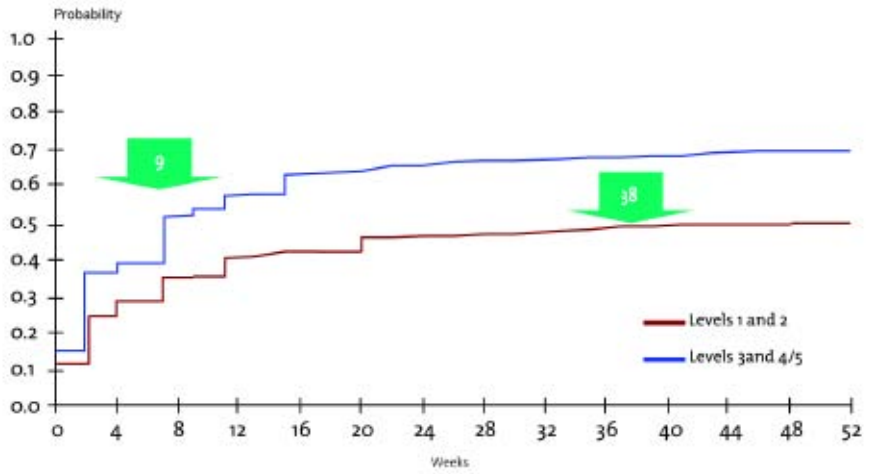


Note: Probability values in shaded ranges are based on observed scale scores with sufficient effective sample sizes.
Source: International Adult Literacy Survey, 1994-98.

In Figure 4.4, countries are ranked by the magnitude of the effect parameter associated with educational attainment. In other words, skill not only exerts a strong

influence on individual employment, it explains a significant fraction of wage variable at the national level, too. Among effects observed in Figure 4.3 and Figure 4.4, the effect on wages is perhaps most interesting. Returns to skill are low in labor markets with high, uniform skill level; and they are high in markets with high demand but variable quality in skill. This

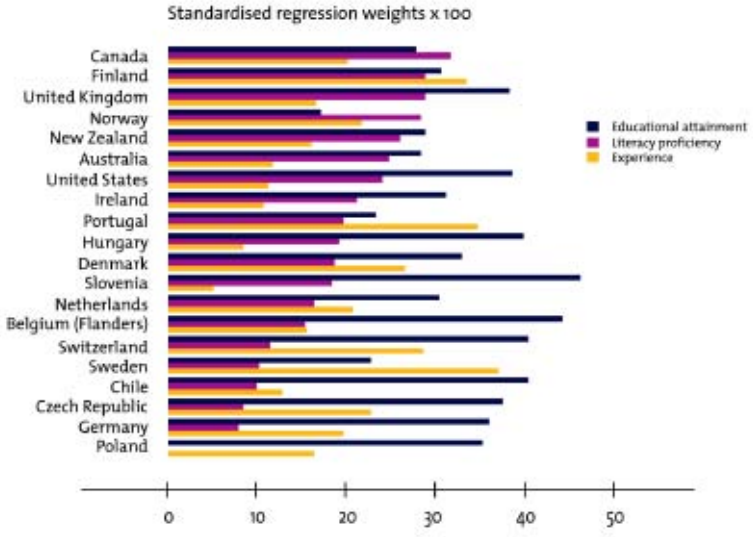
Figure 4.3. Labor Market Outcomes and Skill-Probability of Exiting Unemployment by Skill Level



Source: Adult Literacy and Life Skills Survey, 2003.

suggests that reducing inequalities in adult skill levels would be an effective strategy to reduce social inequalities in individual economic outcomes; and conversely, it calls into question policies that presume that labor markets are filled with economically irrational biases and discrimination.

Figure 4.4. Earnings and Literacy Proficiency, Controlling for Education and Labor Force Experience



Countries are ranked by the magnitude of the effect parameter associated with educational attainment

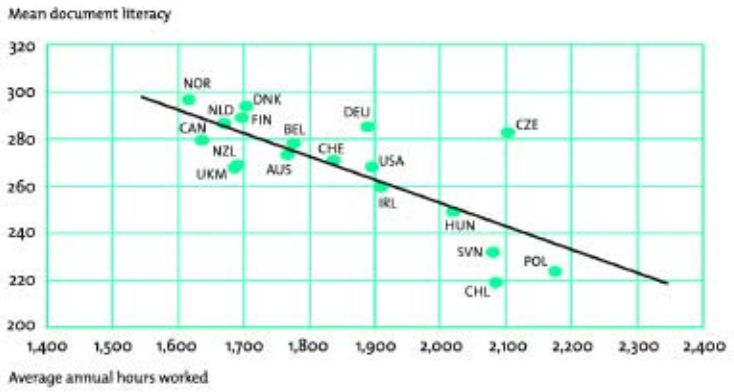
Source: International Adult Literacy Survey, 1994-98.

Turning to the macro level, it would seem that the more literate the labor force, the lower the total hours worked. In document scale, Figure 4.5 shows the average annual hours worked per person in employment, and mean literacy proficiency for the population aged 16 to 65 (1994–98). The figure suggests that workers are taking some of the additional rents that accrue to these skills as leisure.

Endogenous growth modeling by Coulombe, Tremblay, and Marchard (2004) shows that differences in average literacy skill level fully explains 55 percent of differences in the long-term per capita GDP growth in 14 OECD countries. If the pattern observed over the past 45 years holds, then an increase of 1 percent in the average literacy skill would return a 1.5 percent permanent increase in per capita GDP and, even more astounding, a 2.5 percent increase in productivity.

Figure 4.5. Skill and Macroeconomic Outcomes: Labor Volume by Document Literacy

Average annual hours worked per person in employment and mean literacy proficiency, document scale, population aged 16-65, 1994-98



Source: International Adult Literacy Survey, 1994-98.

This finding is remarkable. In other words, the effect of human capital on macroeconomic growth as proxied by literacy skill is roughly equal to the effect observed in individual Mincer-style wage equations, which seeks to explain wage differentials among groups. That is about 15 percent more than economic policy makers would generally assume.

Only a very small number of workers belong to Group D (see page 45), regular ICT users who occupy jobs that require little use of cognitively demanding skills such as literacy.

The authors also find interesting distributional effects. The percentage of individuals with high literacy skill appears to have no impact on the long-term growth of the OECD economies. In contrast, the percentage of individuals with very low literacy skills appears to exert a strong negative effect on growth. These findings imply that educational investments targeted at low-skilled adults would yield good returns.

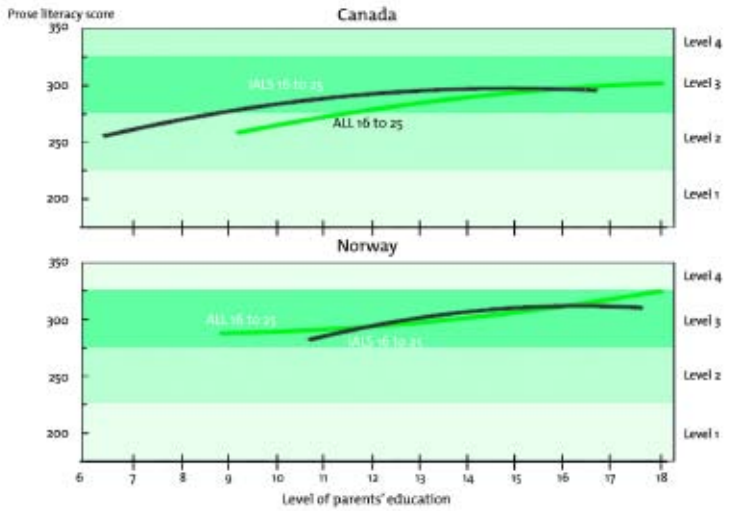
On the other hand, Figure 4.6 suggests that such investments need to be approached with caution. For the population aged 16 to 65, the figure shows the relationship between respondents' prose literacy scores (in 2003) and their parents' education in years. Although the overall evidence is clear that increased skill can drive economic growth, the ALL study provides equally clear evidence that significant skill loss is associated with jobs that have low indices of skill use. This suggests that policy cannot solely be focused on the supply side. The demand for skills must also be sufficient to absorb any new increases in the supply of skills.

Individual Outcomes and Productivity Growth

Having established the importance of skill to the distribution of individual labor market outcomes and to key measures of long-term macroeconomic performance, what can we say about the impact of ICTs on individual outcomes and productivity growth?

Figure 4.6. Equity and Change in the Social Distribution of Skill: Socioeconomic Gradients for Three Adult Cohorts

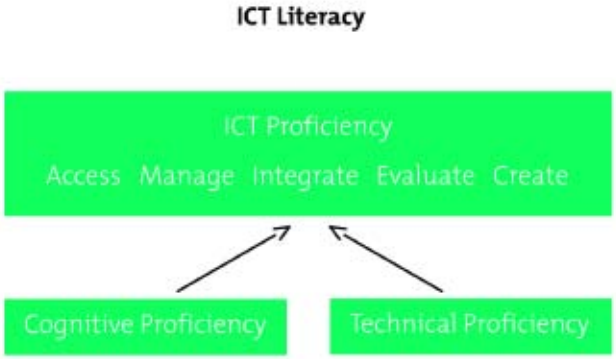
Relationship between respondent's prose literacy scores and parents' education in years, population aged 16 to 25, 26 to 45 and 46 to 65, 2003



Source: International Adult Literacy Survey, 2002.

The measures of ICT skill embodied in the ALL study are based upon work by Irwin Kirsch and his colleagues at the Educational Testing Service (ETS). The ETS framework defines ICT skill as a combination of cognitive skills—literacy, numeracy, and problem-solving—and the technical skill associated with a particular technology—that is, its syntax, user interface, and so forth. Although proficiency depends on the application of both sets of skills, the nature of the task largely dictates the relative difficulty of ICT skills. As illustrated schematically in Figure 4.7, the ETS framework specifies five levels of application—to access, to manage, to integrate, to evaluate, and to create.

Figure 4.7. Information and Communication Literacy



Source: ETS, 2002.

This framework allows individuals to be classified into four categories. As shown in Figure 4.8, each category carries its own implications for the amount of remedial education required to use technology in the workplace. From an employer's point of view, workers who belong to Group B would be ICT-literate and job-ready, while workers who belong to Group A require technical training in the use of ICTs. Workers who belong to Group C require extensive literacy and ICT training. Only a very small number of workers belong to Group D, regular ICT users who require little additional training.

The ALL study carried a battery of questions designed to identify the incidence, frequency, and range of ICT use at work and in daily life. These questions were used to

Figure 4.8. National Skill Covariance Mix

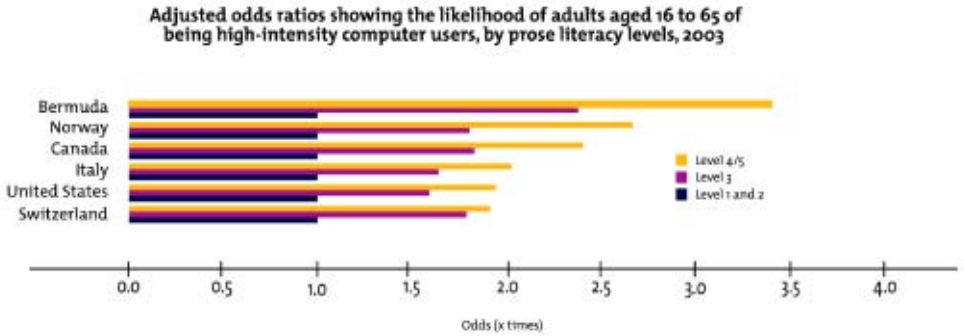
ICT and Cognitive Proficiency

	Low Technical Proficiency	High Technical Proficiency
High Cognitive Proficiency	A	B
Low Cognitive Proficiency	C	D

Source: ETS, 2002.

create a pair of ICT indices. Using adjusted odds ratios by prose literacy levels, Figure 4.9 shows the likelihood of adults aged 16 to 65 being high-intensity computer users (2003). The figure confirms a strong association between literacy skill and ICT use. Intense ICT use appears to depend upon a high level of literacy skill.

Figure 4.9. Likelihood of Being a High-Intensity Computer User by Literacy Skill Levels



Note: Countries are ranked by odds of who scores at level 4/5.
Source: International Adult Literacy Survey, 2002.

The ALL data were used to create a combined literacy and ICT use index. A logistic regression was then used to model the effects of socioeconomic characteristics, as well as literacy skill and computer use profiles on personal income. The combined profiles consist of four groups, shown in Table 4.1.

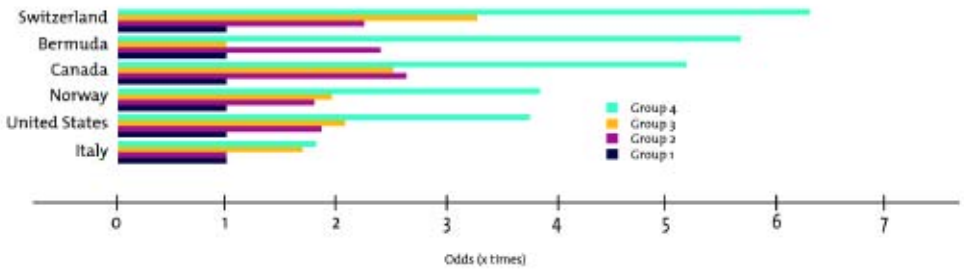
Data in Figure 4.10 show quite clearly that the combination of literacy and intense ICT use has a marked effect upon individual economic outcomes. Combining literacy and computer use profiles for 2003, the figure shows the adjusted odds ratios of any adult between the ages of 16 and 65 being in the top quartile of income earners. It reveals that adults with high scores on both scales are much more likely to have high incomes, a relationship that captures both an employment and a wage effect.

Table 4.1. Measuring Combined Literacy Skilled and Computer Use

Profile	Profile	Use of computers for task oriented purposes
Group 1	Low (levels 1 and 2)	Low intensity (less than the top quartile of computer users)
Group 2	Medium and high (levels 3 and 4/5)	Low intensity (less than the top quartile of computer users)
Group 3	Low (levels 1 and 2)	High intensity (top quartile of computer users)
Group 4	Medium and high	High intensity (top quartile of computer users)

Figure 4.10. Likelihood of Being a Top-Quantile Income Earner by Combined Skills and User Profiles

Adjusted odds ratios1 showing the likelihood of adults aged 16 to 65 of being top income quartile earning, by combined literacy and computer user profiles, 2003



Note: Countries are ranked by the odds of those in Group 4. Odds estimates that are not statistically different from one at conventional levels of significance are reported as one.

Source: International Adult Literacy Survey, 1994-98.

What Are the Policy Implications?

The policy implications of these findings depend upon the economic circumstances of a particular country. Take, for example, the OECD economies. If they wish to remain competitive in global markets, the widespread diffusion of ICT into the production process holds promise for even greater productivity gains. Yet at the same time, this transition may mean greater wage inequality as those with high literacy facility acquire the ICT skills to make them even more productive. Meanwhile, the global supply of cognitive skills continues to rise rapidly in competitor countries too, in response to broad investments in educational quality.

Under normal circumstances, OECD economies would rely on rising educational quality and more years of schooling to provide requisite skills that counter this trend. But declining fertility may deprive them of this luxury—their cohort of young people is simply too small to meet the increasing demand for skill. Thus, OECD economies will be obliged to either import human capital through immigration, or they will have to educate large numbers of adults who presently lack the literacy or technical skills to use technology effectively.

For middle-income and developing countries, these trends provide a new opportunity to compete in global markets. Selective investment in educational quality and quantity should raise the literacy of a sufficient number of workers for rapid diffusion of ICTs, at least in specific industrial sectors. On the other hand, care must be taken to ensure that skill supply does not outstrip skill demand, which as shown here, can result in significant loss of skill. These countries will also have to make sure that other elements that support growth are in place. In some cases, however, non-OECD economies will be able to benefit from switching directly to more efficient work organizations and production processes enabled by ICTs, but without incurring costly refit and restructuring costs.

The UNESCO Institute for Statistics has launched the Literacy Assessment and Monitoring Program (LAMP) in order to profile the distribution of literacy and numeracy skill and ICT use in the developing world. The institute is also working with the OECD and the Educational Testing Service to develop a direct assessment of ICT skill that will be fielded in 2009 or 2010. The final question that these data will answer is not, "Will OECD economies lose jobs?" but rather, "Will their displaced workers have the skills to find well paying, stable replacement jobs for those inevitably lost to the developing world?" Latin American economies stand to gain significant numbers of these "displaced" jobs provided that they continue to improve the quantity and quality of education. Whether North or South, literacy is the key to unlocking the promise and potential of the ICT revolution.

References

Coulombe, S., J. F. Tremblay, and S. Marchand, S. 2004. *Literacy, Human Capital, and Economic Growth in Fourteen OECD Countries*. Ottawa: Statistics Canada and HRDC.

Educational Testing Service (ETS). 2002. *Digital Transformation: A Framework for ICT Literacy*. Princeton: ETS.

HRDC and OECD. 1998. *Literacy Skills for the Knowledge Society: Further Results of the International Adult Literacy*. Ottawa and Paris: HRDC and OECD.

Statistics Canada. 2005. *The Adult Literacy and Life Skills Survey: New Frameworks for Assessment*. Ottawa: Statistics Canada.

Statistics Canada and OECD. 1995. *Literacy, Economy, and Society: First Results of the International Adult Literacy Survey*. Ottawa and Paris: Statistics Canada and OECD.

———. 2000. *Literacy Skills for the Information Age: Final Results of the International Adult Literacy Survey*, Ottawa and Paris.

———. 2005. *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*. Ottawa and Paris: Statistics Canada and OECD.

Chapter 5

Serving the Poor Profitably: Enterprise and Technology to Empower Communities and Households

Allen Hammond, Rob Katz, John Paul, and Julia Tran

Development agencies, national governments, and local governments play important roles in economic growth and in combating poverty. The private sector plays a key role too, though it receives far less attention. This is especially true in the uses of information and communication technology not just in the telecommunications sector, but across developing economies as a whole. In this light, we propose using enterprise and technology to empower poor communities. This approach sees low-income communities not as aid recipients but as sources of innovation and entrepreneurship, as well as significant new markets.

Digital Dividends to Development through Enterprise

The Digital Dividends project of the World Resources Institute (WRI) grew from recognition that the global digital divide represented a business opportunity that could create significant digital *dividends*. As Hammond (2001) put it, "The imaginative use of emerging technologies and the creation of partnerships or cooperative approaches that combine the skills of major corporations with the growing strength of civil society can accelerate development in even the poorest regions and can reverse many of the most worrisome trends." In other words, how can technology be used to create social, economic, and business benefits among four billion people—more than half of humanity—who now live on less than $1,500 per year?

In October 2000, Microsoft Chairman Bill Gates, Hewlett-Packard CEO Carly Fiorina, United Nations Development Programme Administrator Mark Malloch Brown, and nearly 40 other speakers addressed more than 300 representatives of the business and development communities in Seattle, Washington, at the inauguration of the Digital Dividend Project. Digital Dividends set to work with Project Clearinghouse, an interactive database that documented how low-income communities use information technology in development activities. The clearinghouse quickly expanded to include more than 1,200 examples of IT-enabled development on the ground. Research on outstanding projects was published in *What Works*, in-depth case studies of some of the more promising projects in the clearinghouse. These case studies included detailed descriptions and analyses of each business model; a look at the market segment in which each business operates; successes and challenges; potential replicability and scalability; and data permitting, the social impact of respective ventures. The research included project-level data documentation on the relationship between profitability and long-term success.

Business strategists and development experts—including C. K. Prahalad, Stuart Hart, and Allen Hammond—met the same year to explore the role of business in sustainable development. They argued that business could profitably serve the needs of the poor. They hypothesized the concept of the Base (or Bottom) of the Pyramid (BOP) business approach to development (Prahalad and Hart, 2002; Prahalad and Hammond, 2002; Hammond and Prahalad, 2004; Prahalad, 2004; and Hart, 2005).

In late 2004, WRI organized a conference in San Francisco, California, to discuss Eradicating Poverty through Profit. More than 1,000 business people, policy makers, civil society representatives, and

scholars explored the relationship between business and economic development in low-income communities. Subsequently, WRI widened its research priorities to include all BOP business models, not just those enabled by information technology. With this broader view, the project changed its name from Digital Dividends to Development through Enterprise. The expanded project has launched an online community on BOP issues, and it developed an interactive database on BOP activities similar to that of the clearinghouse. Case study research continues, as well as corporate partnerships.

The Catalytic Role of ICT

Information and communication technologies can be powerful enablers. By improving access to information, ICTs enable economic growth. They reduce the cost of producing and transmitting information, thereby increasing efficiency and lowering transaction costs. Economic productivity is enhanced through better coordination and decision-making. ICTs also help developing countries to overcome geographic boundaries, expanding their access to larger markets and the global supply chain. ICTs can help the poor and NGOs to become business partners as suppliers, distributors, and sources of market information for large companies. They can also be used as tools of empowerment, leading to demands for greater openness and transparency in both markets and governments. Finally, developing countries can utilize ICTs to leapfrog traditional development paths, deploying cheaper and more scaleable infrastructure in underserved areas.

Examples from *What Works* of Win–Win Opportunities

The power of ICT coupled with the private sector is illustrated by several examples below. These brief capsules are described in greater detail in *What Works*, case studies available at http://www.digitaldividend.org.

e-Choupal

In India, where 200 million people are engaged in agriculture, ICT is helping to make the sector more competitive internationally by empowering, not eliminating, independent small farmers. A network of Internet-connected kiosks, known as e-Choupals, have been set up in villages to enhance productivity and help small farmers to get better prices at harvest. Farmers now have improved access to information, products, and services. And they can source their produce directly, reducing procurement and transaction costs. Project e-Choupal demonstrates that a large corporate enterprise can help small farmers and rural communities to reorganize markets and increase efficiency of the overall agricultural system, while returning a fair profit to the corporation's shareholders.

Voxiva

As globalization spreads, so do infectious diseases, increasing health threats in both human and economic terms. Early detection and quick reaction are crucial to mitigating these costs. In Peru, the for-profit Voxiva has addressed this need by developing and implementing a technology platform that enables medical professionals to collect and communicate data in real time. Rather than be constrained by rural Peru's low telephone density, Voxiva's Alerta project worked with existing IT infrastructure to provide 24-hour, 365-days-per-year access to data via text messaging and e-mail. Voxiva's flexible solution can be adopted by any end user, both in developed and developing countries.

Vidya

Vidya, Hindi for *knowledge*, is a computer literacy program by Aptech Ltd., one of India's two largest computer education and training companies. As a part of its corporate citizenship effort, Aptech in 1999 decided to open the doors of opportunity wider by expanding its course catalog beyond core

offerings targeted at computer professionals and the corporate market. As a result of its low pricing, Vidya has brought computer training to many low-income students for whom it was previously unaffordable. Aptech has introduced the program at approximately 1,250 of the company's 2,449 centers, enrolling more than 350,000 students. Its success has been based on an effective, replicable business model, a highly motivated management and franchise team, and excellent course materials.

Prodem

PRODEM Private Financial Fund (PRODEM FFP) offers Bolivia's low-income communities and the micro- to-medium enterprises of its informal economy a wide range of savings, credit, and money-transfer services. The 65-branch network is the largest in the country. It reaches rural as well as urban areas. To expand its market and improve its services, the company has developed and deployed a new technology-based solution that employs smart cards, digital fingerprint recognition technology, and Smart ATMs, as well as stand-alone, voice-driven Smart ATMs in local languages with color-coded touch screens. The innovative combination of technologies allows PRODEM FFP to overcome barriers such as illiteracy and to offer secure access to financial services, even in the most remote areas.

ICICI

ICICI Bank, India's second largest financial institution, is betting its future expansion on new partnerships and innovative uses of ICTs to profitably provide banking services to the poorest of the poor. The bank has combined its capital and expertise with the social mobilization prowess of existing microfinance organizations and self-help groups. In just two years, the number of self-help groups that the company serves rose from 1,500 to more than 8,000. To further expand its rural presence, ICICI has partnered with Internet kiosk networks that provide online banking services. By formalizing the rural financial services market, ICICI is starting to address the vast unmet demand for rural credit, especially among women. Access to reliable credit at affordable rates can significantly help borrowers to lift themselves out of poverty.

FMS

First Mile Solutions (FMS) is bringing Internet connectivity to low-income rural communities where real-time access by satellite and landlines is still too costly. FMS provides necessary equipment for e-mail. Users can send/receive Web pages to and from hubs through on-the-ground access points that are ported in cars, motorcycles, and so forth. Special antennas are attached to the end user's computer, the vehicle, and the Internet hub. This provides quick and seamless data transfer at low cost. By 2005, FMS equipment was being used—for more than 30,000 people in four countries—to train schoolchildren in technology, to help urban doctors diagnose the ailments of rural patients, to allow rural craftswomen to sell online globally, and to otherwise improve local processes and economic efficiency.

Vodacom

Vodacom Community Services began under a 1994 government mandate to provide telecommunication services in disadvantaged communities in South Africa. Vodacom developed an innovative way to meet this mandate via entrepreneur-owned and operated phone shops. These have provided affordable communication services to millions of South Africans, empowering thousands of previously disadvantaged individuals with income-generating opportunities and lasting business skills. The Community Services program now provides more than 23,000 cellular lines at approximately 4,400 locations. By investing so extensively in disadvantaged communities, Vodacom is also investing in its own future by creating a distribution channel for its services and a well-recognized brand name. Though full returns may only materialize well into the future, the company is confident that its investments will pay off directly through sales and indirectly through a stronger, better-connected South African economy.

Smart

By paying attention to the low-income market, Smart Communications has become the Philippines' leading wireless provider. The company provides communication services to millions of low-income Filipinos—approximately 98 percent of subscribers are prepaid low-income customers—through electronic sales of airtime via short message service (SMS). The unit size of sales by June 2004 had been reduced to as little as US$0.03 a minute. Smart Communications had almost 12.5 million subscribers and US$554 million in operating revenue. The company is also creating real revenue and business opportunities for its distribution network of over 500,000 reseller agents, many of whom are small shopowners, homemakers, and even students. The distribution system uses SMS technology that allows merchants to take a commission on every local sale. Using technology to deliver low-cost communication services, Smart Communications delivers a triple win by meeting the needs of low-income consumers, small-scale entrepreneurs, and its own bottom line.

Underlying Technology Trends

One reason to take the potential of ICT seriously is that the technology is still evolving rapidly and access is spreading very rapidly. By the end of 2005, there will be an estimated half billion cell phone users in China, India, and Brazil—far more than in the United States or the EU. On a percentage basis, the growth rates in Africa are the highest in the world. Motorola is now shipping a basic GMS phone, designed to meet the global mobile digital standard for emerging markets that is priced at about US$40. Other manufacturers have announced similar low-price models. Companies are also experimenting with reselling airtime or text-messaging units, payment systems, and even remittance transfers over cell phones. A recent study by Vodafone showed that access to mobile telephony has a huge impact in rural communities. It raises incomes by expanding access to jobs, crop prices, and suppliers. It improves access to emergency medical care and government services, and it improves contact with extended families.

A second, parallel trend is the rapid development of fixed wireless broadband technologies, especially the WiFi and WiMax family backed by major corporations such as Intel. Entrepreneurs and development agencies are investing in networks in developing countries that can carry Internet data traffic, voice-over Internet phone service, digital music and images, and even modest-resolution videoconferencing and video services. The result has been lower-cost standardized equipment, extended range, and wider social access. For example, the U.S. Agency for International Development (USAID) is helping to build a nationwide wireless broadband network in Macedonia that will reach every school and a vast number of businesses and homes. USAID is also financing wireless pilot projects in Latin American countries such as Colombia, Ecuador, Peru, Paraguay, and Guatemala. As costs come down, Internet access goes up. As previously described, First Mile Networks has developed equipment for an even lower-cost approach that can be carried on transport vehicles. A bus or motorcycle on a regular route can provide daily (though not continuous) Internet access to remote sites at extremely low cost.

In addition to low-cost networks, low-cost devices and software are gaining market traction. AMD, a major manufacturer of computer chips, now produces an Internet communicator—that is, a personal computer in a small sealed box that an Internet Service Provider deploys in cyber cafes and other local access points for shared connections. The device is powerful, dust-resistant, and virus-resistant. It requires little technical support, and the initial version costs about US$185. The price is expected to drop to under $100. Microsoft now sells local-language versions of Windows at sharply reduced prices in many developing countries.

The applications and uses that drive the expansion of connectivity in poor countries are not necessarily the same as those that drive the market in developed countries. For example, picture mail (a digital image) and voice mail attached to e-mail or stored in a server can be

far more useful in an environment where literacy and written communication are problematic. A digital image of infected cattle, for example, can be sent to a distant veterinarian for diagnosis and advice on treatment. Information about outside market prices and access to suppliers and sales opportunities in faraway markets can be particularly important to farmers, artisans, and small retail businesses. The ability to provide secure ID via digital thumbprint or voice-plus-face recognition can foster e-commerce and secure transactions that do not involve cash. Electronic transmissions of remittances are crucial for labor-rich impoverished areas that export workers abroad. In some cultures, the importance of face-to-face discussion means that videoconferencing, even at low resolution, can make business transactions possible.

Lessons Learned

Many successful business models that involve ICT are built around local entrepreneurs and a franchise model—locally owned kiosks or phone shops selling services to their neighbors but supported by the technical and network resources of larger entities. Similarly, a shared-access model of village phones, cybercafés, or telecenters uses infrastructure efficiently and reduces the cost barriers of individually owned equipment. Prepaid models predominate. No credit requirements, no billing costs, and cash up front are advantageous for operators. The flexibility to buy prepaid units as needed (or as cash is available) with no monthly commitment is advantageous to customers. This can translate to better access to necessary information, more security in financial transactions, and greater opportunities for participating in democratic processes and the global economy.

Many donor-led and philanthropic ICT projects have not been anchored on solid business models, and they have typically failed where local entrepreneurial energy could not be harnessed through reasonable potential for profit. Using profit-based business models, enterprises such as those described here have demonstrated the transformative power of access to information—in transparent governance, market efficiency, and social fairness that continually expand economic opportunity and improve the quality of life.

References

Hammond, A. (2001). "Digitally Empowered Development." *Foreign Affairs 80* (2): 96-106

Hammond, A. and C. K. Prahalad. 2004. "Selling to the Poor." Foreign Policy 142: 30-37.

Hart, S. 2005. *Capitalism at the Crossroads: The Unlimited Opportunities in Solving the World's Most Difficult Problems*. Upper Saddle River, New Jersey: Wharton School Publishing.

Prahalad, C. K. 2004. *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits*. Upper Saddle River, New Jersey: Wharton School Publishing.

Prahalad, C. K. and A. Hammond. 2002. "Serving the Poor, Profitably." *Harvard Business Review* 80 (9):48-57.

Prahalad, C. K., and S. Hart. 2002. "The Fortune at the Bottom of the Pyramid." *Strategy+Business* 26:54-67

Part III

Information and Communication Technology in Governance

Building consensus and mobilizing the resources needed to ensure that development efforts respond to the values, needs, conditions, resources, and aspirations of all citizens depends on the degree of trust that exists among public, private, and civil society organizations. Whether or not ICT continues to strengthening democracy by making public sector institutions more effective and responsive depends on the content and continuity of national dialogue about their deployment. How a government deals with information and communication, as a producer, user and policy maker, can reveal much about its values and priorities.

The relationships involving information and communication technology, governance, and trust are complex. The chapters in Part III help us sort through the maze and approach workable solutions. Antonio Cordella (Chapter 6) reports on a methodological framework he and a team from the London School of Economics and Political Science (LSE) formulated and tested for the Inter-American Development Bank. Shauneen Furlong (Chapter 7) describes how the Canadian people have been building trust by translating citizen-centric governance from theory into reality. Peter Raymond (Chapter 8) describes how ICT can improve transparency in regulatory reporting.

Chapter 6

The Role of Information and Communication Technology in Building Trust in Governance: Toward Results and Effectiveness

Antonio Cordella[1]

This chapter addresses issues raised in reports by Latinobarómetro (2004) and UNDP (2004) showing that Latin Americans are losing confidence in the capacity of democratic institutions to secure economic stability and prosperity. This lack of trust and associated weaknesses in socioeconomic infrastructure must be addressed if Latin America is to rise to the challenge of the UN Millennium Development Goals. The low level of trust in democratic institutions results from structural elements and contingent sociocultural factors. The Latinobarómetro survey identifies two main problems underlying the relationship between citizens and the public administration: public agencies' unequal treatment of citizens, and lack of transparency and accountability in the ways that they operate.

The goal of this chapter is to report on a framework to assess the relationship between trust and e-government policies that was developed collaboratively between the IDB and the Italian Ministry for Innovation and Technologies. Empirical data used to develop the framework was obtained through five case studies conducted in Brazil and Chile. A report for the IDB discusses the relationship between trust, ICT, and government; and it outlines how they pertain to each other. The present chapter highlights key aspects of those relationships, and it proposes a framework for ICT polices that will improve trust between citizens and their governments.

ICT, Trust, and Trustworthiness

Trust is a vague concept; so for clarity, we first needed to spell out how it is associated with the social, cultural, and institutional processes that create it. To that end, we began with a review of the relevant literature. This led us to a conceptual model that interprets trust as the outcome of experiences of interaction taking place within smaller or larger networks of personal, institutional, and cultural relationships. Over relatively long periods, the experiences are consolidated as norms and shared values within the communities of the network.

To study the potential effect of ICT-based reforms, we needed to recognize and understand the characteristics of trust that we are assessing. The characteristics are contextually and culturally embedded norms and values. Necessarily, they shape the development and deployment of any ICT-based state reforms aimed at the relationship between citizens and government.

Conceived in this way, trust forms the backdrop against which we further distinguish between trust as an *interpersonal relationship* and trust as a *social* or *institutional phenomenon*. In regard to the latter, trust captures citizens' expectations of fairness, impartiality, and reliability relative to the less tangible impersonal mechanisms, structures, and processes that underlie the modern state and society.

The distinction between trust as an interpersonal relationship and trust as a social or institutional phenomenon is crucial. An e-government initiative mostly pertains to trust as a tangled social and institutional phenomenon. Clearly understanding the distinction can help the IDB, and donors in general, to design interventions that strengthen the relationships of trust between citizens and government.

[1] This chapter summarizes the findings of "The Role of Information and Communication Technology in Building Trust in Governance: Towards Effectiveness and Results", written by Chrisanty Avgerou, Claudio Ciborra, Antonio Cordella, Janis Kallinikos and Matthew Smith from the London Scholl of Economics and Political Science (LSE) (2005-IDB).

Our analysis furthermore distinguished among trust in *technological artifacts or processes*, trust in a specific *ICT-mediated service*, and trust in *government at large*. Of these, our investigation focused mainly on the second—trust in a specific IT-mediated service. The analysis focused on the characteristics, properties, and conditions that make a service or institution worthy of being trusted. We defined that as "trustworthiness," and assessed the potential of ICT in enhancing those characteristics, conditions, and properties.

The distinction between trust and trustworthiness is a cornerstone of the study. Recognizing the full importance of this distinction is, in itself, a major finding that emerged from the iterations of dialogue between our empirical observations and theoretical predictions. Trustworthiness is an objective characteristic of services, institutions, and technological artifacts. It makes being trusted not needed. Trustworthiness occurs because the role, functions, characteristics, and consequences of institutional actions are clear and transparent—in other words, endogenously worthy of being trusted.

The rationale for distinguishing between trustworthiness and trust derives from two assumptions. First, trustworthiness can be traced back to a set of technological, organizational, and institutional preconditions. To some degree, e-government initiatives can help to shape these conditions in the short or medium term. Trustworthiness sometimes, though not always, leads to trust. In other words, trustworthiness of the public services is a positive but insufficient condition for the emergence of trust. Both assumptions are crucial in mapping out the space within which donors can develop initiatives to improve the trustworthiness of government ICT-based services. Initially, the intervention needs to achieve the necessary condition of trustworthiness in the ICT-mediated services by defining proper ICT policies. Then, donors need to cultivate the milieu within which these polices can be deployed—that is, they need to support the process that ultimately contribute to raising trust. The first step is in the domain of ICT e-government policies; the second is in the domain of social, cultural, and political interventions.

Factors Contributing to Trustworthiness

Drawing on our empirical data and observations, we suggest that trustworthiness represents the outcome of several categories of factors and conditions. These involve the prevailing *technological* and *organizational* factors underlying the delivery of a particular ICT-based service as well as the wider *institutional* and *infrastructural* context within which the development and delivery of that service takes place. The technological, organizational, institutional, and infrastructural factors that shape trustworthiness can be changed through appropriate policy interventions, though the extent varies to which desirable factors can be controlled. The joint outcome of these fours clusters of factors must be distinguished from the attitudinal or perception-based quality of trust that is the outcome of citizens' experience interacting with government services or institutions.

Based on these observations, we suggest that ICT policies, and hence e-government strategies, should aim at improving the level of trustworthiness as the necessary but not sufficient condition for trust. This should be tempered with the understanding that the achievement of ICT-mediated services that are trustworthy is a first but fundamental step. It leads to the *potential* for building of trust. That depends, in turn, on the overall citizen experience with government and on key institutional and cultural conditions, some of which are beyond the means of any individual trust-building initiative.

Our study makes clear that donors should support projects that use ICT to change the characteristics, properties, and conditions that make a service or institution trustworthy. The potential of an ICT project to increase the trustworthiness of a service can be assessed and,

hence, donors can use trustworthiness as a term of reference when programs are developed and implemented.

Theoretical and empirical analysis can identify categories related to trustworthiness before a project is designed. Our analysis distinguishes two levels of categories. First, the institutional *background* and infrastructural conditions help to set parameters on the degree to which an ICT-mediated service can be successfully developed, sustained, and utilized. Second, the organizational and technology *foreground* needs to be mobilized. As argued, the former develops gradually and therefore can be influenced through long-term, large-scale policies and interventions. These have to be negotiated by the full range of institutional and economic stakeholders. The latter are more likely to be influenced by the organization that hosts the ICT-mediated service, so they are more amenable to relatively narrower donor-sponsored projects.

The methodological instrument suggested above requires a combination of qualitative and quantitative assessments. Categories of conditions need to be assessed, and categories of factors need to be considered that both improve trustworthiness and are amenable to a project initiative. The exact list of conditions to be assessed and factors to be changed cannot be prespecified. The suggested instrument can only guide professional decision-making. This methodology addresses the fundamentally imprecise process of trying to construct technologies for their socially desirable effects.

Conclusions

The study recognizes the key role that ICT and related policies can play in improving the quality, equity, and accountability of public administration. Moreover, it highlight ICT as an enabler that can improve the trustworthiness of public services and, hence, achieve necessary preconditions for improving the quality of public services. The goal of ICT policies should be to improve the trustworthiness of public services as a means toward larger, farther-reaching socioeconomic innovation. The report provides an appropriate instrument for assessing the potential of interventions. It propose an overall frame of references for donors who wish to promote ICT policies for trust-related interventions, primarily by focusing on trustworthy mediated services rather than the broader concept of trust. This frame of reference refers not only to kinds of policies but also to the sequence with which they are deployed. Basically, trustworthy conditions breed trust. So dealing with the complexities of sociocultural relations may necessarily precede policy interventions.

In supporting projects of this sort, donors should distinguish between objectives that can be achieved in the short- versus the medium-term—in other words, building trustworthy ICT-based services as opposed to the less predictable, longer-term goal of fostering trust between citizens and government. Our study separated the issue of *trust* from *building trustworthy* services because of the complexity of the factors and processes that lead to trust. We believe that this distinction provides a basis for the methodological and conceptual tools that can guide the deployment of ICT polices aimed at the "trust gap" between citizens and government. As we have emphasized here, trustworthiness is a necessary but insufficient precondition for trust.

Our work with the IDB lays the groundwork for the formulation of a new generation of ICT policies that can improve the relationships between citizens and the government. It clearly articulates that ICT policies are no panacea to the solution of trust in the government of developing countries. However, the work provides analytical overviews and discusses what can be achieved with those policies and what ought to be pursued with policies that deal with change of the socio-cultural milieu that defines the perception of trust in the

government in a specific country. It clearly demarks the goals that can be achieved and ought to be achieved in the design and implementation of ICT policies, increased trustworthiness of government action, and the one that cannot be achieved only with ICT, increase the trust between citizens and the government.

References

Latinobarómetro . 2004. Informe–Resumen. Latinobarómetro 2004. Una década de mediciones. Santiago de Chile: Corporación Latinobarómetro. Agosto 13. www.latinobarometro.org

UNDP. 2004. *Democracy in Latin America: Towards a citizens' democracy*. New York: United Nations Development Programme.

Chapter 7

E-Government in Canada: Building Public Trust through Citizen-Centric Governance

Shauneen Furlong

This chapter briefly outlines the Canadian government's Government On-Line (GOL) initiative; describes some current efforts to seek input from citizens about designing and implementing the program; and highlights a publication that confirms that improved service delivery builds citizen trust in the public sector. Anecdotal evidence is then used to see how citizen trust has been affected by the citizen centricity of GOL, though quantitative evidence is still lacking.

Overview

The Canadian Government On-Line initiative is a multiyear project that provides citizens with the ability to interactively receive information, access programs and services, and do business electronically with public agencies. The initiative brings federal organizations online in stages, with all commonly used programs and services online by the end of 2005.

In the 1999 Speech from the Throne setting the nation's priorities for the upcoming year, Canada's Governor General committed the public sector to become "known around the world as the government most connected to its citizens, with Canadians able to access all government information and services online at the time and place of their choosing" (Clarkson, 1999).

Public Works and Government Services Canada (PWGSC) and the Treasury Board Secretariat (TBS) spearheaded the subsequent GOL initiative. A GOL Project Office was set up within the Treasury Board, moved to PWGSC in 2004, and is now working with 28 key federal departments and agencies to put all commonly used programs and services online by the end of 2005. The Treasury Board Secretariat Advisory Committee's Information Management Sub-Committee (TIMS) shepherds the GOL and is responsible for approving all allocations to federal organizations implementing the initiative.

The first generation of the GOL strategy included three main tiers or phases, which were intended to build on one another toward fully-secured electronic public service delivery. Tier One would provide a federal online presence. Tier Two would provide secure interactive electronic service delivery and "end-to-end" transactions. Tier Three would provide joint interjurisdictional service delivery.

As the initiative progressed, these priorities were refined and modified in line with lessons learned and citizen feedback. The original targets were scaled back from total online services to those most commonly used. This was based on international studies indicating that governments needed to focus on services suitable for online delivery that delivered user value.

Rather than replacing traditional communication channels, electronic access would complement service requests by telephone, mail, and in person. The idea was to continuously improve the ability of citizens to access their government for needed information and services by whatever means was most appropriate.

One key element of the GOL initiative to make that possible was an effort to build conceptual clarity among service users. It involved clustering public services and programs from a citizen's point of view rather than simply mirroring the formal organizational structure of government. These clusters make it easier for citizens to find and access the programs and services they need, recognizing that complex problems may overlap a number of agencies and programs. The government Web site clusters services and programs into three main groups: Services for Canadians, Services for Non-Canadians, and Services for Canadian Businesses. The Web site continues to evolve in response to client and user feedback. Information is organized around specific audiences (such as seniors), subjects (for example, the environment), and life events (for example, finding a job). Each cluster is managed by the most appropriate government department(s).

Many federal departments and agencies have been able to post a wealth of information electronically and numerous services are available, although the quality and scope of service delivery varies. The 2001 Speech from the Throne pledged to "continue to work toward putting its services online by 2004, to better connect with citizens" (Clarkson, 2001).

Later that year, the Federal Budget announced that "more planning is required to properly achieve the [g]overnment's commitment, particularly given rapidly changing technology; as a consequence, the [g]overnment will shift its target to the end of 2005" (Department of Finance, 2001). Since then, departments have worked within the annual budgetary process to produce detailed work plans that outline how they will progress from current levels of achievement to full online service delivery that supports the overall GOL plan.

The Treasury Board Secretariat of Canada has released four annual public progress reports since 2001. Each department also is encouraged to report on its own GOL progress and plans.

Analysis

This chapter focuses on the effect of a people-centric e-government approach on gaining citizen trust. It does not analyze specific e-government programs nor the mechanics of the Canadian government's efforts to transform how public services are delivered nor the impact on public institutions and their staff.

One should note that the institutionwide and centrally driven nature of the GOL initiative facilitates government-wide research. The Treasury Board Secretariat and the Institute of Citizen-Centred Service are in charge of this public opinion research. In addition, most federal departments undertake similar research for their own programs and service delivery. This chapter focuses only on the government-wide, centrally driven research.

The analysis will be in two stages. First, we will look at some of the research undertaken by the government of Canada to develop and implement a citizen-centric e-government focus. Then, we will look at results from the *Citizen First 3* report that reveals that citizen consultation and participation in directing the GOL initiative does improve service delivery (Institute for Citizen-Centred Services, 2003). Presumably this translates into increased citizen trust toward their governmental institutions. Such trust is expressed in terms of citizen participation, demands for improved services, and use of online services.

Listening to Canadians

The Government of Canada undertook a variety of approaches to determine citizens' specific interests. As Gordon (2005) puts it, "Canada's focus on self-examination and its relentless pursuit of user feedback have allowed it to continue to build what is clearly one of the world-

leading customer-focused government online programs." Each of these specific approaches is summarized below.

GOL Guiding Principles

The government's guiding principles for the online initiative were developed from and focused on citizen-centric activities. They are grounded in commitment to a citizen-centric, government-wide strategy that begins with citizen interest in obtaining needed services irrespective of which individual department or level of government is currently charged with providing the service.

Speech from the Throne

The Speech from the Throne officially opens every new session of Parliament, prior to the Senate and the House of Commons beginning public business. It is delivered by the Governor General and sets out the broad goals and direction of the government. Choosing the Speech from the Throne to announce the Government On-Line initiative in 1999 publicly committed the government to become the most connected public service in the world.

Public Opinion Research

Since the 1990s, the government of Canada and the Institute of Citizen-Centred Services have continuously consulted with the public in numerous ways to improve service delivery.

First, the government has conducted extensive polling of public opinion through the Treasury Board Secretariat. There have also been five online surveys of GOL and improved public service delivery. The most recent report was released in January 2005. This research has focused on citizens' feedback on the Canada Web site, gateways, common look and feel approach, and clusters; as well as it addressed the method of navigating around other government Web sites.

Surveys are conducted trimesterly to measure Canadian views on public policy priorities, and public assessment of how the government is responding to meet these priorities. The government also posts toll-free numbers and explains other methods for user feedback on its Canada Web site, including input into preparation of activity reports on the most frequently requested programs and services. These reports help identify the key issues and concerns of Canadians.

Second, the Institute for Citizen-Centred Services conducts public opinion research to fulfill its mission of promoting higher citizen satisfaction with public sector service delivery. The Institute has been conducting such research since 1998, and is currently working on its fourth publication, *Citizen First 4*. The current effort invites citizens to "have your say" and "participate in the latest in a series of world-class research initiatives focused on offering the Canadian government information about how people experience public services in Canada, and insights into how services can be improved."

The research mandate extends to citizens' expectations, satisfaction, and priorities for service improvement, and measurement and monitoring of public sector progress in improving citizen satisfaction with service delivery. In addition to seeking general direction through feedback about service improvements, frequency of contact, and the need for more seamless interjurisdictional service, the institute's research also spotlights specific areas of interest that challenge the conventional structure of government departments. "The need to contact multiple government offices for a single service issue arises most frequently around

certificates, licenses, and registration. These contacts are often triggered by milestones in life, such as getting a new job, going away to university, getting married, a death in the family, or moving" (Institute, 1998: 2).

This information and advice is used by all levels of government to develop their own action plans and implement online strategies tailored to their needs. The public consultation process led to a Citizens-First Service Model that has become a hallmark of GOL design. The model incorporates citizens' service needs, expectations, accessibility, quality, and priorities for improvement (Institute, 1998: 5).

The Institute's publication, *Citizens First 3*, builds on and extends the citizen-centered research agenda that is a cornerstone of the Canadian approach to public service improvement. The pertinent findings of this report are the following (Institute, 2003: 1):

- Service quality shapes citizens' confidence in their governments.
- Citizens have increasingly high expectations of government.
- Electronic service delivery through the Internet can increase satisfaction ratings when multiple contacts are needed to deliver a service or when service delivery is difficult.

Government On-Line Public Reports

Since the inception of GOL in 1999, the government of Canada has been committed to regularly inform the public about program status and progress. Four reports have been issued to date: in December 2001, 2002, 2003, and 2004. These reports are treated as an opportunity to restate the government's commitment, emphasize the people-centric and transformational approach, and encourage pride and interest by all citizens in these developments. The reports highlight enhancements and developments that can be directly attributed to citizen participation and bottom-up effort by government workers. As a recent press release noted:

> Drawing on our leading-edge technology and in-depth experience, we are creating the innovative services and solutions our clients need for online service delivery and e-commerce—services with the speed, convenience and security necessary for acceptance by Canadians, businesses, and international clients. As we progress through this transformation to online service, we remain committed to providing clients with the services and solutions they need, while conducting our business with fairness, transparency, and integrity (Government of Canada, 2004).

Measures of Confidence in Government

It is extremely difficult to demonstrate quantitatively the positive relationship between citizen consultation in GOL and improved citizen trust. The Institute of Citizen-Centred Service (2003) however does construe a positive relationship between improved service and citizen trust, arguing that e-government's acknowledged ability to improve service should also help improve trust. Senior officials within the civil service and the government are widely convinced that a positive relationship exists.

The government's GOL public report issued in March 2004 discusses, as do many other official publications, the importance of privacy and security in obtaining citizens' trust. Providing citizens with the confidence that their information and records will be properly managed and protected is a key element in the GOL strategy. As Government of Canada (2004) states, "The [government] recognizes that Canadians' use of online services depends to a great extent on their perceptions of whether they can securely transact online, and where their personal information is protected." Developing confidence that personal information will be protected when transacting online should favorably impact trust in government.

One example of that public commitment is the government's Secure Channel. This project offers citizens and businesses secure, private, and high-speed access to all the federal governments' online services, and provides a platform environment that enables and encourages departments to integrate common services. The government uses the Secure Channel as a common infrastructure for secure and reliable network services for its departments. The channel also offers additional security, registration, and authentication protocols that enable departments to meet their 2005 GOL goals and deliver the most commonly used services online.

The Secure Channel is the critical link between government programs and their users. Without its common infrastructure and services, and the built-in assurances of security and privacy, GOL's vision of client-centric, cross-government service anytime, anywhere, cannot be realized. All federal departments and agencies use the Secure Channel's network infrastructure and operational interactivity to connect to the Internet and enable citizens to access their services. Currently, several services, primarily those transactional in nature, are available online via the Secure Channel.

The *Citizen First 3* report, as previously stated, affirms the positive correlation between improved service delivery and public trust. The document reports the outcome of longstanding formal public consultation, building on two earlier reports issued in 1998 and 2000 that cumulatively indicate what citizens expect and experience with respect to service delivery. As the report says, it now "breaks new ground by exploring the relationship between service quality and confidence in government... Through *Citizens First 3*, we have quantitative evidence demonstrating that the quality of service that citizens receive has a direct impact on the level of confidence they have in their democratic institutions.... [These results] demonstrate a quantitative link between service quality and confidence in government. Improving service delivery has an effect beyond satisfying the client—it strengthens our government institutions" (Institute, 2003: 2). This supports the corollary inference: since GOL improves service delivery, it improves citizen confidence in government and strengthens government institutions.

Citizen confidence in government is "measured" in the model by information about the public views of transparency, quality of effort, value of money, and responsiveness to people's needs. Using citizen satisfaction with federal, provincial, and municipal service quality as measures, the report found that government services had a positive impact and adequately met citizens' needs. Of course, citizen satisfaction is also influenced by government policies, programs, and political figures and by political parties, as well as an assessment of services delivered. These factors are not considered in this model so it is impossible to weigh relative influence. Nonetheless, for the first time the government of Canada can state, based upon quantitative data, that e-services do enhance citizen trust by providing a more satisfying user experience.

This report also discusses another element of interest to this discussion: Does the Internet improve satisfaction? "The claim that e-services lead to higher satisfaction than traditional channels is regarded as self-evident by some, and greeted with disdain by others" (Institute, 2003: 16). The report concludes that "Internet service will produce higher service quality ratings to the extent that they insulate clients from irritants that arise in traditional channels: a second trip to a service counter, difficulties getting through on the phone, and so on. Trying again on the Internet is much faster and easier than reinitiating physical contact" (Institute, 2003: 17).

Conclusions

When asked to document this experience, this author assumed the case would be almost self-evident. Since e-government has been so successful and received such international

recognition, the relationship between a citizen-centric approach and increased trust in government would be easy to prove, and thereby of value to the Inter-American Development Bank. "The more citizen consultation, the better the public services, and the greater the trust in government institutions," would be a terrific rallying cry. However definitive information and research linking citizen consultation with trust in government has still to be done, so ironclad conclusions cannot be made.

Nonetheless, many senior officials in both the private and public sectors involved in Canada's GOL initiative believe, based on firsthand experience, that our citizen-centric approach has served us well despite our inability to prove its relationship to citizen trust. It has improved service and changed how citizens relate with their government. As Vincent and Marson (2003) say, "Citizens who feel they receive high-quality service when accessing public services have more confidence in the performance of the public sector."

Listening and responding to the interests of citizens in designing GOL has been critical in our success to date. "Keeping the voice of the client at the heart of all that is done is the most important element in service improvement" (Institute, 2003: 27). Citizen participation changed the initial focus of the initiative and impacted the approach of GOL and the kinds of information, subjects, clusters, and gateways that have been designed. Even in individual departments, GOL has helped break down the "silo" compartmentalization that existed prior to the introduction of the online channel. Services have changed due to citizen participation, and so have the mechanisms, organizational structures, and procedures that support those services.

Canada is so committed to this approach that it recently announced the creation of Services Canada, an undertaking that would integrate service offerings from all levels of government into one "space." Initially this would be a virtual space, but potentially it may become physical as well. This commitment to improved service delivery would not have occurred without advice and input from Canadians of all walks of life. Assessing the implications of creating Services Canada has now led the Government of Canada to begin developing a "long-term plan for transforming the federal public and internal services over the next 5 to 10 years by rationalizing responsibilities, reorganizing operations, and reallocating resources among the departments and agencies involved in serving the needs of each of these client groups, in order to break down the barriers that currently exist between departments and agencies" (Government of Canada, 2004: 26–27).

Canada's approach to offering services online works. Experience has shown that the new technology can help citizens make their voices heard and empower service transformation when the government is committed to the process. In order for citizens to reap these benefits, the GOL initiative must be:

- Coordinated to achieve progress government-wide
- Citizen-centric and centrally driven
- Collaborative across departments and jurisdictions
- Transformative and moving toward service and business reengineering and integration, and
- Innovative to create and build new solutions.

These principles could not have been developed without citizen involvement. Citizen interest has been vital since online success depends on citizen cooperation and use to identify what works and what does not. Other jurisdictions assessing Canada's experience will have to weigh the perils and advantages of involving citizens in governance. More consultation can create more demands, which create less satisfaction, which create more consultation. In our case, we were surprised by how "smart" our citizens were once we consulted them, and how

much they influenced the design of this initiative because we "listened." The old adage proved to be true: *People who have a stake in their country are its best citizens*.

References

Accenture. 2005. *Leadership in Customer Service: New Expectations, New Experiences*. Research Report. Government Research & Insights. April 27. www.accenture.com.

Clarkson, A. 1999. Speech from the Throne. Address by Governor General of Canada to Parliament (September). www.pm.gc.ca/speech-from-the-throne/1999.

———. Speech from the Throne. Address by Governor General of Canada to Parliament (September). www.pm.gc.ca/speech-from-the-throne/2001.

Government of Canada, Department of Finance. 2001. *Budget 2001: Securing Progress in an Uncertain World*. http://www.fin.gc.ca/toce/2001/budlist01_e.htm

Government of Canada, Public Works and Government Services Canada, 2004. *Government On-Line* 2004. p. 21 (March).

———. 2005. *Government On-Line 2005*. (April).

Gordon, G. 2005. Accenture press release for *Leadership in Customer Service: New Expectations, New Experiences* (April 27).

Institute for Citizen-Centred Service. 1998. *Citizens First 1998*. http://www.iccs-isac.org/eng/cf-98.htm.

———. 2003. Citizens First 3 (January). http://www.iccs-isac.org/eng/cf-02.htm.

———. n.d. Citizens First 4. http://www.iccs-sac.org/eng/citizensfirst4.htm.

Treasury Board Secretariat, Government of Canada. 2005. *Fifth Online Survey: Results*. Final report (January).

Vincent, C., and B. Marson. 2003. "Service Strategy: Citizen-Centred Service from Research to Results". *Canadian Government Executive* (2).

Chapter 8

How Information and Communication Technology can Strengthen Marketplace Trust and Integrity: Toward Openness and Efficiency in Regulatory Reporting

Peter D. Raymond

The concept of transparency holds great promise for Latin America and the Caribbean, sparking enthusiastic discussion throughout the past decade. In a recent survey of over 257 chief executive officers (CEOs) in six South American countries (Argentina, Brazil, Chile, Colombia, Peru, and Venezuela), for example, PricewaterhouseCoopers found that 65 percent of respondents rated transparency as either "medium" or "low" in their country. While corruption is viewed as the main contributor to the lack of transparency, about 20 percent of CEOs selected the regulatory environment as a key contributor, since it prohibitively constrains the business environment in terms of long-term development and sustainability (PricewaterhouseCoopers, 2005).[1]

The concept of "being transparent" is simple: by disclosing information that was previously regarded as "private" to stakeholders, including the general public, institutions (such as government agencies, nongovernment organizations, and private companies) could increase stakeholder confidence and enable stakeholders to make informed decisions and participate and interact more fully with the institution—as long as the information was deemed trustworthy. If all organizations in a particular market provided this level of openness and transparency, "public trust" would rise and the market as a whole would gain in competitive advantage.

However, the concept is not so simple when an organization recognizes the demand for transparency but is fearful of stakeholder reaction to adverse information or performance results. Unfortunately, this fear may lead organizations to play an expectations game with their stakeholders, providing information based on stakeholders' assumptions. As noted in Dipiazza and Eccles (2002: 3–7), "Sometimes leaders want to hide such issues as compensation policies and conflicts of interest, which they know would not meet public approval if they became available." Rather than building public trust, this expectations game destroys market integrity and public trust.

Information is the lifeblood of the market. Regulatory reporting in the marketplace, or mandated disclosure to an oversight entity, are essential to a market framework that protects stakeholders and preserves both transparency and integrity. Whether in banking, financial services, utilities, or the public sector, organizations are subject to similar oversight: those in a position to affect public trust are subject to an independent audit and regulatory filing for review. Through fair and effective regulatory policy, continuous monitoring, and just reprobation when appropriate, the regulatory framework hopes to provide transparency, accountability, and integrity for all market participants.

After several failures in 2001 in the United States, regulatory bodies around the world are working to strengthen their frameworks. Regulatory policy is being refined with the help of new processes and technologies. Two central themes surround these changes and provide important lessons for any regulatory agency working to improve transparency in the marketplace. First, effective and efficient regulatory reporting is an essential part of the

[1] In the United States, §404 of the 2002 Sarbanes-Oxley Act has been the largest change agent of regulatory reporting requirements.

governmental framework to promote accountability and sustainability in the marketplace. Second, deploying appropriate information and communication technology to support this framework can facilitate the development of transparent, efficient, and effective regulatory regimes.

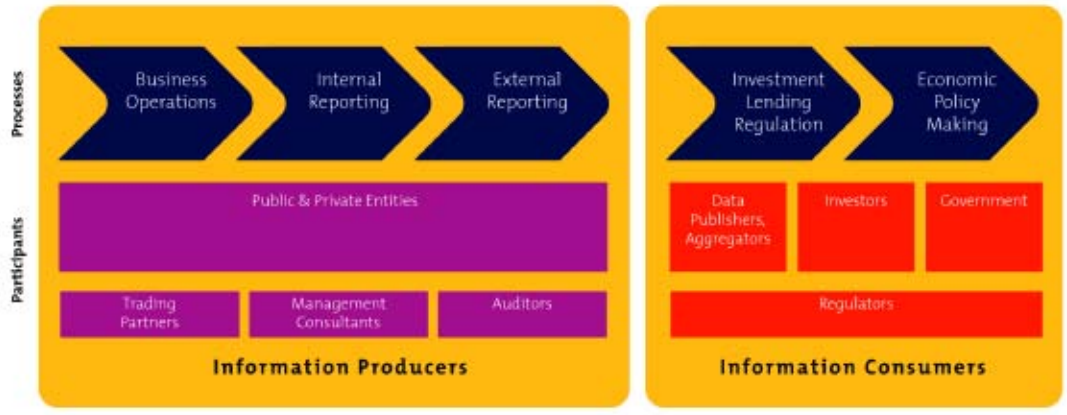
Regulatory Reporting and the Information Supply Chain

In the previously mentioned CEO survey, PricewaterhouseCoopers (2005) also found that, after "corruption" and the "legal system," South American CEOs viewed the lack of fair and effective regulation as the single most limiting factor in market development. Symptomatic manifestations in the marketplace include the following:

- High transaction costs between buyers and sellers
- Inability of auditors to provide reliable information assurance
- Inability of regulators to monitor for fairness and compliance
- Poor public perception of marketplace fairness
- Low participation in the marketplace
- High risk premiums for external investors
- Low foreign direct investment.

Effective regulation is no panacea for these problems, yet it is essential to a framework that protects trust and integrity in the information passed between buyers and sellers (or between producers and consumers) in the marketplace. The concept of an information supply chain, as noted by DiPiazza and Eccles (2002), helps illustrate the dependency on good information between information producers and information consumers as it moves through the market. In Figure 8.1, the uppermost set of directional arrow boxes represents processes in which information flows as input and output. The input quality of each process in the flow, from left to right, is dependent on the output quality of previous processes—that is, on good information. Thus, information flows begin inside of organizations as operational and internal reporting, and then turn outward through public reporting for consumption by external market players. The set of rectangular boxes below the arrow-shaped boxes represents some of the participants in each process, each of whom contributes to the building of trust in the marketplace. In any market, the basic tenets of this information supply chain exist, despite variations in market complexity. Information provides the lifeblood for transactions between buyers and sellers; and it is regulated through a complex framework of market players.

Figure 8.1. The Information Supply Chain



This is not to say that a heavy regulatory regime must be imposed because that also can weaken market activity and create barriers to participation. While lack of effective regulation generally is considered a problem in South America, more than 70 percent of surveyed CEOs also believe that overregulation poses a significant threat to prospects for business growth in the region. Therefore, regulatory policies must be improved to effectively detect fraud and efficiently spot anomalies.

Using information and communication technologies to enable automated processes, such as electronic regulatory filing, is one way that regulators can improve efficiency in the regulatory framework. ICTs provide regulators with a medium for increasing the speed at which data move through the market-information supply chain. This better controls data quality and reduces the cost of producing and consuming it. Ultimately, regulators wield the power to mandate both the form and content for regulatory filings, and they must consider several factors before selecting appropriate requirements. Creating a burdensome and cost-prohibitive filing process could create competitive disadvantages for small- and medium-size organizations, erecting barriers to market participation. Repairing a dilapidated reporting process by simply adding or updating technologies may provide marginal gains in productivity, but it has no real effect on market efficiency. However, improving regulatory reporting with a strategy that makes judicious use of information and communication technologies can strengthen the cohesiveness and fluidity of the information supply chain.

Improving Regulatory Reporting and the Information Supply Chain with ICT

Form and content standards can provide an excellent foundation for promoting a flexible, transparent, and efficient regulatory infrastructure. In setting these standards, regulators must choose standards that are reasonable for the regulated entities, and at the same time, those that meet their own needs for information consumption and processing. This is especially important because regulatory reporting requirements are constantly changing, usually incrementally from year to year. However, a completely new set of requirements is due to sweep Latin America over the next five years.

The Latin American banking sector is expected to adopt Basel II reporting requirements to improve risk mitigation techniques and transparency while promoting overall development of the sector's competitiveness (FELABAN, 2005). In addition, the majority of countries in Latin America and the Caribbean—starting with Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela—are also expected to harmonize national accounting standards with International Accounting Standards (IAS) and to adopt International Financial Reporting Standards (IFRS) as they seek to advance regional and global market integration efforts (Durante, Laínez, and Masci, 2004). Both of these new requirements will invariably transform the reporting regimes in each country, as they already have in parts of Europe and Asia.[2] During these transitions, reporting infrastructures will need to be made flexible, adaptable, and relatively painless to the filers.

How can regulators reduce the burden required to file reports, especially for entities that must file several reports to different regulators? Leveraging the Internet and Internet-enabled technologies to synchronize the regulatory reporting framework with e-government initiatives and the paperless filing movement can help to create an open and flexible framework. At the same time, they improve the effectiveness of the regime by promulgating more timely, accurate, and complete filings. To benefit across the board, regulators must approach filing with a standard data-centric paradigm, moving away from the old paper-to-digital paradigm. In the old paper-to-digital paradigm for information sharing, data were coupled tightly with applications and systems. Data moved internally between departments and systems through paper reports requiring data (re)entry, manual batch transfers, or custom data feeds. When data moved

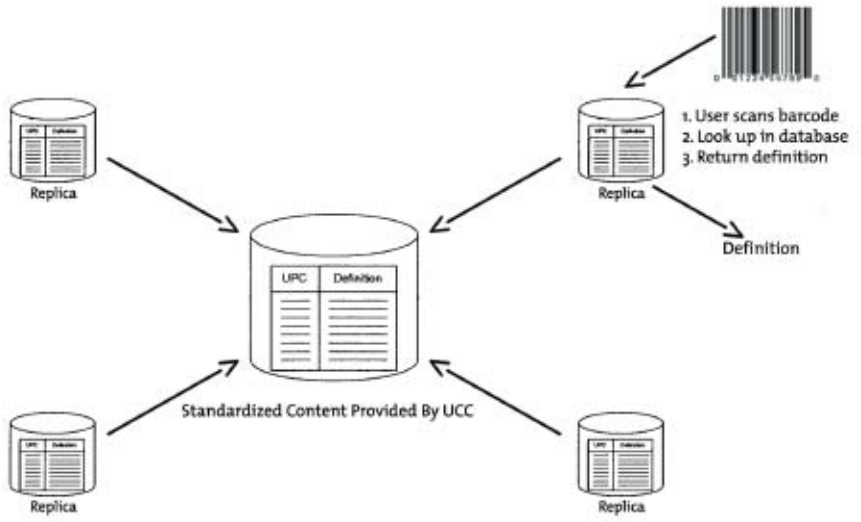
[2] See http://www.integraxml.com/workshop2006/.

externally, or outside an organization, it became locked into common word-processing or spreadsheet applications that resembled electronic forms of paper. If organizations did not use the same word-processing or spreadsheet application, problems arose—for example, documents not properly formatted for consumption by the receiving party. The result was a cryptic set of data, heavily dependent on user formatting, which required further deciphering or translation. Ironically, although standard office productivity software suites are increasingly common, the data contained inside these compatible documents is increasingly complex and difficult to analyze. The aforementioned problem is only exacerbated with new formats for sharing electronic paper, including the portable document format, images, and other graphical representations. These attempts to convert paper to electronic sheets of paper leave the end information consumer with few options for parsing, analyzing, and ultimately reusing the data. For example, a regulator (or any other interested party) would have a difficult time indeed parsing the hundreds or thousands of regulatory filings provided in a spreadsheet or word-processing document, or in graphical format.

Instead, sharing just the data, without the application wrappers, proves to be a much more efficient and timesaving manner of sharing regulatory filing information. In the new "standards and data-centric paradigm" for information communication, standardized form and content requirements provide a baseline from which vendors may build tools and technologies to move information.

The Uniform Product Code (UPC),[3] as shown schematically in Figure 8.2, is used in most grocery stores in the United States for scanning barcodes of commonly found products. The GS1 US, formerly the Uniform Code Council (UCC), maintains a database of all UPC barcodes and their definitions. Any grocery store can use it to look up the definition of the barcode. When a UPC barcode is scanned, the product is automatically recognized through a database look-up. For example, when a grocery store scans the UPC 011110808202, the database will always define it as, "Sweet Golden Corn (Whole Kernel) 15.25 OZ." As the UPC example shows, data standards are an extremely useful tool for centralizing and managing a set of common data.

Figure 8.2. Uniform Product Code

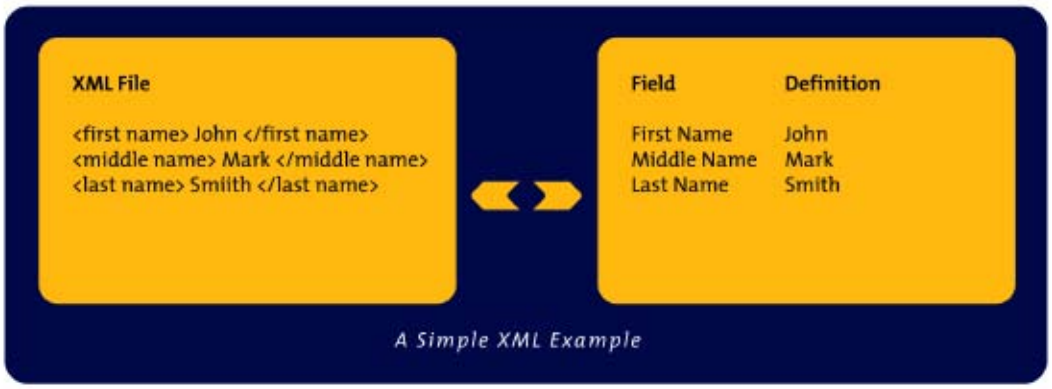


The Extensible Markup Language (XML) enables data to travel over the Internet without being attached to particular software brands or applications. In essence, XML wraps data with a tag, which works like a barcode, so the data can be transferred without being tied to a particular software application. As shown in the example in Figure 8.3, in XML, "<first name>John</first

[3] For more information about international uniform product codes, see the GSI US Web site: http://www.uc-council.org.

name>" takes the data "John" and marks it with the tag or barcode, "first name." The XML data says, "John is a first name." This XML scenario works like the UPC barcode scenario. Each time the UPC is scanned, the standard UPC definition is returned, "011110808202 = Sweet Golden Corn (Whole Kernel) 15.25 OZ." Each time the XML tag is scanned, the appropriate definition is returned, "first name = John."

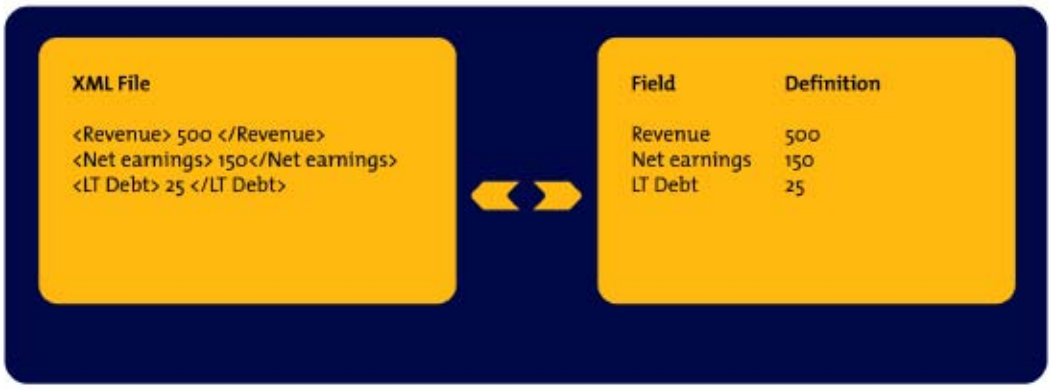
Figure 8.3. Extensible Markup Language for Internet Data Transmision



Extending the new paradigm to regulatory infrastructure improvement, data standards could play an essential role in enabling all market participants to "speak the same language." That is, to all market participants, "Cash and Cash Equivalents" would be defined the same way on paper and electronically, regionally and even globally, and could be easily recognized and compared between organizations conforming to the same standards.

Bringing together XML and the Internet enables the creation and efficient reporting of "bar-coded" standardized regulatory filings. Each field on a filing—for example, "Revenue" shown in Figure 8.4—would have a barcode, and regulatory filings could be transferred over the Internet as an XML file. Since the XML deciphering standard would be public knowledge, stakeholders could readily decipher, parse, analyze and compare filing data for market participants. In this manner, regulators first create a set of standards, which then provide maximum flexibility for change, and the regulated are not burdened with software application-oriented filing requirements.

Figure 8.4. Financial Reporting Sample/XML File for "Revenue"



XML and the Internet allow efficient and standardized reporting. The requirements of multiple reporting entities (which often need similar or the same data but in different formats) can be much more easily addressed. With XML and the Internet, the appropriately tagged (bar-coded) data can be assembled and reported efficiently to multiple entities with a much higher degree of data integrity and confidence than manually generated reports or those using software application-oriented filings.

The Extensible Business Reporting Language

The Extensible Business Reporting Language (XBRL) is the de facto tool for achieving the scenario described above. XBRL is an extension of XML and provides a placeholder for a standard set of tags, definitions, and other functionality to help regulators improve the quality and accessibility of filings. Initiated through the American Institute of Certified Public Accountants (AICPA), the XBRL effort currently is maintained through XBRL International (http://www.xbrl.org), a nonprofit consortium of over 250 public, private, and nonprofit entities worldwide. And just like XML, XBRL is an open-source tool. To use the tool, standard-setting boards—such as the International Accounting Standards Board (IASB) or the Basel Committee on Bank Supervision—fill in the XBRL tags and definitions with their standard tags and definitions. The result is known as a taxonomy—a set of tags designed to work with specific standards and definitions. For example, the taxonomy for the IASB International Financial Reporting Standards can be found at http://xbrl.iasb.org/int/fr/ifrs/gp/2005-05-15/. Using XBRL provides regulators with several benefits:

- Improved quality and accuracy of filings
- Improved ability to analyze and monitor filings at little to no incremental cost
- Reduced administrative burden associated with filing reports
- Ability to tailor filings to preserve economies of scale (so small- and medium-size enterprises are not disadvantaged)
- Greater transparency in market operations.

Filing in XBRL also provides reporting entities with several benefits:

- Ability to report once to multiple regulators with the same filing
- Cost and time savings in preparation of filings
- No mandated software applications
- Improved accuracy in filings
- Increased organizational transparency.

Regulatory bodies around the world have already begun to realize the benefits and potential of XBRL. In Spain, the Netherlands, the United States, the United Kingdom, the Republic of Korea, Japan, Ireland, and several other countries, XBRL is being used to improve regulatory efficiency and effectiveness despite constantly evolving regulatory policies. This can be done because XBRL offers flexibility to both the regulator and the regulated.

Two examples of the application of XBRL in regulatory reporting regimes include the Federal Financial Institutions Examinations Council (FFIEC) in the United States, and the Bank of Spain. At the FFIEC, the quarterly call-report filing process is being reengineered to collect and process reports in XBRL from approximately 8,200 banks. The project's intention is to provide a more flexible reporting framework, increase the data quality of each individual report, decrease the cost of filing (to both the regulator and regulated), and increase overall transparency at FFIEC.[4] Similarly, the Bank of Spain is launching an XBRL filing pilot to modernize the collection of financial information from reporting credit institutions. The XBRL filing pilot will involve seven reporting agencies, and the full implementation will

[4] See http://www.xbrl.org/nmpxbrl.aspx?id=101.

involve over 350. The goals of this project are similar to FFIEC's: reduce reporting costs, increase access to information (transparency), and increase the turnaround time of the information for subsequent distribution.[5] Both projects demonstrate the enormous potential for XBRL. Yet they provide only snippets of the many ways in which XBRL could streamline reporting processes. (See "For Further Information" for more information on how regulators in each of these countries used XBRL to improve regulatory reporting, and for a more detailed look into XBRL. This chapter only scratches the surface of the features and benefits of XBRL adoption.)

In Latin America, several groups are working to realize the benefits of XBRL. In Brazil, the University of São Paulo hosted a second national workshop on XBRL in October 2005 to promote nationwide implementation.[6] In Colombia, several organizations are collaborating to sponsor a workshop in February 2006 and form a national working group to promote its use nationally. Other countries in Latin America are beginning to see its promise, too, including Venezuela, Argentina, Chile, Mexico, and Peru.[7]

Conclusion

Leveraging information and communication technologies such as XBRL in the regulatory reporting framework can provide measurable benefits in reducing the cost of preparing, filing, and validating data; reducing cycle time in the production and consumption of information; and improving organizational transparency as perceived by stakeholders and the public. This is especially important in Latin America and the Caribbean, where the general perception of transparency and effective regulation is low. With these improvements in the regulatory framework, the market as a whole begins to see beneficial changes: increased trust in market data, lower transaction costs, and lower risk premiums. Finally, these improvements contribute to higher market participation (both local and foreign), greater investment and trade, and an increased rate of sustainable economic growth and development.

References

DiPiazza, S. and R. Eccles. *2002. Building Public Trust*. New York: John Wiley and Sons.

Durante, J. J., J. A. Laínez, and P. Masci. 2004. *International Accounting Standards: Transparency, Disclosure and Valuation for Latin America and the Caribbean*. Washington, D.C.: Inter-American Development Bank.

Banking Sector Development and Regulation: Practical Matters. Felaban. 2005. Conference The Effects of Implementing Basel II in Emerging Markets sponsored by the Association of Supervisors of Banks of the Americas. Inter-American Development Bank and Federation of Latin American Banks, Washington, D.C., (May 19–20).

PricewaterhouseCoopers. 2005. *2nd South American Edition of the 8th Annual Global CEO Survey: Managing Risk to Create Value*. http://www.pwc.com/southamericanceosurvey.

For Further Information:

Committee of European Banking Supervisors, European Banks Cooperate to Improve Financial Reporting with XBRL: http://www.c-ebs.org/press/07062005.htm and http://www.c-ebs.org/press/30062005XBRL.htm

KOSDAQ: http://xbrl.kosdaq.com/?lang=english

PricewaterhouseCoopers & XBRL: http://www.pwc.com/xbrl

[5] See http://www.xbrl.org/nmpxbrl.aspx?id=112

[6] See http://www.tecsi.fea.usp.br/eventos/workshopxbr101/

[7] See http://www.xbrl.org for the latest developments in XBRL adoption worldwide.

U.S. Federal Deposit Insurance Corporation, XBRL in the new Call Reporting Process:
http://www.ffiec.gov/find/xbrlfocusgroup.htm
U.S. Securities and Exchange Commission, Spotlight on XBRL:
http://www.sec.gov/spotlight/xbrl.htm
XBRL International: http://www.xbrl.org
XBRL Spain: http://www.xbrl.org.es

Part IV

Information and Communication Technology in Institutional Strengthening

There are no simple solutions to the challenges of development. Whether or not technological advances are effectively integrated into a democratic process of efficient, equitable, and sustainable development depends on how each country creates an enabling environment to make the adjustments needed to deploy new tools, transform organizations, and refine new processes. Since deployment of information and communication technology permeates all parts of the economy and society, communication and collaboration among diverse stakeholders are needed to ensure that the rate and character of Knowledge Economy expansion reflects the values, needs, conditions, resources, and aspirations of each society.

The four chapters in Part IV can be divided into two groups. Each reflects a different aspect of the adjustments needed to strengthen institutions to integrate the Knowledge Economy into development planning.

The first group describes ongoing transformations as two international organizations interact with member countries to more effectively address the challenges and opportunities of Knowledge Economy expansion. Jean-François Soupizet, Paulo Lopes, and Maresa Meissl's look at harmonizing national efforts to achieve regional integration (Chapter 9). Luis Echeverri reflects on efforts at the Board level of the Inter-American Development Bank (chapter 10).

The second group explores how laws and development planning methodologies may need to be adapted/modified to better integrate Knowledge Economy expansion into development processes. Esther Donio Bellegarde Nunes (chapter 11) discusses how basic intellectual property principles are applied in the context of rapidly changing technology. Carl Dahlman and Derek Chen (chapter 12) demonstrate how a Knowledge Economy measurement methodology can catalyze people and groups, who normally do not interact, into a collective development planning process.

Chapter 9

i2010—A European Information Society for Growth and Employment

Jean-François Soupizet, Paulo Lopes, and Maresa Meissl[1]

On June 1, 2005, the European Commission adopted the new initiative i2010—European Information Society for Growth and Employment.[2] Launched by Ms. Viviane Reding, the European Commissioner responsible for Information Society and Media, the initiative aims to boost the digital economy within the European Union and is at the core of the renewed Lisbon Agenda (Box 9.1), a strategy that provides the overall framework to promote growth and employment in the EU.

A Locomotive for Growth and Employment

The i2010 is strongly focused on the main axes of the renewed Lisbon strategy: growth and employment. It also provides tools for good governance, including better regulation commitments and progress reports. ICT services and networks will be crucial to the success of the 2005–08 national reform programs that EU member states presented in October of this year. Reforms will be tailored to national circumstances, but compared and coordinated at the Union level to find the best responses to newly emerging issues. This will improve monitoring and policy consistency.

The strong link in governance between Lisbon and i2010 includes mechanisms for setting commitments and reporting progress:

- ICT services uptake and networks will be part of the 2005–08 national reform programs, along with the new Lisbon "integrated guidelines," due in October 2005.
- ICT is also a core part of the European Community action program on Lisbon, which was approved by the European Commission on February 2, 2005, and endorsed by the European Council in March 2005.

BOX 9.1. THE LISBON AGENDA

By establishing an effective internal market, by boosting research and innovation, and by improving education, the heads of state and government who met in Lisbon in 2000 aimed to make the European Union "the most dynamic and competitive knowledge-based economy in the world" by 2010. The renewed Lisbon Agenda sets out how Europe can meet its growth and jobs challenge in 2005. It launches the idea of a Partnership for Growth and Jobs, supported by a European Union action program and national action programs containing firm commitments. It builds on three central concepts:

- First, *Europe's actions need more focus*. The European Union must concentrate all its efforts on delivering on-the-ground policies that will have the greatest impact.
- Second, Europe has to *mobilize support for change*. Establishing broad and effective ownership of the Lisbon goals is the best way to ensure that words are turned into results.
- Third, Europe needs to *simplify and streamline Lisbon*. This means clarifying who does what, simplifying reporting, and backing up delivery through European Union and national Lisbon action programs.

For more information see: http://europa.eu.int/growthandjobs/index_en.htm

[1] The views expressed here are purely those of the authors and may not in any way be regarded as stating an official position of the European Commission.
[2] http://europa.eu.int/information_society/europe/i2010/i2010/index_en.htm

A Timely Initiative in the Context of Convergence

The i2010 affects one of the most promising sectors of our economy: the communication and media industries. In this sector, we are on the verge of a new phase of growth. This new phase is based on the emergence of a digital convergence between high-speed broadband networks, audiovisual media, and electronic devices. Now is the moment to seize the opportunities of this new economic and technological development. The following examples illustrate how rapidly things are changing:

- Two years ago, the 3G mobile markets were at zero, in 2003 they were at €23 million, and in 2004 they passed to €150 million.
- Cautious estimates indicate that European markets for online content could grow three times in the next three years to reach €30 billion.
- German consumers last year spent €360 million just to download ring tones on their cell phones. Globally this market is estimated at €1.5 billion.
- In Japan and Korea, people are now spending more time online than watching television, and this development is also expected to happen soon in Europe.
- Voice-over Internet services are growing rapidly. One of the leading companies in Internet telephony claims, for instance, to be adding 150,000 customers daily.

The European communication and media industries have a strong potential for growth. Already today, information and communication technologies account for 40 percent of Europe's productivity growth. The ICT industry generates 6–8 percent of Europe's GDP and devotes between 10 and 20 percent of its output to research generating new knowledge. Furthermore, ICT plays a unique role in fostering innovation, creativity, and competitiveness—attributes that are crucial to the long-run performance of Europe's industries and services. Investing in ICT is Europe's best bet for delivering sustained growth and skilled jobs. To this end, it is essential to ensure that the right framework for the digital economy and for investment in ICT is in place. This is the direct responsibility of the European Commission and constitutes one of the key fields of action in the i2010 initiative.

The convergence of technologies such as communications networks, media content, and electronic devices requires "policy convergence." This means putting together all the tools and instruments available to the EU and its member states to promote and accelerate a favorable development of the communications and media industries. Such a policy convergence is the main objective of the i2010 initiative.

The Three Pillars of i2010

The i2010 is built on three pillars: a single European information space; innovation and investment in ICT research; and inclusion, better services for citizens, and better quality of life.

A Single European Information Space

The first pillar of i2010 means establishing an appropriate framework for the emerging digital economy (Box 9.2). Here, i2010 underlines the need to modernize existing EU rules to match the emerging digital economy and includes the European Commission's readiness to review rules that stifle development of the communications and media industries. In this context, the Commission will propose, at the end of this year, modernization of the EU rules on audiovisual content services, which are currently limited to traditional broadcasting and still reflect, to a large extent, the technology and the regulatory thinking of the 1980s.

BOX 9.2. EU REGULATORY FRAMEWORK ON ELECTRONIC COMMUNICATIONS

To reflect the market dynamism brought about by liberalization and by technological convergence, the EU has adopted a regulatory framework on electronic communications networks and services. It aims to drive forward the liberalization of telecommunications markets by adapting regulation to the requirements of the Information Society and the digital revolution. This framework is composed of five directives and one decision that lay down certain principles and procedures for the provision and regulation of electronic communications services: the Framework Directive (2002/21/EC) sets the framework conditions and the institutional interplay; the Authorizations Directive (2002/20/EC) lays down the conditions for market entry; the Access and Interconnection Directive (2002/19/EC) sets out the relations between network operators and service providers to ensure unrestricted interconnection at wholesale level; the Universal Service Directive (2002/22/EC) fixes the minimum requirements and modalities for provision of universal service; the Data Protection Directive (2002/58/EC) lays down provisions for the protection of personal data in the Information Society (spam, cookies); the Radio Spectrum Decision (676/2002/EC) establishes principles and procedures for the development and implementation of EU radio spectrum policy.

For more information see: http://europa.eu.int/growthandjobs/index_en.htm

The European Commission will also make sure that the rules of the EU "telecoms package"—that is, the regulatory framework for electronic communications, which entered into force in 2003 and is due for review in 2006—will be used even more than before to encourage openness and competition in electronic communications services. Because we have seen that competition increases the service offer, this leads to affordable prices and encourages take-up by consumers. Review of the telecoms package will—without calling into question the basic principles of our rules—encourage investments in new high-speed infrastructures.

Finally, the Commission will develop, in the course of 2005, a proactive European radio spectrum policy. Such a policy is required for efficient and cross-border use of this very valuable economic resource.

Innovation and Investment in ICT Research

The second pillar of i2010 promotes European competitiveness through research and innovation in ICT. To remain competitive, Europe has to step up its investments into ICT research and development. Finally, it must also promote the wide adoption of ICT by businesses through an environment conducive to the reorganization of business processes. i2010 addresses these various aspects but the research challenge is an issue which calls for a strong commitment at the EU level. Europe's key competitors—the United States and Japan—invest more than one third of their total private and public research spending in ICT, while Europe is only at about 20 percent at the moment. This is why in i2010 the Commission proposes to increase European Union ICT research spending by 80 percent as of 2007 (Box 9.3).

A recent study indicates that one euro invested in the EC Framework Programme for Research yields a net gain of seven euros. This shows that European research spending has an excellent return on investment. Industrialists from all over Europe, large and small, are eager to be part

BOX 9.3. THE FRAMEWORK PROGRAMME FOR RESEARCH

The Sixth Framework Programme (FP6) is the EU's main instrument for funding research in Europe. Proposed by the European Commission and adopted by the European Council and Parliament in co-decision, it is open to all public and private entities, large or small. The overall budget covering the four-year period 2003–06 is €17.5 billion, representing an increase of 17 percent from the Fifth Framework Programme and making up 3.9 percent of the Union's total budget (2001), and 6 percent of the Union's public (civilian) research budget. There are no national quotas for FP6 funds. Seven key areas for the advancement of knowledge and technological progress within FP6 have been chosen: genomics and biotechnology for health, Information Society technologies, nanotechnologies and nanosciences, aeronautics and space, food safety, sustainable development, and economic and social sciences. With a view toward achieving the biggest possible impact, over €12 billion are being allocated to them. The main focus of FP6 is creation of a visionary European Research Area. It aims at scientific excellence, improved competitiveness and innovation through the promotion of increased cooperation, and greater complementarity and improved coordination between relevant actors at all levels.

Looking forward, the Commission adopted on April 6, 2005, a proposal of decision for the European Council and Parliament on the Seventh Framework Programme covering the 2007–13 period. This proposal encompasses four major objectives for European research policy: *cooperation* to support the whole range of research activities, *ideas* for creation of an autonomous European Research Council, *people* by training and career development of researchers, and *capacities* for supporting key aspects of research and innovation (such as infrastructures).

For more information see:
http://europa.eu.int/comm/research/fp6/index_en.cfm?p=0_sitemap#FP6home

of the European technology platforms within the framework program, for example those on nanoelectronics, on embedded systems, and on mobile communications.

This program is open to the participation of partners from outside Europe, including from the Latin American and Caribbean region, with financing under that program. It therefore provides opportunities for partnerships between Europe and Latin America and the Caribbean for the development of future Information Society technologies and applications. Latin American partners already participate in R&D projects in this context, in consortia with European organizations. The ICT research priority is the largest single slice of the Seventh Framework Programme for Research and Technological Development, which will run from 2007 to 2013. This adds up to 30 percent of the thematic research funding.

Inclusion, Better Citizen Services, and Better Quality of Life

As the use of ICT grows, so does its impact on society. i2010 recognizes this in three ways: making sure that ICT benefits all citizens; making public services better, more cost effective and more accessible; and improving quality of life. This includes using ICT to help meet the growing demand for better health care, education and lifelong learning. Here the Commission will also focus on developing better ICT-enabled public services. In particular,

i2010 proposes three ICT flagship initiatives to encourage and focus the research and deployment efforts.

- The first will investigate how ICT can help to care for the elderly at home.
- The second, called "intelligent car," will explore how to make autos safer, smarter, and cleaner with the help of information and communication technologies.
- Finally, the third deals with digital libraries. It is becoming ever more important to use high-tech tools to make Europe's rich literary and audiovisual heritage available to as many people as possible.

i2010 and the External Dimension

The i2010 initiative is an important element of the dialogue and cooperation with partners outside the EU. This is, in particular, the case with Latin America, where the European Commission's @LIS (Alliance for the Information Society) program[3] provides a framework for dialogue and cooperation about the Information Society (Box 9.4). This notably includes a policy and regulatory dialogue, launched at the end of 2004 and implemented with the support of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). This cooperation will support implementation of the eLAC 2007 Action Plan, which was launched at the Regional Ministerial Preparatory Conference for the second phase of the World Summit on the Information Society, held in Rio de Janeiro on June 8–10, 2005. The Commission has been working together with the Inter-American Development Bank in the context of the @LIS program.

BOX 9.4. THE @LIS COOPERATION PROGRAM

The Alliance for the Information Society (@LIS) is a cooperation program with Latin America to promote the Information Society and fight the digital divide throughout the region. Adopted by the European Commission in 2001, the @LIS program has a budget of €77.5 million, of which €63.5 million is financed by the EC. The @LIS covers a wide spectrum of objectives promoting a long-term partnership between the two regions in building an Information Society. It focuses on the following activities: a dialogue on policy and regulatory aspects; the development of standards; the implementation of demonstration projects to strengthen civil society through e-government, e-learning, e-health, and e-inclusion; a network of regulators; and the interconnection of research centers.

For more information see: http://europa.eu.int/alis

With i2010, the European Union sets out to create fresh impetus for an Information Society for all, ahead of the second meeting of the World Summit on the Information Society (WSIS) in November 2005. The EU will draw on its experience with i2010 for the implementation of the WSIS Plan of Action[4] adopted in Geneva in 2003. To this end, the EU Council of Telecom Ministers held in June 2005 tabled the EU priorities for the second part of the WSIS process, focusing its action on an enabling environment; e-inclusion, e-government, e-learning, e-health, and e-business; and broad use of R&D results, including innovation for development and extension of communication and research infrastructures to global partners. Moreover, the EU Council promoted further actions in the development of access, based on progress observed in emerging economies from setting up an appropriate enabling environment. It

[3] http://europa.eu.int/comm/europeaid/projects/alis/index_en.htm.
[4] http://www.itu.intwsis/

also highlighted the development of creative content and applications through comprehensive strategies for Information Society development, with an emphasis on inclusion, a better life for citizens, ICT for democracy, and enhanced crisis management and disaster prevention.

Conclusion

The i2010 is the strategic framework for European Information Society and media policies during the next five years. With this initiative, the European Commission has now announced its policies to boost the digital economy and to make the Information Society an economic and social reality. The WSIS in Tunis and the launch of the i2010 initiative in the EU both highlight the growing importance of the Information Society. They invite Latin American and Caribbean countries to speed up their own strategies for seizing the potential of ICT to meet the challenges confronting their societies.

Chapter 10

Leadership in Science and Technology in Latin America and the Caribbean: A Changing Path for the IDB

Luis Guillermo Echeverri

> All future empires will be knowledge empires. The only nations that succeed will be those that understand how to generate knowledge and how to protect it, how to reach the young that have the talent to do it and assure that they stay in the country. Other nations may have beautiful beaches, churches, mines, and a fantastic history. But they probably will not be able to have the same flag, the same borders; and they will definitely not achieve economic success.
>
> —Albert Einstein

Regionwide Commitment to Science and Technology

The Inter-American Development Bank's Board of Executive Directors—of which I am honored to be a member—is concerned about the IDB's institutional role in promoting science and technology in Latin America and the Caribbean. For both our internal and external work, this is a high priority. Our obligation to expand knowledge among the peoples of the region will be a crucial factor in determining the equality and well-being of future generations.

How the IDB responds in this area matters. We are now incorporating science and technology, especially information technology, as a significant component within our credit programs. And we are providing real value-added to our borrowers through technical cooperation and nonreimbursable funds devoted to entrepreneurial development. In particular, we are targeting small- and medium-size enterprises.

The Bank views science and technology as a foundation for better education across our region. They are the gateway to knowledge and competitiveness and to social and economic prosperity. For us, applied scientific and technical knowledge represents our best chance—the "ticket to ride" in today's knowledge-based economy. Value added from science and technology will be the single most important factor in increasing the net return on our regional exports. Realistically, it presents the only alternative for the region to remain competitive, even in its own domestic markets.

At the IDB, our mission is about improving infrastructure, and promoting integration, and education—the Bank's strategy is to foster sustainable development, which is the primary antidote to poverty. Yet in a globally competitive environment, improvements in infrastructure, integration, and education will prove insufficient and ineffective if not implemented through technological advances grounded upon new science.

A Constantly Evolving Knowledge Economy

Make no mistake—with every passing moment, the Knowledge Economy either enriches or impoverishes our lives, depending on how we work and cope with what is happening. The new Knowledge Economy behaves differently than our "conventional" economy, challenging traditional assumptions and rules of economics as we know them. It works by turning real-time data into information and then into knowledge, outstripping historical time-series analysis. It expresses itself through the digital and genetic alphabets and how science and

technology evolve within them. It is about constant change with no rules except one—that decisions made today are somehow already obsolete.

Creative anticipation and openness to constant change (which is itself the outcome of continuous evolution in science and technology) is one of the few tools that the public and private sectors can use to make positive contributions to their societies. Today, "vision" means being ready to anticipate change. It is the capacity to act before change rolls over us and leaves us in its wake.

In today's world, knowledge is the engine for growth in the private sector, the public sector, and in public-private partnerships. Knowledge is the only factor that can shield society from violence, drugs, corruption, and other escapes from the pressures that poverty and inequality place upon us at so many levels.

The Knowledge Economy is also a function of competitiveness. The choice *not* to participate is to accept the separation of nations—those that work with the value added from science and technology are in one group; those that will plunge into deepening poverty and inequality are in the other.

Unlocking Future Wealth with Intellectual Property

During the 1990s, Mexico, Brazil, and Argentina doubled the number of new patents issued from 50 to 100 a year. That's impressive. Yet the Republic of Korea increased its tally during the same period to 3,400 patents a year—and the pace is still climbing! In 1998, IBM alone produced more patents than 167 countries.

What accounts for this extraordinary difference? I believe that it is largely a matter of vision—the ability to anticipate change by incorporating science and technology, with further acceleration sparked by information technology. Korea's planning and development policies—not to mention those of Singapore, Scotland, Norway, India, and Ireland—exemplify how a society can target its development around science and technology and then leapfrog hurdles that once seemed insurmountable.

No trade agreement and no integration factors can guarantee positive sustainable outcomes unless they incorporate sound, balanced, equitable intellectual property rules. The world must look to knowledge—that is, to science and technology—as the only realistic vehicle if we wish to protect the environment and attaining the Millennium Development Goals. Activism creates awareness. Yet we must find the vision to build on what we learn, connect the lessons together. Too narrow a focus on individual problems will miss the underlying conditions that threaten the natural resource base and provide a decent standard of living that is the right of all human beings.

The Challenge for the Region and the IDB Group

Our social problems in Latin America can be traced invariably back to huge education deficits. While investment in the physical components of technology allow us to update and sometimes compensate for lags in learning, it is the lack of usable knowledge—too little science and technology, reflecting insufficient investment in education—that represents the greatest enemy to development.

As science and technology advance exponentially, IDB support can strengthen countries' capacity to keep pace and manage the new landscape. Some important social trade-offs need to be properly sorted out; but one way or another, the larger point remains the same: we

cannot afford not to change. If we resist the need to change, our development efforts will not only be inefficient, they will wobble precariously and fail.

The IDB finances development in the region by facilitating the transfer of technology. This involves effective investments in solutions to poverty. What are these solutions? Using land properly, planning well, and formulating sound policy in the social and educational spheres; establishing land ownership through proper titling; improving infrastructure to assist populations that will migrate, so that they can take advantage of opportunities from targeted investments; providing small- and medium-size enterprises with fair access to sufficient credit; creating sufficient and sustainable job opportunities, supported by public investment in basic infrastructure; and instituting measures to improve safety and competitiveness.

Managing the state with modern tools means using knowledge rather than political barter. Like it or not, science and technology go hand in hand with cultural change. For the IDB and member countries, this means making decisions that will help in overcoming corruption, mismanagement, and the lack of independent institutions. This means—and will continue to mean—the need for basic structural reforms across Latin America and the Caribbean.

It is worth repeating that the knowledge produced by investing in science and technology can be a bridge for integration within Latin America and the Caribbean and with the global economy. The lack of such investments will drive our region to digital and genetic obscurantism, thereby creating even higher levels of poverty and inequality.

The Need to Manage Change

Latin America and the Caribbean are not keeping up with the changes that are sweeping the rest of the world. Unfortunately, we tend to respond to the moment, as if we were unable to see the larger transformations that are taking place all around us. In order to carry out our development agenda more effectively, we will need to incorporate another concept—change management.

To gain and retain knowledge, we need to devise short-, medium-, and long-term strategies. The short-term strategies are unlikely to take us anywhere if we do not know fundamentally, where we are going. Should we fail to incorporate information technology and its derivative sciences as a medium-term strategy in a development model with a broader social vision, there will *be* no long-term development. We will simply wander with no place to go, wasting our natural resources to manage ever-increasing poverty rather than using it to generate new wealth.

That is why the role of the IDB—with its clear focus on science and technology—is now so particularly important. Its job is to lead the way, and it does so in four key areas:

- Education, including its scientific and technical content and its multilingual and digital components;
- Overall investment in science and technology, especially information technology;
- Scientific and technological work in public and private universities, as well as in the private sector; and
- Development of short-, medium-, and long-term science and technology strategies.

Conclusion

We must embrace change with vision and goodwill if we truly are to achieve development and long-term well-being across our region. The necessary commitment to change

management requires a positive attitude. It does not require us to become "techies." It is enough to keep open and curious minds, entertaining the willingness to change and passing on that desire to others.

As institutional change managers, our job at the IDB is not to implement technology; it is to know what questions to ask, and to invest continuously in the future as soon as new questions are posed and answered. For starters, we need to accept the reality that just about every task these days can be accomplished in a better, faster, and cheaper way. Well, maybe not *every task*. But, if there is a better way—and if the solution lies in science and technology—we will find it.

Chapter 11

Legal and Policy Challenges to Expanding Brazil's Knowledge Economy

Esther Donio Bellegarde Nunes[1]

As time passes, the world changes. Modernity has accelerated the pace of change, particularly through global expansion of the Knowledge Economy. In the midst of these revolutionary changes, Brazil has not floated astray. Instead, Brazil has adjusted to the tides of modernization by adopting policies and laws that steer toward a positive course. In recent years, Brazil has adopted many measures that integrate the country into the global economy. Laws (and for that matter, citizens) have adapted to modern times. The New Industrial Policy and the Innovation Law, which are discussed in this chapter, are particularly good illustrations of the legal and policy challenges that Brazil faces in adapting to the global Knowledge Economy.

The New Industrial Policy

Among many reasons why 2004 was a good year for Brazil, we can point to new public policy that not only set goals for the country but provided citizens and government with an entirely new social and economic perspective. The New Industrial Policy was released during the first half of 2004. It was the fruit of the Brazilian Ministry of Development, Industry, and Foreign Trade, which aims at modernization in three key sectors—industry, technology, and foreign trade. The main goal of the New Industrial Policy was to foster investments in the industrial sector, creating a more efficient environment for production and expanding Brazil's exports and its presence in foreign markets. The idea was to redirect various venture segments as a means of fostering research and development and production activities, primarily in semiconductors, software, capital goods, pharmaceuticals, and medicines. These investments were not goals in themselves, but means toward strengthening Brazil's global presence in the fields of biotechnology, nanotechnology, and biomass.

As the New Industrial Policy was being conceptualized, Brazil's new minister of development stepped back and observed that while good scientists and robust research are indeed necessary, there would be little point to the state investing in them if the academic and corporate spheres were not closely linked. The New Industrial Policy did not seek out isolated project investments; instead, it sought promising *fields* where prospective ventures and companies could be integrated with resources for longer-term production and implementation of particular ideas. To this end, the government passed several laws to support the new policy. Among them, the Innovation Law is particularly important.

The Innovation Law

The Innovation Law (Law 10973/04) was published on December 2, 2004. As its name suggests, it was created to help the country leapfrog development obstacles through innovation under the aegis of the New Industrial Policy. Among its goals, the law sought to do the following:

- Create alliances between the public and private sectors for research activities in the national interest

[1] The author is grateful to Joamir M. R. Alves for aiding in the survey and in the preparation of this article.

- Build innovative and creative environments where researchers could make use of federal, state, and municipal facilities to conduct their experiments
- Provide research incentives and create management mechanisms for institutes of science and technology, aiming at increased productivity and efficiency.

The goals set forth in the Innovation Law clearly reflect its underlying principles—that is, to make the most of synergies between public and private efforts and resources, as well as to generate incentives to develop science and technology. To do so, the law proposed science and technology institutes working with government to support private investment and companies in taking new ideas from the drawing board to implementation. Research facilities would be made available to *any* inventor or researcher with solid ideas and the capacity to contribute. Inventors can access government funds and resources. In return, the fruits—that is, useful invention—would be put to government use and, possibly, to public use, as guided by the goals of the new policy.

Since the science and technology institutes are public entities, they already enjoy access to government licenses and contain considerable government expertise. These assets can be offered to private partners who want to develop new products and technologies. This means a better allocation of company resources since capital for licenses and working facilities can be used elsewhere, shortening product development time and the cost of going to market.

The Innovation Law is still in its infancy. Its long-term impact remains to be seen, but its provisions are sure to mobilize investments for higher-quality production, generating overall benefits to the economy.

Public-Private Partnerships

Public-private partnerships (PPPs) were already under discussion two years before the Innovation Law was enacted. Including public-private partnerships in the Innovation Law may have benefited from the debates taking place in the Brazilian Congress over a separate PPP law, which was being drafted concurrently.

On December 30, 2004, the president sanctioned the legislative bill on PPPs into law. The underlying rationale of the legislation was to find means for offsetting the scarcity of public funds relative to the emerging opportunities of a modern economy. By combining private and public resources, the government hoped to speed up capital improvements and services, boost economic growth, and improve the living standards of citizens. Private investments were welcomed, and private companies were given the authority to deliver public utility services.

The details of PPPs are complex; but there are two basic modes—administrative and sponsored. The minimum value for private investments is R$20 million (approximately US$8 million) for 5 through 20 years.

Intellectual Property Laws and Protection Measures

Before delving into intellectual property, it is worth noting that intellectual and industrial property rights (the Brazilian equivalent of copyrights and patents) are regulated by Laws 9609/98 (Software Law), 9610/98 (Copyright Law), and 9279/96 (Patent Law). The Copyright Law grants protection to authors. Intellectual property is defined as "creations of the mind, expressed by any means or fixed on any support, whether tangible or intangible, known or yet to be invented." The law protects literary, artistic, or scientific texts; musical composition; and audiovisual products, including lectures, speeches, and sermons. Computer programs are protected separately.

Legally speaking, intellectual property rights operate *ex lege*—that is, their effects are automatic and they exist irrespective of actions taken by their owner. The author of an intellectual property need not file any document in order to be protected under law. The work is protected automatically from the moment of creation. If an attempt is made to copy or steal the work, any dispute over ownership is to be resolved in court.

In contrast, the Patent Law does not operate *ex lege*. Those who wish to protect their work as industrial property must apply for patent registration to the National Institute of Industrial Property. Patents are granted to anyone devising an invention or a new utility model. The foreword to the Patent Law specifies that its intent is to grant patents to inventors in order to prevent illegal competition and unauthorized use of third-party industrial property.

Open Source Software

As elsewhere in the world, open source software (OSS) found its way to Brazil primarily over the Internet. Once introduced, OSS provoked much discussion and debate, especially over potential conflicts between open source licenses and Brazilian industrial and intellectual property laws.

On more than one occasion, the Brazilian government pronounced in favor of OSS. In 2005, however, the minister of development stated that discarding proprietary software would work against the country's technological development and growth. He argued that an OSS option would not coincide with the New Industrial Policy, which projects R$7 billion in software exports by 2007. If OSS were to be fully adopted, this target would be nearly impossible to reach. Subsequently, the newly nominated minister of communications also expressed reservations over the long-term benefits of OSS because of its relatively high maintenance costs.

As of mid-2005, the government's policy was to offer incentives and prioritize open source over proprietary software. For example, several entities owned or controlled by the government, including the Bank of Brazil, opted for OSS. Similarly, OSS was implicitly adopted through various government policies and projects under the broader national aim of increasing economic productivity and efficiency at lower costs. Most entities of the Brazilian government have defended OSS as a way to reduce operating expenses and improve the local economy. The prevailing opinion is that OSS saves public money, provides incentives for technological development, and helps create jobs.

To transform this debate into concrete action, the government has replaced proprietary software with OSS in most public instrumentalities and government agencies, provoking a deluge of claims from proprietary software producers. Local governments have also promoted and sponsored fairs and seminars to widen the support and to implement OSS, including many presentations on its advantages.

Several laws and legislative bills have been drafted to institutionalize the preference for OSS over proprietary software in government procurement and bidding. Most adopt a similar definition: "Open source software is that which has an industrial or intellectual property license that does not restrict in any way the program's assignment, distribution, usage, or change in its original characteristics." As the issue gains momentum, expectation is mounting that legislative bills will soon follow—followed by the inevitable legal suits that will eventually carry the question to the Federal Supreme Court of Brazil.

Tension has also risen in the state and municipal spheres because many states have drafted laws to make OSS use mandatory or preferred by local authorities. Many of these laws have

been put into practice; others are now being challenged in court. As of mid-2005, only one decision had been rendered on the legality of imposed OSS preference. Law 11871/02, which was issued by the state of Rio Grande do Sul, was held by the presiding court to be inconsistent with the federal Constitution, and thus void. Among other arguments, the justices ruled that OSS limits the freedom of private sector operators who are otherwise willing to provide services and products to government entities and instrumentalities, and is thus contrary to constitutional precepts upon which the concept of bidding procedures is based.

Overall, three main issues related to law and legal precedent need to be reconciled.

- The General Public License (GPL) and other open source licenses and their warranty exclusion provisions may be contrary to the Consumer Protection Code, which imposes certain warranty obligations on suppliers.
- OSS distributor and maintenance services may be contrary to Article 8 of the Software Law (Law 9609/98), which also imposes maintenance obligations on suppliers.
- OSS licenses and their sublicensing provision may be contrary to Article 5, XXVII of the federal Constitution and Article 30 of the Copyright Law, which both guarantee proprietary rights and protection to intellectual property.

The Ministry of Culture

The word *modernization* as used here subsumes the concept of globalization, which is nearly synonymous in today's world. Most countries are running hard to keep up with the challenges and constant innovation of our highly globalized era. Yet at the same time, care must be taken to preserve the culture that makes each country unique.

The Ministry of Culture, headed by Gilberto Gil, has worked to protect and preserve Brazilian culture while also preparing for the accelerating effects of cultural change. Among many measures, the project known as Jogos Br is worthy of particular note. Jogos Br offers incentives to individuals and companies to produce computer games, on an open source platform, that positively reflect elements of Brazilian culture. The government recognizes developers by awarding prizes as well as helping them mass produce and export the games. Since these programs are developed by Brazilians, OSS can be used. In other words, a national software industry is being developed through mass-market games showing popular culture and customs in a highly attractive light.

Within the Ministry of Culture, the Intellectual Property Management Department designs educational programs and sponsors events related to intellectual property. It also protects, preserves, and encourages the creation of artistic works with cultural merit.

Piracy and Smuggling

Common sense tells us that change has both positive and negative aspects, and which is which depends greatly on personal perspective. The same holds for modernization, and rapid technological development, which has brought sweeping changes in Brazilian social behavior.

The positive/negative aspects of change are nowhere more evident than in the debate over "piracy" of intellectual property. We face a dilemma. On the one hand, we want to stringently protect and reward artists, inventors, and innovators; but on the other hand, we want to expand public access to information and technology in pursuit of broad economic, educational, and technical advancement.

Because of the low cost of copying CDs and DVDs, pirated versions of just about everything are routinely sold at incredibly low prices in Brazil. Not surprisingly, most low-income and many

middle-class consumers purchase so-called "alternative products" in parallel and black markets. Piracy and smuggling have heavily affected the Brazilian economy during recent years, especially in the music and software industries. Recent studies show that approximately US$3 billion is stolen annually from the economy. The damage is especially severe in the music and software industries. According to statistics from the Brazilian Association of Record Producers, fully one-third of CDs purchased by middle-income people in Brazil and half of those bought by low-income people are unlicensed copies or counterfitted versions. The Federation of Industries reports that nearly 60 percent of the population of the state of Rio de Janeiro shops in the black market. Piracy and smuggling are so widespread as to have reached a state of crisis. One way or another, action will be needed against illegal marketing to prevent degradation of the economy.

In order to address this challenge, the Ministry of Justice set up the National Council to Combat Piracy. Its goal is to end piracy and smuggling under appropriate guidelines and strategies. Recent measures include tightening of security at the Brazil–Paraguay border, which is a notorious crossing point for smuggled and counterfit goods. The council has also proposed amending the penal code to impose harsher penalties for piracy and smuggling.

Health, Environment, and Technology

Change in the biotechnology and the health industries is occurring rapidly at the global level. Despite overall limitations in available resources, including natural resources, any country that aspires to keep up with the times must invest and develop in these areas. In this regard, much recent debate has swirled around the question of whether Brazil should produce and market genetically modified products.

On March 24, 2005, the Biosecurity Law (Law 11105/05) was published, stirring considerable controversy. Among other things, the law deals with the issue of biotechnology patents. First, it defines genetically modified organisms as those whose genetic material has been modified by any genetic engineering technique. This is significant because, according to Brazilian patent law, natural organisms cannot be patented while modified organisms can (that is, those not found in nature, such as genetically modified organisms). This differs from U.S. patent law, which permits unknown species, fauna, and flora in nature to be patented.

Article 5 of the Biosecurity Law stipulates that only those persons and institutions enrolled with the National Technical Committee for Biosecurity (CTNBio) can undertake procedures for genetic manipulation and development of genetically modified organisms. This allows the government to keep track of what is being done by whom, as well as discoveries and inventions.

One current debate is whether biotech patents can require royalty payments to biotech patent holders. The Ministry of Agriculture has ruled against mandatory royalty payments for the 2005 harvest, but producers who use genetically modified seeds will be subject to royalty payments in coming years. Some companies and producers are adding royalty costs to the selling price of the genetically modified products, thereby sidestepping independent royalty payments.

Biotechnology and genetic modification are of paramount importance in that they can help to reduce harvest losses and pesticide dependency. On the other hand, much uncertainty remains over potential effects on human health and the surrounding environment—including the "environment" of the economy.

The Patent Law says that patents can be subject to a compulsory license in the event of insufficient exploitation, abusive exclusive exercise of the rights on a patent, abuse of market

power, in national emergencies, or in the public interest. In determining what constitutes the "public interest," facts that can be considered include, among others, public health, nutrition, environmental defense, and the technological, social, and economic development of the country.

In recent years, the government and the pharmaceutical industry have negotiated reduced prices for medicines, especially antiviral drugs to treat HIV/AIDS. By granting a compulsory license, the government in effect breaks certain patents related to such drugs. Following breakdown of negotiations, Decree No. 985/2005 was issued on June 24, 2005, declaring that compound medicines composed of the active ingredients Lopinavir and Ritonavir are in the public interest. This action constituted a first step toward breaking the patent.

Conclusion

The measures, laws, and policies discussed in this chapter represent a small sample of actions that Brazil has taken to secure its place in the global economy and the modernized world. Much work remains to be done in the legal realm, particularly in the area of intellectual property. Controversy is keen around areas such as open source software, the pirating of creative work, protection of Brazilian culture, genetic modification in agriculture, the cost of new drugs, and on and on. Yet the seeds for a fair and prosperous modernization have been sown. It is up to Brazil's government and its citizens to watch carefully and nurture their healthy development.

Chapter 12

The Knowledge Assessment Methodology and World Bank Country Operations in an Age of Global Competition

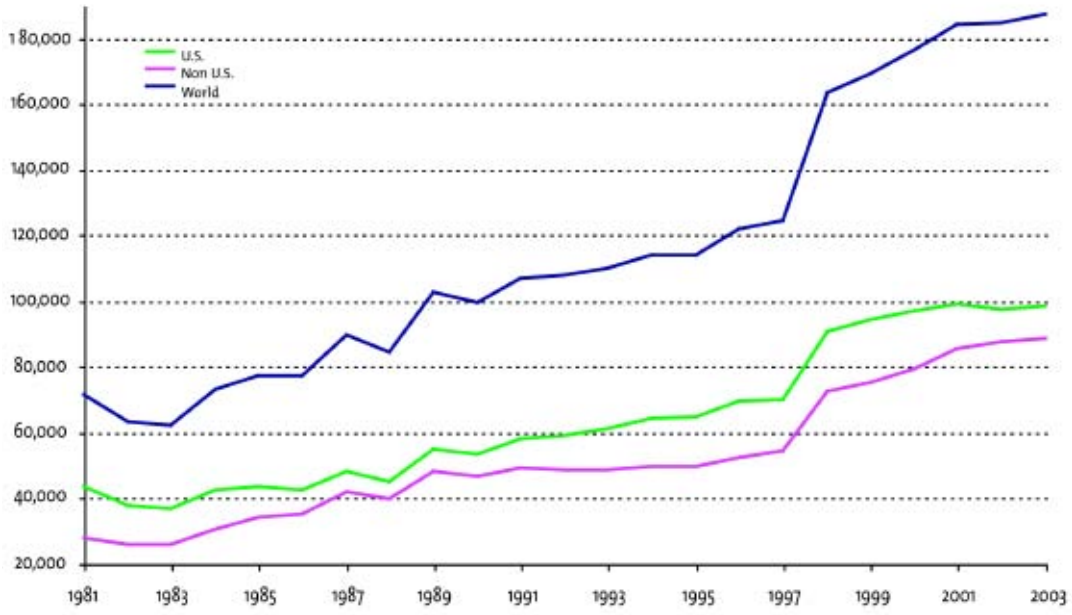
Derek H. C. Chen and Carl J. Dahlman[1]

Over the past quarter century, the rate of knowledge creation and dissemination has increased significantly. One reason is that advances in information and communication technologies have significantly reduced the cost of computing power and electronic networking. With increasing affordability, the use of computation power and electronic networking have surged dramatically, along with the efficient dissemination of existing knowledge. Modern ICTs also enable researchers in different locations to work together which, consequently, enhances their productivity. The result has been rapid advance in research and development, and the generation of new technologies.

One indicator of the pace at which knowledge and new technologies are being created is the number of annual patents issued by the United States Patent and Trademark Office (USPTO). As shown in Figure 12.1, from just over 71,000 patents in 1981, the world total rose to more than 187,000 in 2003. It should be noted that the share of patents granted to inventors outside of the United States increased from 39 percent in 1981 to 47 percent in 2003. In other words, the increased rate of creation of new technologies is a recent global trend.

The increased speed in the creation and dissemination of knowledge has led to the rapid spread of modern and efficient production techniques, plus the increased probability of leapfrogging, which has consequently resulted in the world economy becoming much more

Figure 12.1. World Patent Count, 1981-2003

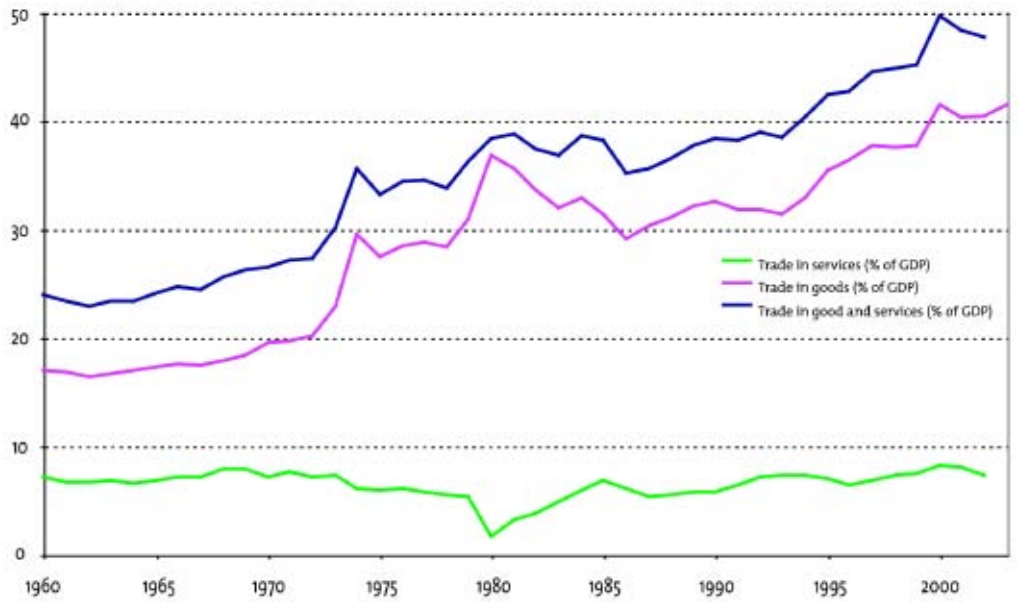


Source: Authors' construction based on data from the United States Patent and Trademark Office Website

[1] The views expressed in this paper do not necessarily represent those of the World Bank. The authors are grateful to Anuja Utz, Alexey Volynets and Yevgeny Kuznetsov for their helpful comments and suggestions.

competitive. As shown in Figure 12.2, the share of world trade (exports and imports) in world GDP, an indicator of globalization and competition in the global economy, increased from 24 percent in 1960 to 47 percent in 2002. The knowledge revolution and globalization present significant opportunities for economic and social development. Yet countries unable to keep pace with the rapid changes face the very real risk of falling behind.

Figure 12.2. World Trade, 1960-2003



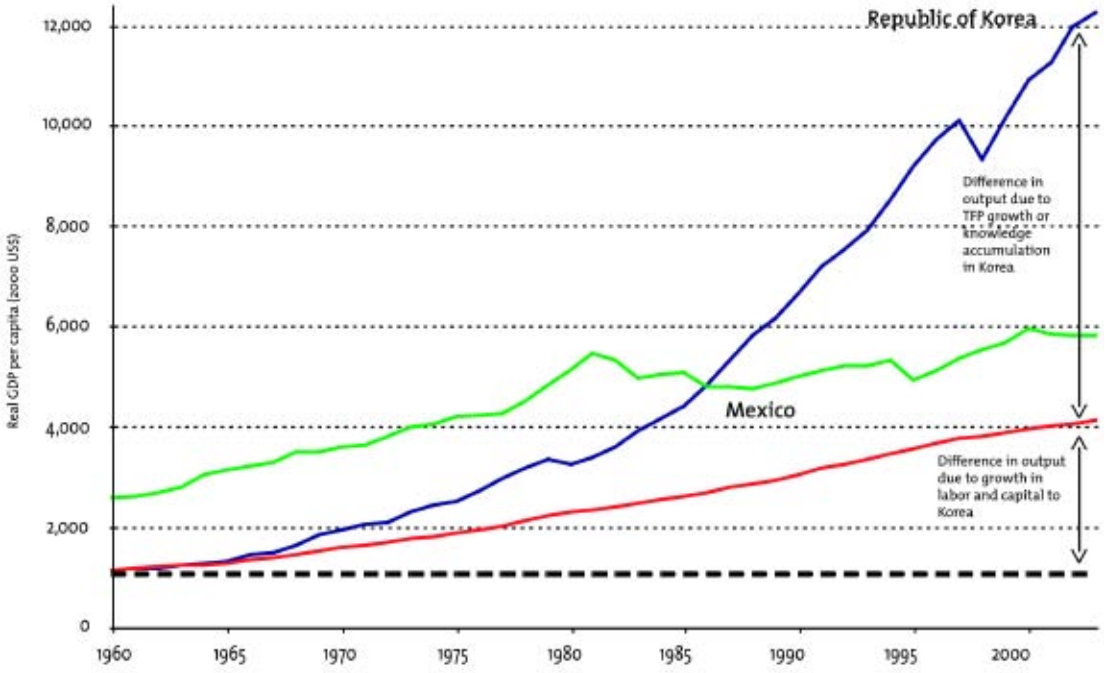
Source: Authors' construction based on data from the *World Development Indicators*.

More than just increasing in size, the *nature* of competition has also changed. Cost is no longer the sole basis; speed and innovation are also essential. Commodity production usually is allocated to lowest-cost producers, but intense competition resulting from globalization has driven the profits in commodity production to approximately zero. Obtaining additional value-added from product differentiation—innovative designs, effective marketing, efficient distribution, reputable brand names, and so forth—has therefore become crucial. In order to prosper, it is not only necessary to contribute productively to global value chains but to generate *new* value chains. The key does not necessarily lie in production but in innovation and the shift toward high-value services.

In light of this, sustained economic growth in this new world economy depends on developing successful strategies that involve the sustained use and creation of knowledge at the core of the development process. At lower levels of development, which typically imply lower levels of scientific and technological capability, knowledge strategies typically involve adapting foreign technologies to local conditions to enhance domestic productivity. Higher levels of development typically imply higher levels of scientific and technological capability. Knowledge strategies hinge critically on domestic innovation and underlie the shift toward higher value-added products and services that can sustain the high-wages characteristic of these economies.

Figure 12.3 presents the decomposition of the Republic of Korea's economic growth over the past four decades. Knowledge is represented by total factor productivity. In 1960, Korea's

Figure 12.3. Knowledge Makes the Difference



Source: Authors' computations.

real GDP per capita was just over US$1,100, increasing eleven-fold to about US$12,200 by 2003. In contrast, Mexico's real GDP per capita slightly more than doubled, from US$2,560 to US$5,800 over the same period. The figure illustrates that without the contribution of knowledge, Korea's real GDP per capita in 2003 would have remained less than Mexico's, illustrating this factor's enormous potential in accelerating and sustaining long-term economic development.

The Knowledge Economy

With sustained use and creation of knowledge at the center of the economic development process, an economy essentially becomes a knowledge economy. A *Knowledge Economy* effectively utilizes knowledge as the key engine of economic growth. The term refers to an economy where knowledge is acquired, created, disseminated, and used effectively to enhance economic development. Contrary to some beliefs, the concept of the Knowledge Economy does not necessarily revolve around high technology or information technology. For example, the application of new techniques to subsistence farming can increase yields significantly, or the use of information and logistical services can enable traditional craft sectors to serve broader markets than before.

It has been found that the successful transition to the Knowledge Economy typically involves elements such as long-term investments in education, developing innovation capability, modernizing information infrastructure, and having the market environment that is conducive to market transactions. These elements have been termed by the World Bank as the pillars of the Knowledge Economy and together constitute its framework.

The following four pillars of the Knowledge Economy framework are:

- *Economic incentives and institutional regime*. It provides good economic policies and institutions that permit efficient mobilization and allocation of resources. It also stimulates creativity, dissemination and use of existing knowledge.
- *Educated and skilled workers*. The labor force continuously upgrades and adapts their skills to efficiently create and use knowledge.
- *An innovation system of firms, research centers, universities, consultants, and other organizations*. This system effectively keeps up with the knowledge revolution; it can tap into the growing stock of global knowledge, assimilating and adapting it to local needs.
- *A modern and adequate information infrastructure*. Information and knowledge are effectively communicated, disseminated, and processed.

The knowledge economy framework thus asserts that investments in these four pillars are necessary to sustain the creation, adoption, and adaptation of knowledge in domestic economic production. This sustained use leads to higher value-added goods and services. The result is increased probability of economic success, and hence economic development, in the current highly competitive and globalized world economy.[2]

The Knowledge Assessment Methodology (KAM)

The Knowledge Assessment Methodology (KAM)[3] is an interactive diagnostic and benchmarking tool developed by the Knowledge for Development (K4D) Program of the World Bank Institute. It is a user-friendly tool that provides a basic assessment of country and regional readiness for the Knowledge Economy. The KAM is designed to help countries understand their strengths and weaknesses. They can use it to compare themselves with neighbors, competitors, and countries that they may wish to emulate. The KAM is useful for identifying problems and opportunities. It helps to focus policy attention and future investments for making the transition to a Knowledge Economy. The unique strength of the KAM lies in its cross-sectoral approach, which allows a holistic view of the wide spectrum of factors relevant to the Knowledge Economy.

Comparisons in the KAM are currently based on 80 structural and qualitative variables available for 128 countries and 9 regional groupings. These variables serve as proxies for the four Knowledge Economy pillars. The comparisons are presented in a variety of charts and figures, which visually highlight the similarities and differences across countries. The data on which the KAM is based are obtained from data sets published by respected institutions. The data and country coverage are continuously updated and expanded.

The most recent version of the methodology, *KAM 2005*, can assess the position of a country or region at several levels:

- A global scale, when compared to all 128 countries or the nine regions in the KAM database
- A regional scale, when compared with countries in the same region
- The basis of human development, when compared with other countries in the same category of human development
- The basis on income levels, when compared with other countries of the same income-level category.

The KAM is also able to indicate performance and hence allows comparisons across two periods—1995 and the most recent available year. It is able to illustrate those comparisons in a variety of charts and graphic formats. Because the 80 variables span different ranges of

[2] Chen and Dahlman (2004) provide a brief review of the literature on the contribution of each of the four Knowledge Economy pillars to economic growth. In addition, using various indicators to proxy for the four pillars, they also found econometric evidence showing that the four pillars exert significant positive effects on long-term economic growth.
[3] See www.worldbank.org/kam.

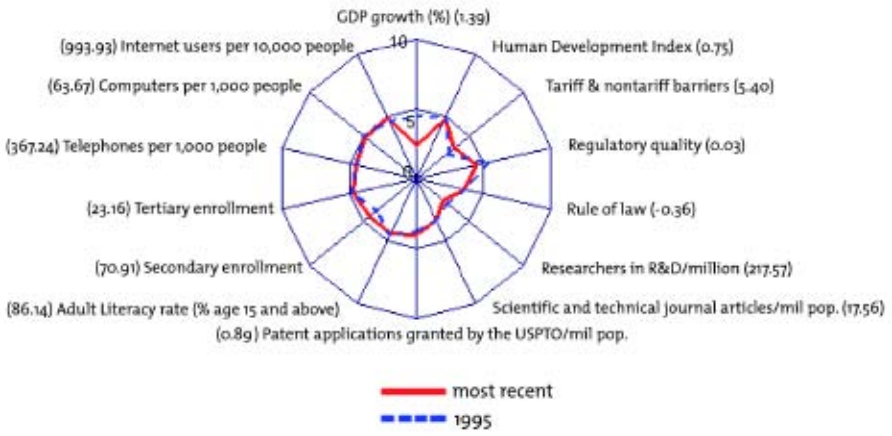
values, all variables in the KAM are normalized from 0 (weakest) to 10 (strongest) before the 128 countries and nine regions are ranked on an ordinal scale.

The Basic Scorecard

The basic "scorecard" is one of the most frequently used KAM charts. It provides an overview of the performance of a country or region in terms of all four pillars of the knowledge economy. Using the Latin American region as a whole as an example, Figure 12.4 illustrates the KAM basic scorecard. The scorecard includes 14 standard variables—2 performance variables and 12 knowledge indicators, with 3 variables representing each of the four pillars. While other data may be more robust in describing preparedness for a knowledge-based economy, the 12 selected variables are generally available for relatively long time series, and most countries assessed by the KAM update these data regularly.

The KAM uses the "spider chart" representation for the basic scorecard. The center of the chart denotes the minimum normalized value of 0, while the outer perimeter denotes the maximum normalized value of 10. Thus, a "bigger" or "fuller" spider chart implies that the country or region is better positioned in terms of the knowledge economy. Figure 12.4 presents data for 1995 and the most recent year, which is currently 2002. The actual or raw values of the variables for the most recent year are

Figure 12.4. The Basic Scorecard for Latin America, 1995 and Most Recent



Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

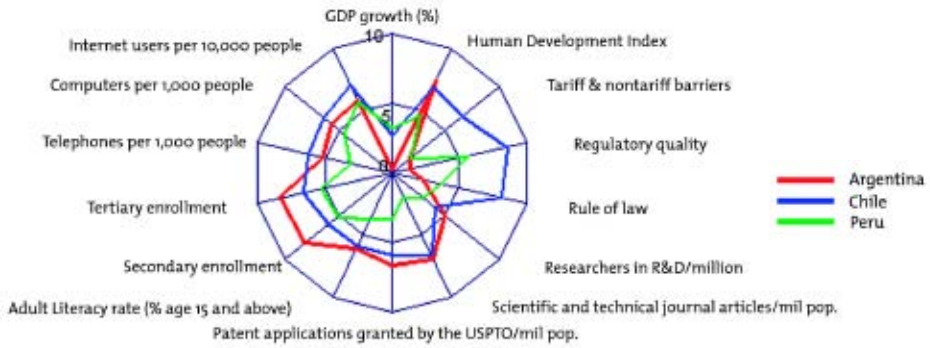
provided in the parentheses.[3] As can be seen, the Latin American region's performance for the most recent year in the education- and ICT-related indicators are just below the 50th percentile, while those for the institutional quality and innovation pillars are generally weaker. In addition, we note that tariff and nontariff barriers have declined, and secondary-school enrollment has improved since 1995; while regulatory quality and the number of researchers in R&D per million persons have declined.

Because countries are ranked on an ordinal scale, the KAM illustrates the relative performance of a country as compared with other countries in the KAM database. As such, an indicated decline of a country's performance in a specific variable could have occurred for two reasons. First, the country's performance in that variable declined, which resulted in lower values in absolute terms. Alternatively, the country's performance could have improved and resulted in large absolute values; but other countries experienced even larger improvements, leading to the country's ordinal ranking falling and a lower value in relative terms.

[3] The KAM basic scorecard provides the option of displaying the actual, normalized, or no values in the chart.

Another mode of the KAM enables the basic scorecards of up to three countries or regions to be plotted on one spider chart. Figure 12.5 illustrates this mode using the most recent data of Argentina, Chile, and Peru as examples.

Figure 12.5. Basic Scorecard for Argentina, Chile and Peru



Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

As can be seen, Chile is relatively strong in many of indicators in the basic scorecard—for example, above the 80th percentile in the institutional indicators of regulatory quality and rule of law. In contrast, Chile is not so strong in terms of researchers in R&D. Chile is in the 40th percentile, while Argentina is close to the 50th percentile. In fact, Argentina is generally stronger than Chile in the education and innovation pillars, but it is weaker for the economic and institutional regime and ICTs. Peru is generally weaker than either Argentina or Chile in terms of the indicators in the KAM basic scorecard. The exceptions are regulatory quality and rule of law, in which Peru performs better than Argentina.

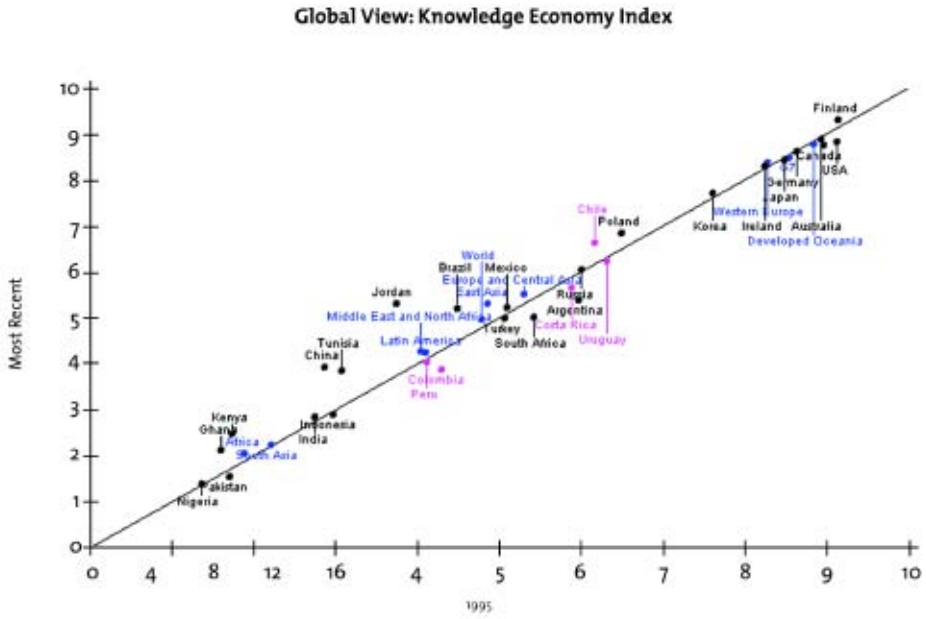
The Knowledge Economy Index

The KAM Knowledge Economy Index (KEI) is an aggregate index that represents the overall level of development of a country or region in terms of a Knowledge Economy. The index summarizes performance over the four pillars. It is constructed as the simple average over the normalized values of the 12 knowledge indicators of the basic scorecard. While there are several ways to illustrate performance in the KEI, the Global Knowledge Economy mode made presents a simple way to visualize and compare countries and regions. Figure 12.6 locates countries and regions on a scatter plot based on their relative performance in the KEI for 1995 and "most recent year".[4] The horizontal axis plots performance in the KEI in 1995, while the vertical axis plots performance for the most recent year, currently 2002. The diagonal line represents the locus of points where the KEI values in 1995 and in the most recent year are equal. As such, countries and regions that appear above the diagonal line have made an improvement in the KEI since 1995. Those that appear below the diagonal line have experienced deterioration in terms of the KEI.

It can be seen that all countries and the region in Figure 12.6 fall between the 40th and 70th percentile for both 1995 and the most recent year. In addition, Brazil, Chile, Mexico, and the Latin American region appear above the diagonal line, indicating that their performance in the KEI has improved since 1995. In contrast, Argentina, Colombia, Costa Rica, Peru, and Uruguay appear below the diagonal line, indicating that their performance has worsened since 1995.

[4] In the KAM Global Knowledge Economy Comparisons mode, the user can select up to five countries, in addition to a default group of selected countries and regions, to be tracked in the scatter plot. The user may opt to demonstrate performance in the aggregate Knowledge Economy Index or the individual pillars that define them: Economic Incentive Regime, Education, Innovation, and Information Infrastructure. Values for each pillar are constructed as the simple average of the normalized values of the respective three variables (in the basic scorecard).

Figure 12.6. Knowledge Economy Index for Selected Countries 1995 and Most Recent



Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

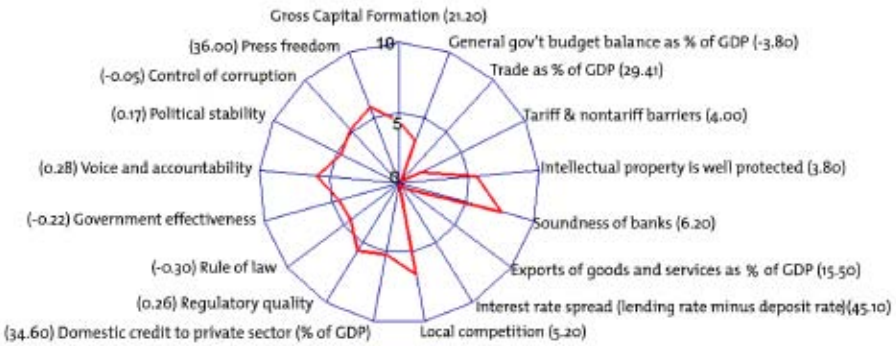
Table 12.1 tabulates the KEI index and the indices for the individual pillars for all Latin American and Caribbean countries that are currently available in the KAM. We see that Barbados has the highest KEI of 7.00, which is also substantially higher that the KEI in 1995 of 4.92. On the other hand, Haiti has a KEI of 0.85, the lowest KEI in the region.

Other Scorecards

Apart from the basic scorecard, the KAM also allows the user to customize by combining variables for benchmarking comparisons. The Create Your Own Scorecard mode allows the user to compare any two countries or regions for any of the 80 variables included in the KAM database. Very frequently, this mode is used to generate scorecards that focus solely on individual pillars or sectors of the Knowledge Economy.

For example, Figure 12.7 presents all the available variables for the economic and institutional regime for Brazil. We see that Brazil is relatively strong and performing better than the 50th percentile for indicators such as intellectual property protection, soundness of banks, local competition, voice and

Figure 12.7. Most Recent Economic and Institutional Regime-Brazil



Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

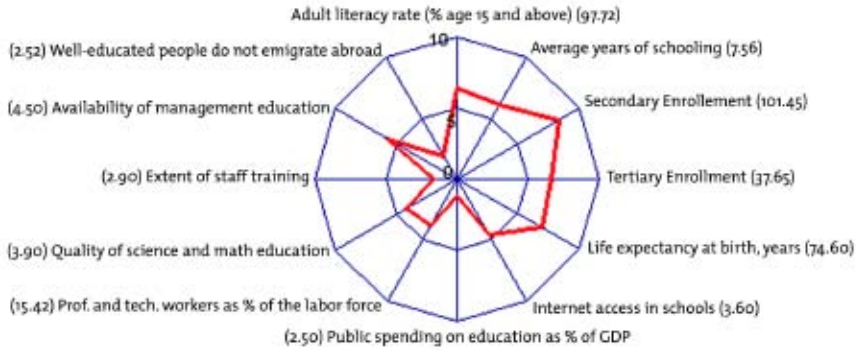
Table 12.1 Knowledge Economy Index and Indices of Individual Knowledge Economy Pillars of Latin American and Caribbean Countries

Country	Most Recent Year					1995				
	KEI	Econ. Incentive Regime	Innovation	Education	Information Infrastructure	KEI	Econ. Incentive Regime	Innovation	Education	Information Infrastructure
Argentina	5.24	1.79	6.15	7.49	5.53	5.97	5.57	6.06	6.39	5.85
Barbados	7.00	6.02	6.99	7.77	7.23	4.92	3.13	3.54	7.17	5.83
Bolivia	3.63	3.74	1.76	5.52	3.51	3.63	5.50	1.33	4.11	3.57
Brazil	5.05	3.94	5.02	5.75	5.50	4.49	4.18	4.59	3.85	5.32
Chile	6.49	7.73	5.51	6.13	6.59	6.16	6.89	5.58	5.87	6.31
Colombia	3.73	2.79	3.14	4.40	4.60	4.29	4.12	2.96	4.53	5.53
Costa Rica	5.50	5.89	5.29	4.56	6.28	5.87	5.71	5.52	5.34	6.91
Dominican Republic	2.96	2.65	0.35	3.93	4.92	3.30	2.37	2.56	4.26	4.02
Ecuador	3.21	2.13	2.67	3.88	4.17	3.39	3.49	1.27	4.40	4.42
El Salvador	3.50	4.98	1.48	3.17	4.37	3.57	4.51	1.79	3.45	4.53
Guatemala	2.83	3.42	2.58	2.15	3.18	1.73	1.82	1.15	2.23	1.74
Haiti	0.85	0.95	0.08	0.97	1.41	0.86	0.26	0.08	1.18	1.91
Honduras	2.63	3.16	2.12	2.49	2.76	2.80	2.33	2.95	2.64	3.28
Jamaica	4.45	3.94	3.18	4.55	6.12	4.42	4.7	4.17	3.98	4.83
Mexico	5.10	5.79	4.67	4.43	5.51	5.10	5.69	4.75	4.40	5.54
Nicaragua	2.86	4.06	2.12	2.54	2.73	2.28	1.47	1.13	3.01	3.52
Paraguay	2.86	2.53	0.89	4.19	3.84	3.43	4.97	1.28	3.78	3.68
Peru	3.90	3.65	2.74	4.71	4.50	4.11	3.47	3.40	5.39	4.19
Uruguay	6.11	6.37	4.88	7.17	6.02	6.30	6.66	5.56	6.68	6.32
Venezuela	3.82	1.82	4.33	4.27	4.85	4.68	3.02	5.02	4.85	5.86
Latin America	4.10	3.87	3.30	4.500	4.73	4.09	3.99	3.27	4.38	4.73

Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

accountability, and press freedom. On the other hand, Brazil is relatively weak in areas such as reduction in tariff and nontariff barriers, and exports of goods and services. Figure 12.8 illustrates the KAM variables for education and training for Uruguay. We see that Uruguay is relatively strong in indicators such as average years of schooling and secondary and tertiary enrollments. Ecuador's performance in the innovation and technological adoption pillar are shown in Figure 12.9. For most of the variables, Ecuador ranks below the 50th percentile, with exceptions being the cost of registering a business, the level of foreign direct investment, and the amount of royalty payments. Finally, Venezuela illustrates the ICT pillar scorecard. As can be seen in Figure 12.10, Venezuela performs relatively well for e-government and the circulation of newspapers, but it ranks at or below the 50th percentile for the rest of the ICT variables.

Figure 12.8 Most Recent Education-Uruguay

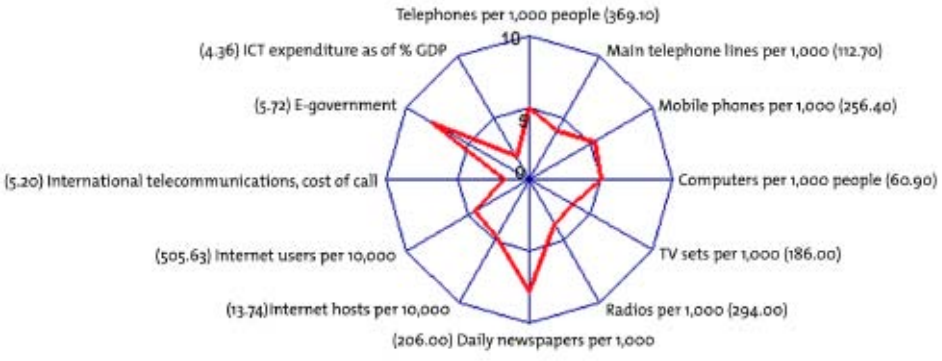


Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

Figure 12.9 Most Recent Innovation and Technology Adoption-Ecuador

Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

Figure 12.10 Most Recent Infrastructure-Venezuela



Source: The Knowledge Assesment Methodology (KAM) Web site (www.worldbank.org/kam).

The KAM and Country Operations

The KAM has successfully been used in facilitating engagements with World Bank country teams as well as policy discussions with government officials from client countries. Moreover, the KAM has been broadly applied to various economic and sector work, including China, India, the Republic of Korea, Japan, Finland, Mexico, Argentina, and Chile. In this section, we highlight features that allow the KAM as a tool to play a critical role in World Bank country operations.

First, the KAM is based on a framework for the Knowledge Economy that is holistic in nature, because it integrates four areas (the "pillars") that are crucial for knowledge to contribute effectively to sustained economic growth. Using this fresh approach to economic development, the KAM tends to bring together specialists and policy makers in the fields of education and lifelong learning, R&D and innovation, ICT infrastructure, and economic environment and institutions. The broader approach encourages them to work together on formulating integrative strategies. To maximize civil participation in economic development strategies, the World Bank also makes conscious efforts to include private sector executives, academics, and representatives from think tanks. As a result, discussions relating to the KAM and the Knowledge Economy tend to involve individuals representing many fields of specialization and diverse facets of government and society. Discussions of the KAM Knowledge Economy approach provide them with a shared opportunity to exchange ideas and viewpoints. Together, they are more likely to derive a coherent sets of policies and strategies in which the application of knowledge will drive long-term economic development.

As explained, the KAM can perform analysis and do benchmarking with variables and indicators other than the 14 preselected variables used in the basic scorecard. Moreover, the user can choose to benchmark countries using any of the 80 variables in the KAM database. This feature is important because certain variables will be more relevant for some countries than for others. This option significantly increases KAM's versatility by allowing the user to select the most relevant variables for the country or region of interest. In addition, this option allows the KAM to perform analysis by sector or individual pillar. As such, while the KAM is based on a holistic Knowledge Economy framework, it is sufficiently versatile to perform sector-specific analyses.

Perhaps the most important feature of the KAM is its ability to place country and regional performance in a global comparative context. The current version of the methodology, *KAM*

2005, can benchmark countries contemporaneously using data for 1995 or for the most recent period. The ability to compare countries' performance across the two periods is also useful for highlighting whether they are catching up or falling behind. Highlighting areas in which countries have fallen behind—or the equivalent, areas in which other countries have surged ahead—provides a reality check on performance relative to other countries. When they are able to "see" their relative global position in the Knowledge Economy, policy makers frequently act upon the need for coherent policies to place knowledge at the core of national development strategies.

Conclusion

With the spread of modern and efficient information and communication technologies, the world economy has become more competitive as well as interdependent. As such, economic survival makes knowledge creation essential to long-term development strategies—in other words, to make the critical transition toward a knowledge economy.

The Knowledge Assessment Methodology (KAM) was developed by the Knowledge for Development Program of the World Bank. Since 1999, it has not only helped to identify problems and opportunities, it has helped to focus policy attention and future investments with respect to the transition to the Knowledge Economy. The unique strength of the KAM lies in its cross-sectoral approach, which allows a holistic view of the wide spectrum of relevant factors. Because of its transparency, simplicity, and versatility, the KAM has been widely used and accepted for facilitating policy discussions between World Bank country teams and government officials from its client countries.

References

Chen, D. H. C., and C. J. Dahlman. 2004. "Knowledge and Development: A Cross-Section Approach." Policy Research Working Paper No. 3366, World Bank, Washington, D.C. (November).

Dahlman, C. J., and T. Andersson. 2000. *Korea and the Knowledge-Based Economy: Making the Transition*. Washington, D.C.: World Bank.

Dahlman, C.J. and Jean-Eric Aubert (2001). *China and the Knowledge Economy: Seizing the 21st Century*. The World Bank, Washington, D.C.

Dahlman, C. J., and A. Utz. 2005. *India and the Knowledge Economy: Leveraging Strengths and Opportunities*. World Bank Institute (WBI) Development Studies, The World Bank. Washington D.C..

Conclusion

A Third Way: Value-Added Development?

Robert A. Vitro

Development is and always has been knowledge-based. An important difference among countries can be traced to their relative political will to build human capital by leveraging access to information and the tools to use it to build and apply knowledge into an economic force.

Various countries with abundant natural resources have been plagued by chronic economic, social, and political inequalities. Yet other countries without abundant natural resources have sustained significant economic growth by focusing instead on building human capital. Why? Because high macroeconomic growth—the kind of growth that leads to true development—can be enhanced by expanding a knowledge-based economy that simultaneously contributes to diversification of local production while increasing local purchasing power.

This book focused on some areas for applying the tools and techniques of development effectiveness to measure, monitor, and evaluate the contribution of Knowledge Economy expansion to increasing the rate of sustainable economic growth and reducing poverty while promoting equity. Individually and as a group, the authors suggested new ways to visualize both development and the role of development organizations in the context of a global Knowledge Economy. They challenge the reader to look differently at the familiar, considering new challenges and identifying opportunities for more productive partnerships.

This conclusion attempts to stimulate thinking about linking the perspectives discussed in the previous chapters and, in so doing, contribute to this work in progress—achieving greater effectiveness of targeted investment through stronger partnerships for Knowledge Economy expansion. It includes some speculation on value-added development followed by the suggestion of possible benchmark studies that could be used as a basis for further discussion of that concept.

Partnership Perspectives for Development Effectiveness

Partnerships are based on a shared vision, or at least on a commitment to work together toward one. The vision of the countries of Latin America and the Caribbean regarding their place in the emerging knowledge-based global economy is still taking shape. Consequently, partnerships within each country, among the countries, and between the countries and international organizations (such as IDB) are still evolving.

A New Paradigm for Development?

Increasingly, segments of the development community are calling for a new development paradigm. It could well be that such calls stem from inadequate understanding of the current paradigm—in particular, the role to be played by information and knowledge.

As noted in the Preface, the countries of Latin America and the Caribbean have clearly made a major commitment to accelerate Knowledge Economy expansion in their development efforts. One way to interpret this commitment is in the context of the debate about the development

paradigm. Some call for increases in development assistance while others see development as a byproduct of increasing trade. Yet it may be that a third way exists, and it has always existed.

Implicitly at least, this third way has been at work for many years through the partnerships between beneficiary countries and development assistance organizations. The time may now have arrived to make this approach less implicit and more explicit. Economists and specialists in ICT, the Information Society, and the Knowledge Economy may be coming closer to understanding and speaking each other's languages. More precisely, countries are recognizing that they are already building their capacity to create and distribute new wealth by adding value (that is, increasing the information content) to their human, material, and financial resources. Acknowledging *value-added* development as a third way could have an impact on the character and volume of aid as well as on trade.

The third way, as contemplated here, is primarily economic not political (i.e., the sense in which leaders from some countries around the North Atlantic use the phrase). Nor should it be presumed that value-added development is being suggested as a substitute for either trade or aid. Rather, the third way could provide a perspective on the other two, helping us to better understand how they might evolve. Of course, nothing new is being proposed, just a different way of looking at the familiar. Other fields have discussed similar concepts with different language. It might even be asserted that the value added of development institutions is to enhance the capacity of counties to add value to local resources. What *is* different here is the emphasis on greater collaboration between economists and those people working in information and knowledge fields. More than anything else, this is a call for them to work together more closely to shape a common vision and approach as well as produce the statistics that development policy makers and planners need to make and implement more effective decisions regarding Knowledge Economy expansion.

Value-Added Development

How does value-added development link to sustainable economic growth, reductions in poverty and greater equity? Adding value means increasing the information content of resources. This is done through, among other activities, market research, communications, process design, learning, and scientific and technological research and development. As human beings add value to themselves they are better able to add tangible value to other resources. This process creates and distributes new wealth. Thus, value-added development can be understood as reinforcing a human-centered approach to development. Value-added development depends on creating the mechanisms that expand access to needed information in a timely and cost-effective manner so that people can use it to build and apply knowledge.

A *knowledge* economy reflects the capacity to add value to the factors of production—in other words, to increase the information content in raw materials and financial and human resources. These resources can be "mixed" in new ways to create and distribute wealth in an efficient, equitable, and sustainable manner. A Knowledge Economy can be understood as one which activities that facilitate the production, distribution, and use of information (that is, the cultural and content industries, learning, scientific research, technological innovation, and advances in information and communications technology) are a significant portion of overall economic activity.

Adding value takes place in two domains. First, raw data in text, image, audio, and multimedia formats is organized and transformed into information for transactions in the marketplace. It is far more valuable for users when it is complete, accurate, and accessible in a

timely and cost-effective manner. When that happens, value is "added" to raw data. Second, as organizations use information (purchased in the marketplace and produced internally) as an input to create and apply their knowledge to non-information resources, the resulting products and services also acquire more value for potential consumers. The combination of the economic activities in both of these domains contributes to sustainable economic growth. In this way, these two domains and the interaction between them suggest how adding value offers the potential to change the volume and character of the supply and demand for all goods and services.

Benchmarking Value-Added Development for Effectiveness

The region could benefit from more comprehensive and comparative macroeconomic measures of the production, distribution, and use of information. Unfortunately, development policy makers and planners are being asked to make decisions about efforts to grow the Knowledge Economy without the relevant benchmark economic statistics. Correcting this situation would strengthen the capacity of countries to ensure that Knowledge Economy expansion takes place according to the full range of values, needs, resources, conditions, and aspirations in each country.

A climate for correcting this situation is emerging. In his foreword, Carlos M. Jarque suggests that "conditions in the region and the Bank are currently ripe for renewal of the Bank's efforts in the context of improving development effectiveness." He adds, "At the core of this renewal is the growing understanding that the expansion of the Knowledge Economy is a conceptual and programmatic 'bridge' between the Bank's two overarching objectives: fostering sustainable economic growth and reducing poverty while promoting equity."

Translating the concept of value-added development into usable economic statistics could well enhance the engagement of diverse stakeholders in the issues that emerge. The benchmark studies described below are but a few of the comprehensive examples that could help test the concept, orient project design, and provide yardsticks for measuring the effect of value-added development. They could also be used as reference documents and learning tools for dialogue between countries and development institutions.

Value Added in Sustainable Economic Growth (measuring value added to nonhuman resources). Using a methodology from the Organization for Economic Cooperation and Development (OECD) to reaggregate statistics already compiled by the countries in the region, it is possible to calculate the information sector as a percentage of gross national product, the number of information workers in the labor force, and the percentage of information goods trade in international trade. Since the OECD methodology is based on international standards for statistical compilation, comparisons among countries and subregions could be used to formulate regional integration projects that leverage national efforts to increase value added. A set of studies like these could complement the insights described by Mokyr, Mitchell, and Villaschi in Part I of this book.

Value Added in Human Capital Formation (measuring value added to human resources). To complement the occupational measurements proposed above, it would be very useful to define the structure and measure the size of the human capital industry emerging in Latin America and the Caribbean. A human capital industry framework, one that includes but transcends primary, secondary and university education, could serve as a basis for more effective decision making in the area of human development. Such a framework would reflect the diverse learning environments emerging from innovations by public, private, civil society, and academic organizations. By combining measurement of information workers in the labor force and fuller description of the human capital industry with the assessments

discussed in Part II by Murray as well as Hammond's insights into the informal learning taking place at the bottom of the pyramid, new development opportunities could emerge.

Value Added in Democratic Governance (measuring how the value-added approach strengthens democracy). Governments at all levels have a multiplicity of roles to play in boosting capacity to add value. They are sources of public information, purchasers of information produced in the private sector, and providers of learning environments as well as financiers of others who create learning environments. They are also managers of change responsible for formulating policies and regulations with the private sector and civil society to shape the Knowledge Economy and define the terms of a new social contract based on expanding that economy.

Measurements can be carried out in each area. For example, the macro-measurements produced by the OECD methodology would reveal the size and character of the public bureaucracy that is part of the secondary information sector. Above all, governments must remember the fundamental point. The approach they take toward information and knowledge in society is a barometer of the trust being placed in citizens and of the commitment to transparency and to strengthening democracy. Developing sound indicators can help citizens determine the degree of trustworthiness described by Cordella, build on Furlong's description of a citizen-centric focus and Raymond's description of transparency in Part III.

Focusing partnership efforts on producing such benchmark measurements could strengthen *institutional arrangements* and have a multiplier effect on achieving development effectiveness in all areas. Results from studies such as these could bring together stakeholders who otherwise see themselves as separate communities.

Moving Forward

The people of Latin America and the Caribbean possess a rich cultural heritage as well as enormous creativity and entrepreneurial energy. Much of it is untapped or underutilized in the informal sector and among low-income groups as well as in the middle class. These qualities can be leveraged through Knowledge Economy expansion and value-added development. Should this process gather momentum, opportunities could expand for a critical mass of educated citizens to carry out second-generation reforms. This type of economic growth could also spark a healthy reverse migration. Many knowledge workers who left their native countries might find it worthwhile to return—more willing and better able to contribute to a Knowledge Economy that operates efficiently and fairly.

Whether or not these qualities will be leveraged depends, in large measure, on the degree to which development effectiveness in Knowledge Economy expansion is achieved. Hopefully, the contributions by the authors of the chapters in this book have helped refine the focus and energized discussions about how to move forward in building partnerships for development effectiveness.

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