Information Societies in Latin America and the Caribbean

Development of Technologies and Technologies for Development

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Editors

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Foreword

This book complements and builds on the other studies published since 2002 by the Economic Commission for Latin America and the Caribbean (ECLAC) on the challenges and opportunities that come with the emergence of Information Societies in Latin America and the Caribbean. Information and communications technology (ICT) issues have played an increasingly important role in the policy agendas of the countries of the region. In its preceding institutional publication on the topic (ECLAC, 2003a), ECLAC posed the following questions: What type of information society do we wish to create? What are the basic characteristics and specific features of the transition to the information society in the region? What policy measures might be adopted to further the process? While these questions remain relevant, another, even more important one, has emerged: After nearly a decade of work in the area, has the relationship between ICT and development had noticeable positive repercussions? Data are now available to assess how far the region's countries have advanced towards the objective of becoming full-fledged members of the information society. ECLAC has conducted such assessments, exploring the priorities, interests and measures, as reflected in public policies, designed to achieve that objective. In doing so, it has focused particular attention on policies designed to reduce the digital divide, in terms of both the global technological frontier and the gaps between different social groups within the countries. In an environment in which accelerating technological change leads to a constant redefinition of objectives and goals, it becomes particularly important to close these gaps.

The United Nations has a long history of work on this subject. As early as 1999, the Economic and Social Council decided to devote high-level meetings of its 2000 session to the subject of "Development and international cooperation in the twenty-first century: the role of information technology in the context of a knowledge-based economy". As a result of these meetings, the Latin American and Caribbean countries, brought together by the Brazilian government and ECLAC in July 2000, issued the Declaration of Florianopolis, which focused on the use of ICT as an instrument for development. The declaration marked the beginning of a process that is ongoing —one that, as outlined in the present book, continues to represent a major challenge for the region. Among the objectives set forth in the Declaration were "the shared aspirations of the Latin American and Caribbean countries to become full-fledged members of the information society by the year 2005 on an efficient, effective and sustainable basis within the framework of the global knowledge-based economy". In taking that initial step, the region's leaders recognized the importance of adopting proactive public policies to promote the countries' incorporation in the information society and the importance of addressing the digital divide. As they stated, "allowing the evolution of the information and knowledge-based society to be guided solely by market mechanisms entails the risk of an amplification of the social gaps existing within our societies, the creation of new modes of exclusion, an increase in the negative aspects of globalization and a widening of the distances between developed and developing countries". This book reviews the results of region's aspirations and its recognition of the steps that need to be taken.

As part of the global process linked to the World Summit on the Information Society (WSIS), held in two stages (Geneva in 2003 and Tunis in 2005),[1] Latin American and Caribbean authorities intensified their efforts to create a regional perspective in dealing with the development of the countries' information societies. Several meetings of the regional United Nations ICT Task Force between 2001 and 2003 highlighted the importance of collaboration among the interested parties in dealing with this challenge. The Agenda for Connectivity in the Americas and the 2002 Plan of Action of Quito also stressed the need to formulate realistic national plans of action and strategies. The 2003 Declaration of Bávaro was a decisive step in establishing the fundamental principles for Latin America and the Caribbean in their efforts to become information societies, since it helped to identify the principal characteristics of the transition in the region. That document has had notable repercussions: it was the first political declaration to incorporate the issues of Internet governance and open-source software into the official WSIS process. These two topics subsequently became major themes in the global discussion.

The preparatory meetings for the second phase of the World Summit on the Information Society, held in Quito in May 2005, and the Regional

[1] The Summit produced the Geneva Declaration of Principles and the Plan of Action, as well as the Tunis Commitment and the Tunis Agenda for the Information Society (http://www.itu.int/wsis).

Ministerial Conference of Latin America and the Caribbean, held in Rio de Janeiro in June of that year, were the result of a number of years of dialogue on the relationship between ICT and the issues of growth and equity. They culminated in approval of the Plan of Action of the Information Society in Latin America and the Caribbean (eLAC 2007) and the declaration known as the Rio de Janeiro Commitment. The Plan of Action is the result of an extended learning process, thus constituting a landmark in a wide range of information society issues in the region. In the context of the 167 global goals established by the World Summit for the year 2015, eLAC 2007 attempted to identify the most urgent short-term goals for the region. For 2005-2007, 30 goals and 70 specific measures were articulated to link international goals with local needs, in an effort to achieve the global goals. The Plan recognizes the dynamic nature of ICT and the need for a realistic approach, as well as the importance of working to achieve the World Summit goals and the Millennium Development Goals —processes that converge in 2015.

As was clearly reflected in the Declaration of Santo Domingo: "Governance and Development in the Knowledge-based Society" (approved at the thirty-sixth regular session of the General Assembly of the Organization of American States in June 2006, in Washington, D.C.), the process of bringing the citizens of Latin America and the Caribbean into the global information society and ensuring that they receive its benefits continues to be fraught with challenges. The Declaration of Santiago, issued at the seventeenth Ibero-American Summit of Heads of State and Government (Santiago, November 2007), reiterated support for eLAC 2007 and for extending it to 2010 as a framework for working towards an inclusive, development-focused and person-centred information society, an aspiration also articulated at the World Summit on the Information Society. In addition, at the nineteenth Summit of Heads of State and Government, held in Georgetown in March 2007, the Permanent Mechanism for Political Consultation and Coordination (the Rio Group) recognized eLAC 2007 as the most important regional initiative on this issue.

Eight years after the Declaration of Florianapolis and five years after the Declaration of Bávaro, in the course of finalizing the Plan of Action of the Information Society in Latin America and the Caribbean (eLAC 2007), ECLAC used the occasion of the second Ministerial Conference on the Information Society in Latin America and the Caribbean (El Salvador, 6-8 February 2008) to examine the progress achieved since the initial pronouncements. This book is part of this regional inventory, which has resulted in the inter-governmental approbation of a consecutive Regional Plan of Action: eLAC2010. In this plan, governments, private sector and civil society set forth 83 concrete goals for the period after 2008, most of them as a direct response to the challenges discussed in this book. eLAC2010 covers the period between 2007-2010. In 2010, countries of the region will gather in Lima, Peru, to approve a consecutive action plan as the next step towards fulfilling the Millennium Development Goals and the goals of the World Summit on the Information Society by 2015.

In recent years, the countries of the region have made significant strides towards applying ICT on a mass scale for wide-ranging aspects of economic and social development, including installation of digital information infrastructure, modernization of the State, digitization of economic processes to increase productivity and improve the quality of education and health services, and management of natural disasters. ECLAC believes that the evolution of the countries of the region, as they move towards becoming information societies, has produced positive results in a short time, rendering ICT a tangible solution for challenges on the development agenda. Technological progress has continued and is accelerating, however, adding new challenges to already familiar ones. Becoming an information society is not an isolated process, but, rather, one that involves the region's societal structures. Thus, on top of the new challenges, certain structural problems continue to demand attention —e.g., low per capita income, unequal income distribution, institutional shortcomings, and limited educational and skills levels.

In attempting to effectively use ICT for development, it must be borne in mind that these technologies are tools, not ends in themselves. Thus, a fundamental question is: should ICT be at the centre of the sectoral approach to development, or should development challenges take centre stage while the digital revolution unfolds? It is the question of "development of ICT" vs. "development with ICT" that informs this book, leading directly to the central issues of the debate on the role of information and communications technologies, the role of development, and the complementarities necessary in these two spheres.

The book represents a culmination of efforts made possible by financial support from the European Union, through the Alliance for the Information Society (@LIS), and from Canada's International Development Research Centre (IDRC). Also worthy of particular mention are two individuals who have been central, within ECLAC, in propelling the debate on the ideas explored here: the former Executive Secretary of ECLAC, José Luis Machinea, and the former Director of the ECLAC Division for Production, Productivity and Management, João Carlos Ferraz.

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Summary

This book analyses the development of information societies in the countries of Latin America and the Caribbean, and provides input for public policy on information and communications technologies (ICT) issues.

The first part of the book presents the theoretical concepts that inform it, based on an evolutionary view of technical progress, innovation and development. This section of the book examines the nature and causes of international and domestic digital divides, and details the results of quantitative exercises to measure the impact of ICT on economic growth and productivity in the region.

Given this analytical approach, special importance is placed on technological variables and on the complementarities resulting from the co-evolution of technological, economic, social and institutional structures.

The second part of the book focuses on the development of technologies, specifically on the production of ICT goods and services, such as hardware, software and telecommunications providers. It supplements this analysis with an examination of issues such as telecommunications regulation and the debate on intellectual property rights in the context of ICT. The third part of the book examines advances in the field of technologies for development, especially ICT applications in areas such as education, public administration, business, disaster management and health. The fourth deals with public policies relating to the development of ICT and to ICT for development in the region, and describes ECLAC recommendations in this area.

The recommendations cover seven areas: developing the complementarities necessary to ensure that ICT impact economic and social development; improving coordination in the use of scarce resources and foster initiatives to create synergies; continuing and strengthening intraregional cooperation; transferring policy leadership from actors interested in ICT per se to those responsible for the areas in which the technologies are effectively employed; and strengthening the institutions responsible for policy implementation, in order to reduce the separation between the processes of policy-making and policy implementation in a field of fast innovation.

In short, this book is framed by a recognition of the tension that exists between the demands of a fundamentally exogenous and accelerating technological revolution, and the productive and institutional structures of the region's countries, whose paths of evolution have led to deficiencies which, in a context of great uncertainty, limit their ability to respond to the pressures of the digital paradigm.

Introduction and overview

After such knowledge, what forgiveness?
T.S. Eliot, Gerontion

The widespread expansion in the capacity to capture, communicate, compute and store information has led to a profound restructuring of economic and social organization (Webster, 1995). While this creates new opportunities for the countries of Latin America and the Caribbean, it also brings with it a multitude of new threats. The path to becoming an information society varies from country to country, depending on the initial conditions, the technological, economic, social and cultural dynamics, and the public policy strategies employed (ECLAC, 2003a). From a traditional ECLAC perspective, the last of these factors is the most important. Policy agendas are the result of processes that involve broadly opposing forces within a society. These agendas can be seen as a dynamic sequence involving the recognition of problems and opportunities, formulation of proposals, and political facts or events (Kingdon, 1995). The initial recognition of problems and opportunities involves selecting the issues that society recognizes as important. In this phase, citizens, civil society organizations and communications media work to raise interest in certain issues, and to create specific awareness and understanding of their nature. Policy formulation, which constitutes the second phase, involves redefining options for addressing the problems that have been identified. For a proposal to remain valid and to ultimately be considered, it must meet various criteria, including political acceptance, conformity with established values and current sentiment, and budgetary, technical and institutional feasibility. The third phase is one of political dynamics.

While the search for solutions centres on analysis and persuasion, political consensus is achieved through negotiation involving different approaches to solving specific problems, based on the options identified.

In this context, the objective of the present book is to contribute to awareness and to the identification of solutions by providing information that furthers insight into the development of information societies in Latin America and the Caribbean. Throughout this book, it is shown that such insight can serve as a basis for formulating public policy to facilitate such development. The book is therefore more than a mere descriptive inventory and is rich in policy-oriented analysis. It is divided into four parts and contains a total of 13 chapters.

Part one consists of three chapters, the first of which is devoted to presenting the concepts that serve as a theoretical basis for the book. These have two fundamental underpinnings. One is an evolutionary perspective on technical innovation and development. This bears a close relationship to the concepts of national innovation systems and techno-economic paradigms. The second is the dynamics that have exerted the greatest effect on the technological trajectories of the digital ICT paradigm —trajectories that have produced the technological convergence that is so apparent today. Based on these fundamental concepts, each chapter of the book attempts to elucidate the historical dynamics that gave rise to the current environment, with special emphasis on technological and economic analysis. These dynamics are major determinants of potential future paths (a phenomenon known as "path dependency"). Reiterated throughout the book is a proposition set forth in chapter I: that policy analysis and formulation must take account not only of the speed, but also of the acceleration of technological change, as well as of the uncertainty that accompanies it.

The objectives of the second and third chapters are to present and analyse the spread of the digital paradigm and its impact on growth and productivity in the region's countries. Two long-standing concerns of ECLAC are brought to bear: equity (chapter II) and growth (chapter III). Chapter II presents and analyses the dynamics of the digital divide in the region (at both the international and domestic levels), identifying the principal variables responsible for this divide. These factors include income levels and distribution, and the formal education of the population. The resulting analyses give rise to one of the book's most important postulates, particularly with regard to the formulation of public policy, namely, that the digital divide is a moving target. The rapidity with which the digital paradigm is evolving means that there is an equally rapid reduction in the time available to overcome the gaps. In only a few years, the focus of ICT policymaking has shifted from basic telephony solutions to the issue of fixed and mobile Internet access —followed by a specific emphasis on broadband (a term that, in turn, is being constantly redefined). Accordingly, the book moves from the concept of a gap in coverage (access) to a gap in depth (quality of access).

Chapter III presents the results of efforts to measure quantitatively the impact of ICT on economic growth and productivity, employing different perspectives. First, growth accounting breaks down the contributions of capital and labour as productive factors. Second, an evolutionary perspective examines changing labour productivity. Despite their methodological differences, the various elements explored in this chapter point to the same conclusion: the evolution of the ICT paradigm has a positive impact on economic dynamics in Latin America and the Caribbean, and this can be increased by progress in a broad array of complementary economic, social and institutional variables, such as developments in technology and innovation, changes in the productive structures of specific sectors by more intensive incorporation of knowledge in the production of goods and services, and strengthening of economic and social institutions. The succeeding chapters return repeatedly to the need for developing these complementary variables as a prerequisite to taking full advantage of the digital paradigm.

The remaining three parts of the book are informed by this evolutionary framework, in which the technological variables and complementarities resulting from the co-evolution of technological, economic, social and institutional structures play a major role.

Part two, entitled “The Development of ICT”, focuses on the production of ICT-related goods and services in the region. Chapters IV and V analyse the manufacture of hardware (i.e., telecommunications and IT equipment, and consumer electronics), the software industry and related services, and the activities of telecommunications providers. The content of these chapters reflects the diversity of the region’s productive structures and economic development. Hardware production is concentrated almost exclusively in the larger countries that have sizable domestic markets or that serve as platforms for export to the developed world. Software production and related services are somewhat less concentrated and have a significant presence in smaller countries with elevated educational levels. Unlike the larger countries in the region, these smaller ones often concentrate on exports. At the same time, the telecommunications sector includes markets with a high concentration of ownership or control in services such as fixed and mobile telephony, especially at the subnational level.

The analysis of these three major ICT-related goods and services sectors in the region shows that they play rather differing roles in the global economy. The region’s hardware production sector is very limited, with the exception of Brazil's production for the domestic market and Mexico's production for export to the United States and Canada —and in both of these cases the role of local components is minimal. National capacities are more developed in the software field, although in all cases the leading players are large transnational firms that have come into the region for the purpose of supplying the local market. In contrast with these low levels of hardware and software production —and particularly in the first of these two categories— the region's major telecommunications providers operate at the regional or even global level. The shortcomings of their services (e.g., in terms of cost and access) are, to only a minor extent, due to the limitations of the firms themselves, and can be attributed more generally to the deficiencies and ineffectiveness of the regulatory frameworks in which they operate. Chapter VI examines these frameworks. The analysis focuses on the elements needed to increase regulatory agencies' independence and institutional capacities, on their need to adapt to the changes demanded by technological convergence, and on the conditions conducive to pursuing multiple objectives, e.g., efficient resource allocation, network expansion and the incorporation of social goals through measures such as providing access to marginalized, poor or geographically isolated populations. Concluding the section, chapter VII describes the debate on intellectual property rights, with a focus on open-source software and technological means of protection. Costs for the region's users and firms will be affected by the results of this debate and the strategies adopted.

Having examined ICT production, the book turns, in the third section, to "ICT for Development", exploring advances in using these technologies in broad areas such as education, public administration, business, disaster management and health (chapters VIII through XI). The level of development in these fields varies markedly from field to field and from country to country. With regard to differences between sectors, it is notable that although electronic government (e-government) has advanced significantly in terms of tax collection, procurement and national security, electronic advances are only barely beginning to be used in the health field, particularly in the essential areas of interoperability and user interfaces —issues that go far beyond simply pioneering technology for the most advanced healthcare venues. There are also notable differences between countries. While some are leaders in e-government, even at the world level, others —in almost all cases, the less developed countries— still lack efficient public e-procurement systems. Despite these disparities, the gaps in ICT access and use are smaller than those present in ICT production.

The two chapters that make up the fourth section of the book examine issues directly associated with public policy. Chapter XII analyses and assesses the repercussions —both national and regional— of the countries' ICT policies. This consideration of national and regional repercussions complements the examination of sectoral policies presented in the foregoing two sections, and places the policies within the broader context in which they are deployed, for example, national development plans.

Lastly, chapter XIII presents ECLAC recommendations, based on the prior examination of sectoral, national and regional policies. Beyond the specifics of the advances and problems examined in the previous chapters, seven general issues —with corresponding recommendations— emerge. First, there are complementarities that must be developed to make real the potential impact of ICT on economic performance and social integration. Second, the capacity to develop software and related services must be increased in such a way as to meet the growing digital needs of the region's economic and social organizations. Third, the objectives of efficiency and universal access imposed on regulatory agencies must be balanced, while at the same time strengthening the independence and technical capacities of the responsible agencies. Fourth, there must be further development and strengthening of resource coordination and of initiatives already in place in the countries, so as to create synergies and avoid duplications, asynchronies and even incompatibility of objectives. Fifth, the different stages of progress in ICT deployment and use in the different countries must be taken into account in seeking to continue, consolidate and launch intraregional cooperation initiatives. Sixth, policy leadership must be shifted from actors interested in ICT per se to those responsible for the areas that employ the technologies. Seventh, the instruments and institutions responsible for policy implementation must be strengthened, and the wide gap between plans and accomplishments, between declarations and realities, must be narrowed given the unprecedented speed at which technology advances in this field.

Part one

The digital paradigm: its diffusion and impact

Chapter I

Technological revolution and digital convergence

A. The digital paradigm and the information society

Technologically-mediated information has played a fundamental role throughout human history, and the possibilities of sharing information using man-made tools continue to astonish humanity. The exchange of information defines human behaviour. Indeed, linguists and biologists maintain that the storage of information in various formats —such as art, language and tools— was the driving force that transformed human beings into the planet's dominant species.

While in no way denying the long-standing importance of information and communication for human life and existence, this book's approach to the concept focuses on the most recent socio-economic transformations, which have been induced by a pervasive technological revolution. In the information society, the capture, storage, communication and computing of information have become the most important socioeconomic activities.[1] As Wiener (1948) states, "society can only be understood through a study of the messages and the communication facilities which belong to it, and … in the future, development of these messages and communication facilities on whose future development communication between man and machine,

[1] This book uses the terms information society and information societies, although there is a tendency to use the singular for the analytical concept, and the plural in referring to dynamics within or among countries, since it is explicitly recognized that there is no single model that all must, or wish to, apply.

between machine and man, and among machines themselves, will have an ever greater importance".

The concept of the information society originated with Machlup (1962), who concluded that more people were dedicated to the management and processing of information than to physical tasks. Other authors, such as Drucker (1969) and Bell (1973), stated that knowledge would be the principal factor in creating wealth in the society of the future. Masuda (1981) also regarded information as the principal component of this wealth creation and the primary technological prerequisite to it. As the titles of these works and others reflect, the concept of the information society was developed in theoretical thinking about innovation and long historical cycles, i.e., in the framework of an evolutionary approach to development.

Various concepts are invoked to define the nature of innovative activity (paradigms, regimes, trajectories, major features, indicators and dominant technological designs). All of these attempts to take account of the common features of technical change and their complementarity with other economic, social and institutional factors (Cimoli and Dosi, 1995), and all share three features that are present in information and communications technologies (ICT).

First, any satisfactory description of what technology is and how it changes must address the fact that all productive activity incorporates specific forms of knowledge. Technology cannot be reduced to the sets of designs or plans that define products. On the contrary, it consists of problem-solving activities that incorporate knowledge in the form of individual or institutional processes. It could be said that a technology implements algorithms, which are effective methods for solving problems using a finite sequence of instructions

Second, paradigms are defined on the basis of "general purpose technologies" that improve over time, and have a wide variety of different applications in social, cultural and economic conduct. Each paradigm refers to at least one "general purpose technology" that leads the technological process through continuous technical improvements, driven by an almost unlimited supply of the new technology and dramatic price reductions as a result of the constant breakthroughs made through research and development.

Third, one feature of technological change is the local and cumulative nature of learning —"local" in the sense that the new techniques explored and developed are likely to be close to existing techniques, and "cumulative" in the sense that any level of technological development is the result of past experience with production and innovation and, thus, of a sequence of solutions to specific problems. Although this cumulation is not linear and disruptive innovations are possible, there is an undeniable path dependence that contributes to the process.

In the ICT context, these characteristics are easily recognizable, since the technologies involve activities designed to solve specific problems: the capture, processing, transfer and storage of information.

Any technological paradigm is associated with a progressive exploitation of opportunities for innovation, and these opportunities can be measured in terms of the fundamental technical changes of the paradigm's characteristic "general purpose technology". Thus, the technical and physical characteristics of the family of technologies that includes semiconductors, microprocessors, hard disc drives, storage systems and graphic and visual devices, which are analysed below, define the major parameters for the development and expansion of the ICT paradigm.

The "technological paradigm" concept is complemented by the broader notion of a "techno-economic" regime or paradigm that reflects an evolution involving the confluence of technological change and economic development. Table I.1 shows the five technological revolutions that occurred between 1770 and 2000, and the corresponding techno-economic paradigms, as well as the characteristics of the industries and infrastructures on which they were based (Freeman and Pérez, 1988, Castaldi and Dosi, 2007).

The usefulness of techno-economic paradigms lies in the fact that they explain the effects of technological revolutions, by identifying a basic set of factors that define the particular characteristics of a system of innovation in a given country or region (Cimoli and Dosi, 1995). In this context, economies are described in terms of their specific modalities of institutional governance, which include specific policies, standards, incentives and constraints.[2]

Each techno-economic paradigm requires a new infrastructure to disseminate the emerging technologies through the economic system, while industry reorients its dominant features to the processes that permit the manufacture and distribution of new products. Each paradigm contains common factors that affect relative costs, supply, dissemination of new technologies, and organization of productive processes (Dosi, 1984). These include: "(i) relative cost perceived as low and declining;

[2] Metcalfe (1995) defines a system of innovation as "the set of institutions that contribute jointly and individually to developing and disseminating new technologies, and that provide a framework within which governments create and implement policy to influence the innovation process".

(ii) seemingly unlimited supply; (iii) potentially widespread dissemination in the productive sphere; and (iv) a great capacity for reducing costs and changing the quality of capital goods, labour and products through technical and organizational innovation" (Pérez, 1985).

Table I.1
PARADIGMS, INDUSTRIES AND INFRASTRUCTURES OF THE TECHNOLOGICAL REVOLUTIONS

Technological revolution	New or redefined infrastructures	New or redefined technologies and sectors
First 1771+ "Industrial Revolution." Great Britain.	Canals and waterways. Turnpikes. Hydraulic energy (greatly improved waterwheels).	Mechanization of the cotton industry. Forged iron. Machinery.
Second 1829+ The steam and railroad age. Great Britain, extending to the European continent and the United States.	Railroads (use of steam-based machinery). Universal postal service. Telegraph (principally domestic, across railways). Large ports, warehouses and sailing vessels worldwide. Natural gas in cities.	Steam engines and machinery (made of iron and operated with coal). Iron and coal mining (already essential for growth). Railroad construction. Production of rolling stock. Steam energy for various industries (including textiles).
Third 1875+ The steel age. Electricity and heavy engineering. United States and Germany surpass Great Britain.	Worldwide shipping in fast steel steamships (use of Suez Canal). Worldwide railroads (use of standard-size rails and steel bolts. Large bridges and tunnels. Global telegraph. Telephony (principally national) Electrical networks (for lighting and industry).	Inexpensive steel (especially Bessemer). Full development of steam engine for steel steamships. Heavy chemical industry and civil engineering. Electrical equipment industry. Copper and cables. Canned and bottled foods. Paper and packaging.
Fourth 1908+ The oil age. Automobiles and mass production in the United States, extending to Western Europe.	Road networks, highways, ports and airports. Pipeline networks. Universal electricity (industrial and residential). Worldwide wired and wireless analogue telecommunications (telephone, telex, cable).	Mass production of automobiles. Oil and oil fuels. Petrochemicals (synthetic). Internal combustion engines for automobiles, transport, tractors, airplanes, tanks and electricity. Electrical household appliances. Refrigerated and frozen foods.
Fifth Early 1970s+ Information and telecommunications age. United States, extending first to Europe and Asia, then becoming global.	Worldwide digital telecommunications (cable, fibre optic, radio, satellite). Internet, e-mail and other electronic services. Multiple-use and flexible-use electronic networks. High-speed transportation connections (land, air, water).	Information Revolution. Inexpensive microelectronics. Computers and software. Telecommunications. Control instruments. Biotechnology aided by computers and new materials.

Source: Based on Carlota Pérez, *Technological Revolutions and Financial Capital*, Cheltenham, Edward Elgar, 2002.

These common factors are present in the ICT paradigm, whose infrastructure enables the proliferation of intangible information goods and services. The fall of prices and increasing capacity of microelectronic devices, computers, telecommunications equipment and control instruments have been decisive factors in the massive increase in installed information processing capacities around the world. Table I.2. shows sustained annual growth rates of up to 76% over 25 years, which are outstanding, especially when compared to other socio-economic rates of change (for example, annual economic growth rates are typically between 3% and 6%).

Table I.2
INCREASE IN INSTALLED CAPACITIES AND REDUCTIONS IN PRICES ON THE ICT TECHNOLOGICAL FRONTIER, BETWEEN 1980 AND 2005

	Installed capacity per inhabitant			Technological frontier per dollars		
Basic function	1980	2005	Factor of increase between 1980 and 2005	1980	2005	Factor of increase between 1980 and 2005
Telecommunications transmission (kilobit/second)	4.6	193	42	7 x 10-4 (Apple II modem)	48 (WiMax)	68 571
Computation (millions of computations/second)	4 x 10-4	649	1 622 500	6,890 (IBM4341)	1 x 1010 (Precision Workstation 690)	1 450 000
Storage (MB)	0.015	30 658	2 043 867	0.0032 (5 MB hard disc drive)	2,000 (hard disc)	625 000

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on M. Hilbert, “How much does it cost to close the digital divide in Latin America and the Caribbean?”, Santiago, Chile, 2008, unpublished.

Technological learning is disseminated through collective experience and socioeconomic structures. Microeconomically, the technologies involved are largely incorporated into specific institutions (mainly firms, but also other organizational entities, such as municipalities, hospitals and schools) whose characteristics, decision-making standards, capacities and behaviours are fundamental in defining the direction and pace of technical progress (Cimoli and Dosi, 1995). For their part, the producers and users of the new technologies are part of relationship networks that also include other institutional actors, ranging from government agencies to universities, research laboratories and civil society organizations (Freeman, 1994 and 2001; Pérez, 2002). The contributions of these institutions are complementary, although their motivations and levels of commitment to disseminating the knowledge created can vary considerably.

In the process by which new techno-economic paradigms are established, technology is closely intertwined with the social sphere: “Each technological revolution, received at first as a totally new set of opportunities, is also perceived as a threat to the established way of doing things in firms, institutions and society in general. The new techno-economic paradigm is gradually established as a new form of common sense for acting effectively in any area. Although competitive forces, profit seeking and pressures to survive contribute to spreading changes in the economy, the broadest social and institutional spheres, which are also in need of change, suffer from the inertia generated by routine, ideology and established interests… Thus, the first 20 or 30 years of dissemination of each technological revolution increase the disarticulation between the economy and the social and normative systems” (Pérez, 2002, p. 26). This incessant dynamic is the nature of innovation and has famously been coined “creative destruction” by Joseph Schumpeter.

Technological revolutions develop through a prolonged process of dissemination, since they involve the co-evolution and co-adaptation of new technologies (Rogers, 2003), forms of organization, institutions and consumption patterns: “Ultimately, the replacement of an entrenched techno-economic regime implies profound changes, the revolutionary nature of which is seen more in the breadth and depth of the conglomerates where innovation emerges than in the pace with which they succeed in exercising their influence. Precisely because of the breadth and depth of the changes involved, the detailed and positive creation of a new ‘general use’ technology requires generating and coordinating multiple tangible and intangible complementary elements: new equipment and physical plant, new types of work techniques, new forms of organization, new forms of legal ownership, new regulatory structures, new preferences in terms of habits of thinking and behaviour.” (David, 2001, p. 53).

B. Trajectories of the digital paradigm

The emergence of the digital paradigm is identified with the introduction of the microprocessor in the early 1970s (Freeman and Louça, 2001). In this case, the trigger for change was an innovation with systemic effects on a particular type of information process: the use of an integrated circuit of transistors on a single semiconductor component as a means of handling information. The scientific paradigm that led to this innovation far antedated the microprocessor, and was characterized by the introduction of scientific notion of the binary digit, or bit, as the method of coding information (Shannon, 1948).

The Second World War marked the beginning of a recognition, in various academic circles, of the importance of analysing information scientifically. This took place in the context of deciphering codes and executing logistical operations. Scientific research and development centred on “the massive task of making more accessible our bewildering store of knowledge” (Bush, 1945). Well-known scientists began to state publicly that technology, properly developed, would permit human beings to manage and “master ancestral knowledge”. These statements were based on the engineering achievements that occurred from the 1930s to the 1960s, which were closely associated with names like Shannon, Turing, von Neumann and Wiener.

1. The bit: foundation of the digital age

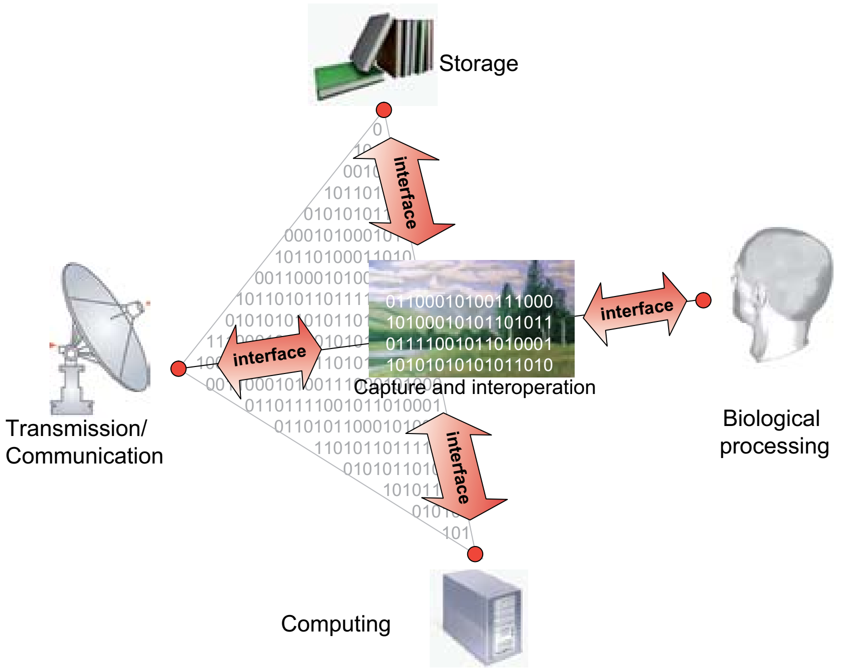
In the digital paradigm, technological solutions are developed to adapt, compute, transmit and store information. The starting point for this process involved distinguishing the two components of “information”: meaning (semantics) and signifier (the symbols that represent the meaning). Initially, engineers concentrated on the symbols, taking up the analysis of meaning only very recently (see, for example, Feigenbaum et. al, 2007).

The basic symbol of information is the bit, or binary digit, which, as Shannon (1948) showed, is the most effective way of representing information. The bit was the engine that drove the convergence of ICT, a process in which radio, television, fixed and mobile telephony and the Internet tend to merge into a single digital network.

The conversion of information into bits makes it possible to execute four basic operations within a single system: (i) capture and translation, i.e., the reproduction of information in a format different from the original; (ii) transmission, i.e., reproducing at one point a message selected at another; (iii) computation, i.e., managing information according to a set procedure; and (iv) storage in a memory (see figure I.1). These functions are closely related and interdependent, and make up the technological system known as information and communications technologies, or ICT. The fifth component which, of course, is fundamental to a complete scheme of the information and communication processes consists of the human brain and its functions.

Below is an analysis of the four operations cited earlier, along with their corresponding technological trajectories, beginning in each case with a summary of the relevant history and theory, and then examining some of the most important repercussions of the operation/trajectory in question. A final section examines the impact of the convergence of the different elements that make up the ICT system.

Figure I.1
BASIC INFORMATION TECHNOLOGY OPERATIONS



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Hilbert and Cairó, 2008.

2. Capture and translation

The process begins with capturing information and translating it from its original format (which could be audio, visual or even tactile) into the digital format, which is the most efficient way to represent information (since it uses the most basic alphabet: a binary yes-no decision). This translation function is a prerequisite to working with the same information in different systems. In other words, in order to process the information, it must first be captured and then adapted to an appropriate format (which, in the digital paradigm, means it must be translated into binary code). The information can then be used in any one of three different operations or a combination of them: storage, communication or computation. In general, any capture and translation of information, and its representation in a technological format, is based on information interoperability, that is to say, it is an adaptation that involves sensors,[3] interfaces and translators.

[3] A sensor is a device that detects or measures manifestations of physical qualities or phenomena, such as energy, velocity, acceleration and light, and converts them to analogue or digital signals. In reality, it is a type of adaptor that transforms the magnitude of what is measured into a quantifiable signal.

Technological progress in this area has led to a dizzying increase in the volume of information captured. It is estimated that the world produced 1.5 hexabytes of information (1,500 million gigabytes, or 1.5 x 10^{18} bytes) in 1999.[4] By 2000, this figure increased to 5 exabytes, and by 2008 it had grown to 486 exabytes —approximately 7 billion times the information contained in all of the books written throughout history. This increase was possible thanks to innovations in information capture, storage, exchange and computation.

Among the most important phenomena for assessing the economic impact of different interfaces are the so-called "lock-in" effect and switching costs, as analysed, for example, by Shapiro and Varian (1999). Once a user is accustomed to a given interface and its subsequent versions, a change of interface has a cost, in large part because of the role of habit. Switching costs affect technological evolution and strategies, which are the key to success in markets such as the software market, especially in the case of applications with functions similar to those of operating systems.

Currently, interface research and design is aimed principally at making them more intuitive and user-friendly, focusing, among other things, on the development of voice and dialogue interfaces, voice recognition and recognition of other human manifestations (gestures, movements), computer-aided vision and cerebral interfaces.

3. Communication

Various technological solutions have been used to transmit information, entailing various types of problems. The first problem was to find the best code for transmitting different messages; here, information was shown to be very efficiently adaptable to binary code. A second problem was finding a technological solution to better modulate the symbols, something that can be accomplished by means of electrical currents, light waves, radio waves, etc. A third problem was how to avoid or reduce "noise" in communications.[5] Rather than simply filtering it, mechanisms based on sophisticated methods were developed to control and optimize channel capacity. In essence, the whole problem of efficient and error-free communication turns out to be that of removing from messages the somewhat inefficient redundancy which they have (compress the message) and then adding redundancy of the right sort (a kind of feedback) in order

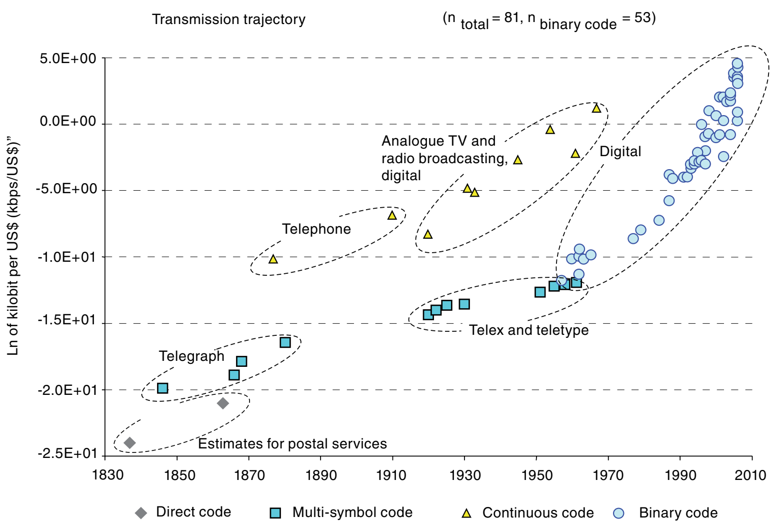
4 See: http://www.emc.com/digital_universe, http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/, http://www2.sims.berkeley.edu/research/projects/how-much-info/.

5 "Noise" refers to the uncertainty caused by the imperfections of instruments and observers participating in any measurement.

to allow correction of errors made in transmission (for an understandable and eloquent introduction to information theory see Pierce, 1980).

Simple ideas such as these led to the incorporation of new features into information processes. The resulting vast increase in the performance-cost ratio of transmission led to the reorganization of societies and economies in the course of a few decades (see figure I.2). For example, the new methods of transmitting data make it possible to manage the time-space relationship of information flows, which is now limited only by the capacity of the processing medium (its channel capacity) and not by distance or speed of transmission (as electromagnetic radio waves or optical signals already travel at the speed of light). It therefore possible to transmit information in real time over vast distances, greatly increasing the speed of and scope for information exchange. Thus, it has been said that the spread of information and digital products and services has led to "the death of distance" (Cairncross, 1995), a phenomenon present in activities as different as those involving purchases, financial transactions, voting, music, films, games, and many other digitizable activities.

Figure I.2
PERFORMANCE-COST RATIO OF INFORMATION TRANSMISSION



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on M. Hilbert, "How much does it cost to close the digital divide in Latin America and the Caribbean?", Santiago, Chile, 2008, unpublished.

Another feature of digital information exchange relates to the nature of multidirectional networks (Shapiro and Varian, 1999). Unlike unidirectional communications (from one to one or one to many), multidirectional networks allow information to circulate between a number of points simultaneously (from many to many). For example, e-mail and videoconferencing can be used as multidirectional means of communication. Unlike letters written on paper, e-mail messages can be sent from one to one or many to one, and, thanks to the non-rival nature of bits, also from one to many or many to many. It is both practical and efficient to use these four types of channels simultaneously. Most importantly, however, for the first time in the history of communications, a single, harmonized medium serves all of these different purposes, removing the need to switch between media (see table I.3).

Table I.3
COMMUNICATION VARIANTS

	From one	From many
To one	Analogue or digital telephony, personal letter	Voting, applause, survey, auction
To many	Press, radio, TV, lecture, direct mail campaigns, communication correspondence	Meetings, chat, electronic fora, software for groups, e-mail lists, audio and videoconferencing

Source: The authors.

The architecture of many-to-many communication can take the form of a star, chain, ring or network, and these multidirectional connections are subject to external factors. The greater the number of users connected, the greater the network's value to each participant (Shapiro and Varian, 1999; Kelly, 2005). The architecture of the network affects the benefit that the information represents for a user, and it increases as the number of users using it increases. Hence the increased value of a network as each new participant is added. To be precise, it is a function of x^2-x, where x is the number of participants. Thus, the fundamental objective of commercial firms operating on the Internet is to increase the number of clients using their networks.[6]

Since the early 1990s, telecommunications progress has been characterized by two trends: (i) wireless mobile telephony; and (ii) data transmission via the Internet. From the point of view of network technology, convergence has involved two complementary movements: on one hand, the convergence of transmission services involving voice, data and images, and on the other the convergence of fixed and mobile networks. The

6 The fact that firms such as Skype and YouTube have market values in billions of dollars is not due to the technology that they use to provide their services, but exclusively to the magnitudes of their user bases. The presence of network externalities increases their value in a manner more than proportional to their number of users.

technical implications of these innovations lead to technological change and provoke radical changes in network architectures, in operational protocols and in the integration of the different network functionalities.

Convergence involves major investments to upgrade existing networks or install new ones, such as "next generation" networks (NGN),[7] which are based entirely on Internet protocol (IP). This concept refers to architecture in which all services can be provided through a single packet-switching network. A horizontal consolidation of this type provides advantages such as reduced operating and maintenance costs, convergence of different services and networks, and implementation of new combined services. A next generation network must satisfy traditional networks' criteria for reliability, availability, quality and capacity.

4. Computing

Shannon also played an important role in research on the processing and transforming of binary format information, by showing in his Master's thesis that Boolean algebra and binary arithmetic could be used to simplify electromagnetic switching systems in telephone switchboard consoles. He then inverted the concept to show that it was equally possible to use these switching systems to solve problems in Boolean algebra (Shannon, 1937). This opened the door to applying the properties of electrical switches to logical exercises.

In the same year that Shannon showed how to implement logic gates in electromechanical devices, Turing (1937) defined the sequence in which such gates should be aligned, and analysed the possibility of an "effective procedure", i.e., an algorithm or detailed list of instructions, each of which stipulates exactly what operation is to be carried out next. For this purpose, he created the model of a machine that could compute information, the so-called "Turing machine". The Turing machine can process abstract symbols which, despite their simplicity, can be adapted to simulate the logic of any computer built. The list of instructions has a beginning and end, and uses an algorithm to tell the machine exactly what to do in each situation and

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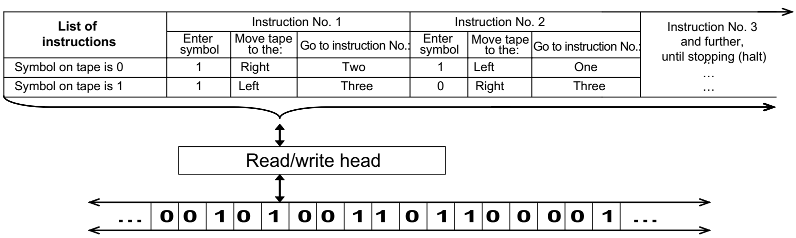
[7] The International Telecommunications Union (ITU) (2004) defines an NGN as a packet switched network designed to provide services including telecommunications, and that has the ability to function with multiple broadband transport technologies with quality-of-service mechanisms, and where the functions related to the service are independent of the low-level transport technologies. In addition, it must offer users unrestricted access to different service providers. It is important to emphasize the difference between the Internet and an NGN network. Although both can use IP protocol as an element to agglutinate services, the network is transparent in the Internet model, and services are provided through devices connected to the end points. In an NGN network, on the other hand, the service providers and network provider control access to the network's services and resources, for which users can be charged. In exchange for this controlled environment, users obtain better quality of service and unique authentication (Knightson and others, 2005).

for each symbol, until it reaches the point where it is to stop (see figure I.3). The ground-breaking nature of Turing's contribution consists in the fact that he showed that any kind of information-processing device requires an interface to capture (read) and display (write) information, a temporary storage unit to back up information and a unit that stores instructions, as well as communication channels to transfer information among all of these and the ability to perform any kind of computation (information manipulation) on the basis of them. Our "four basic information operations" from figure I.1 are therefore really only three. What we commonly refer to as "computation" is essentially a guided process of storage and communication inside a system known as a computer (or Turing machine). Given the emergent properties of such a system, we will nevertheless treat "computers" as standalone subsystems of the ICT family. In other words, what is generally referred to as a "computer" is essentially a subsystem of guided communication and storage processes (within the computer), which are embedded into higher level communication and storage processes (between "computers"). In this sense, the entire "Internet" of computers could be seen as one gigantic "computer system", which constantly stores and communicates information according to (more or less defined) processes.

Figure I.3
GRAPHIC REPRESENTATION OF A TURING MACHINE



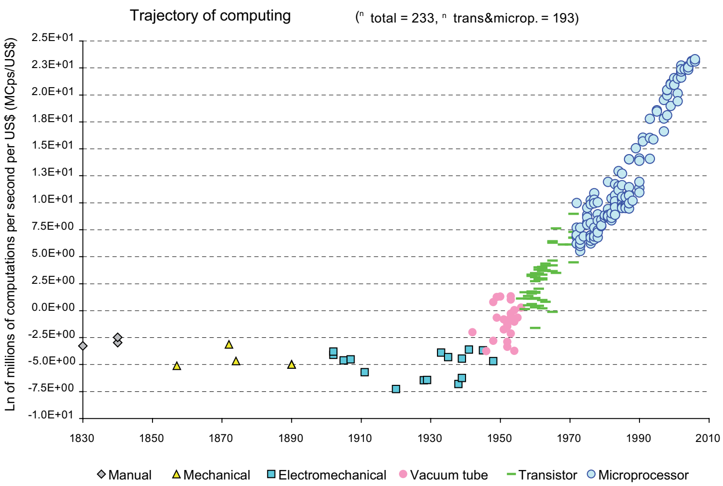
Source: The authors.

Increased computing efficiency has been and is one of the principal driving forces behind the progress in ICT. The exponential advance of the technological paradigm of the microprocessor is characterized by what is known as Moore's law,[8] which has proven to be one of the most durable in the history of technological development (see figure I.4). The key to this trajectory of innovation continues to lie in a process of structural innovation: miniaturization. Although this model of ongoing improvement of the technological system has been successful for over

8 In 1965, the co-founder of Intel, Gordon Moore, suggested that the number of transistors in a chip would double every two years. The result was an exponential trajectory of innovation.

40 years, it will soon reach its end. As Moore himself indicated, "as to dimensions, it may be seen that we are approaching the size of the atom, which is a fundamental barrier, but two or three generations of microprocessors will pass before we get that far" (Dubash, 2005). Around 2019, the layers of a microprocessor should be no more than a few atoms thick, which would invalidate the traditional meaning of Moore's law. While some analysts maintain that this will represent the end of the exponential growth of technological progress in computing, others point out that, with any technology, the exhaustion of one trajectory (in this case, the trajectory based on the silicon microprocessor) does not necessarily mean the end of a broader paradigm.

Figure I.4
CHANGES IN COMPUTER PERFORMANCE
(Logarithm of millions of computations per second, in dollars)



Source: Hilbert and Cairo, 2008, based on W.D. Nordhaus, "An Economic History of Computing", Yale University Press, 2006.

Considering these precedents, it is to be expected that new solutions will emerge to continue improving the artificial processing of information. The complexity of the tension between technology push (research and development) and pull (market demand) makes it impossible to predict what dominant technology will replace the current paradigm, although various possibilities may be glimpsed on the horizon. One of the options for ensuring continued increasing performance in computing is three-dimensional silicon processors. Another possibility is to incorporate multiple molecular or DNA-based circuits. In addition, quantum computing offers the possibility of replacing the bit by a three-level quantum bit, or qubit, which would provide several-fold increases in the processing capacity of various devices. All of these solutions involve the need for substantial new innovations in computing, as the end of the long and gradual learning curve based on silicon microprocessors approaches. It is highly probable that innovations in nanotechnology, molecular technology, genetic technology and quantum technology will require an adaptation of systems and lead to a new hardware paradigm.

In addition to the hardware challenge, there is the software challenge. This calls for more in-depth study than it has so far received, and implies an approach complementary to the traditional approach to artificial intelligence, which is based on programmed intelligence and processing speed, as well as on learning mechanisms. During recent decades, the dominating software paradigm was based on the idea of feeding instructions into a static program, which would then be executed on demand. New learning algorithms are more dynamic and learn "on the go". The initial program might be quite basic, but has the potential to identify patterns and learn to do things that would have been almost impossible to program manually beforehand. Such an alternative approach could even lead to the conclusion that it is no longer necessary to restrict computers to a "von Neumann architecture", as well as to the possibility (among others) of developing extensive and powerful neural networks.[9]

5. Storage

Paper continues to be one of the principal media used for storing information, but it is clearly at a disadvantage compared to modern magnetic and optical media.

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[9] The versatility of a computer derives from its ability to store instructions and symbols that are processed according to a changeable program, creating what is called "stored program architecture" or "von Neumann architecture" (von Neumann, 1945). The Turing machine —which requires a tape to provide data, save results and store the list of instructions— shows that the memory function is basic to information processing. Without a flexible storage function, a machine ceases to be a universal computer and is merely a device for processing digital signals. This is for example the case of traditional calculators or music- or video-reproduction devices. The hardware structure of most calculators includes the computing functions defined by Turing, but it cannot be changed. It is the design of the communications network inside a calculator that enables calculations. The instructions on how to add are not stored in a storage unit; they are encoded in the "guts" of the calculator. This is where a universal Turing machine, such as von Neumann's design, is different: it has a central storage for instructions. What we call "computers" today are based on this type of architecture, the definition of which is framed by the limits of the dominant paradigm. Neural networks, on the other hand, are an example of a paradigm that does not follow the von Neumann scheme.

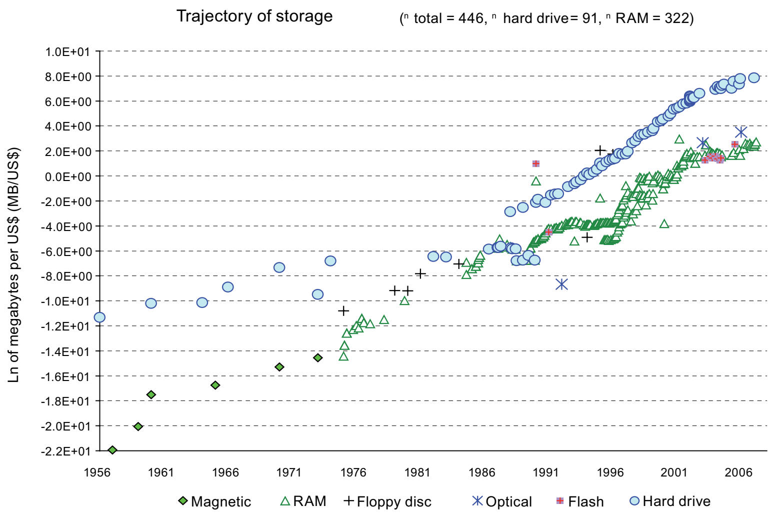
To date, there is no optimal and universal storage medium, since all of the available media have their advantages and disadvantages. Thus, different computer systems use different storage media, each with its own purpose. The processing and storage of information are closely related. In a Turing machine, the principal storage unit, which provides the basic support functions, is equivalent to the scratch paper used in the different stages of a manual calculation. It is a temporary memory and is directly connected to the processing unit. The time that the processing unit takes to read or write information, called storage latency, is decisive for computing speed. In addition to assistance from the main memory, the computing process requires registers that provide the data needed to execute an instruction at a given moment. A diagram of the Turing machine represents these as a list of instructions. Briefly stated, executing a computation requires two basic types of storage: the main memory, i.e., the "notepad" or scratch paper on which intermediate results are stored, and the list of instructions. Innovations have been introduced in both types of storage (e.g., cache memories and multi-level caches) to increase the recording function of processors and of random access memory (RAM), which can arbitrarily select a point in the main memory to read or record a symbol.

In addition to the type of memory that functions as support for the computing process, there are types of memory that save information for later use. Although magnetic technology has been the most widely used solution in storage devices (especially in hard drives), optical technology is coming under increasing consideration. Figure I.5 shows the performance of both types of storage (primary, such as RAM, and secondary, such as hard drives) and their marked growth in the last decades.

One of the advantages of storing information in digital form is that the bits can be applied to different "non rival" and non-mutually exclusive uses since they are not "used up" during consumption. Digital information can always be reread, divided, cut up, mixed or redistributed, but not consumed. Unlike other consumer items, such as apples or cars, digital information can be re-used by many other users without limiting the usage of the original consumer which creates important effects in terms of scale. The cost of producing digital information (e.g., a piece of software or a film) may be high, but it can be duplicated through simple "copy and paste" instructions. Thus, the cost of digital information is almost totally determined by its fixed production costs, while its variable unit costs are close to nil.

Since bits can move around the world at the speed of light, digital information does not experience delays. In addition to providing practically unlimited storage of data, this creates a new way of managing time, since the information stored can be transmitted, processed or edited with any desired flexibility. The sharing of information is possible not only in real time, but also asynchronically, for example, when stored on a platform with open access 24 hours a day. Thus, it combines the advantages of traditional telecommunications with those of the storage and distribution of information of printed material in traditional libraries. In this sense, ICT give rise to new forms of accumulation, selective processing and exchange of information.

Figure I.5
CHANGES IN PERFORMANCE AND STORAGE COSTS
(Logarithm of megabytes, in dollars)



Source: Vasquez and Hilbert, in Hilbert and Cairo, 2008, “Quo vadis TIC”.

Regardless of the material used to store information (magnetic tape, optical material, etc.), the future of information storage depends on network design. The optimal solution would put memory as close as possible to the processor. Considering the high cost of the main memory, however, and the network effects arising from sharing storage space, the growing trend is to use network-based memory. Mass storage based on hard disk technology is known as secondary storage, and external devices with removable databases are known as tertiary storage. Both types can be connected to a computer for access to the large databases or data banks of firms or academic entities through specific networks. In this context, bandwidth becomes decisive, demonstrating once again the interdependence of storage and transmission systems, while the speed with which information is transmitted between the processing unit and the memory becomes the principal constraint on computing capacity. If the bandwidth problem could be overcome, it would no longer be important where on a network information was stored. The non-rival characteristic of the bits could exponentially increase their power, as occurs in well-known peer-to-peer communications such as those initially pioneered by Napster, KaZaa and BitTorrent, and shared external storage arrangements, such as YouTube and Google documents.

6. ICT convergence

Today's system of ICT technology is a convergence of the four trajectories of the digital paradigm centring on the bit. It is the fact that all of the various media use the bit that makes it possible for them to converge and create a broader network. In the economic realm, this results in the convergence of three traditional sectors: communications (telephony, coaxial cable, satellite, wireless devices), computing (computers, software and all kinds of information processing services) and the capture, storage and display of information (including the so-called "content industry", such as publications and entertainment, information) (Tapscott, 1996). Emergent properties are the result, which are notable when the network is analysed at a higher level of abstraction.[10] A computer is an ICT system at a small scale (a Turing machine, consisting of storage and communication operations), while the network is a large-scale ICT system (consisting of storage, communication and lower-level computation systems). The convergence of ICT means that the network becomes the computer. When looked at from a higher level of abstraction, the network becomes a unified multi-level and open-ended information processing system. Some parts of the network store information, others process it locally, while the channels exchange information, which again leads to information processing among the nodes of the network. The network itself becomes a gigantic Turing machine, which does nothing but read, write and store information according to the logic determined by the users and the instructions they issue. This concept is equally applicable to the digitized firm (a network of workers), a totally digital economy (a network of firms) or the information society as a whole. The levels and interconnections between networks (and networks of networks) define the scope of the information processing entity. "In sum, the information technology paradigm does not evolve

[10] At a lower level of abstraction, the term "technological convergence" has at least four meanings: (i) generic: the fusion of the telecommunications, information technology and audiovisual media (communications and broadcasting); (ii) between services: the provision of the same services, applications and content over different networks (triple-pack transmission), as in fixed telephony, television and Internet access, or quadruple-pack, in which cellular telephony is joined with the other three; (iii) between networks: different services on a single network; and (iv) between terminals: different types of terminals permitting access to services.

toward its closures as a system, but toward its openness as a multi-edged network. It is powerful and imposing in its materiality, but adaptive and open-ended in its historical development" (Castells, 2000).

The network has the ability to evolve and adapt to a changing internal and external environment. Hyperlinks, for example, ensure the flexibility and universality of the network. As Berners-Lee (2005) states, "The dream is that the Internet will become a common space in which we communicate by exchanging information. Its universality is essential: a hyperlink can lead to any type of document, whether personal, local or international, published or unpublished." Networks open the door to an unprecedented combination of information and intelligence, both artificial and human, and to connecting computing and thinking power with databases in a dynamic range of hyperlinks, independent of geographical location. While this may occur in a synchronized manner in real time, it may also be asynchronous. The non-rival and non-mutually exclusive characteristic of digital data and network externalities increases the value of the network's content, making the network a reflection of our work, play and social activities.

The exponential value of networked information, along with the efficiency, effectiveness and transparency of digital information, leads to ever more precise representations of reality in virtual space. The network thus becomes a gigantic knowledge algorithm, an effective and versatile process that digitizes ways of doing things, including the digitization of our culture, habits, work, coordination mechanisms and institutions. This establishes the institutional framework for the information society and the omnipresent importance of technology in everyday life and in national development.

C. Conclusions and the future of the digital paradigm

Summing up, during the last decades society at large has started to embrace the new digital tools, which changed forever the way we communicate, coordinate our activities and organize social interactions. The ensuing process of social transformation has been given many names, including the "post-industrial society" (Bell, 1973), the "fifth Kondratiev" (Perez, 1983), the "Information Society" (Webster, 1995), the "digital age" (Negroponte, 1995), the "Network Society" (Castells, 1996), and the "age of Information and Communication Technology (ICT)" (Freeman and Louça, 2001). All of them refer to the same phenomena and the cost-effectiveness of multi-directional information network usage which leads to a distinct mode of development and modernizes social, productive, political and cultural organization. After an extensive and oft-cited analysis, Castells (1998) reaches the conclusion that "the generation of wealth, the exercise of power, and the creation of cultural codes came to depend on the technological capacity of societies and individuals, with information technologies as the core of this capacity."

At the beginning of the Chapter, we saw that ICT is not the first general purpose technology to transform our social and productive organization. Previous examples include electricity and the combustion engine (see table I.1). The later part of the chapter has shown us that table I.1 is just a rough schematization of the respective dominating paradigm and that innovations like the telephone, analogue tape recorders and mechanical calculators paved the way for the digital paradigm. Although humankind has long employed some kind of information and communication technology, it has only been in recent decades that the performance these solutions in per-dollar terms has experienced an annual growth rate of 56%-76% (table I.2). It is this kind of technological progress that converts a general purpose technology into the enabler of a socio-economic paradigm shift.

Four future trends emerge from the analysis presented in this chapter. First, the technological evolution of ICT will continue since there is no reason why the technological progress in adaptation, storage, transmission and processing should slow down any time soon. At the same time that this exponential growth passes decisive points of inflection (such as the current production of more information each year than in the last several millennia), innovation constantly lends greater uncertainty to future developments. Cerebral interfaces, quantum-based communication, the colossal depositories of information about almost everything in existence, and molecular and quantum computing, represent a new generation of ICT and demand an evolutionary vision in policy-making.

Second, while ICT innovations continue to occur, there are expected to be changes in nearly all of the paradigm's technological trajectories, which are approaching the limit of their current pattern of innovation. Thus, today's methods of hardware production face limitations in terms of the miniaturization of silicon devices. Communication has to optimise compression mechanisms for fibre optic channels and the speed of reading and writing from storage devices limits the performance of today's computers. Furthermore, the "brute force" approach to designing software and artificial intelligence (i.e., the large-scale reproduction of similar processes rather than the creation of new ones) has not yielded the hoped-for benefits. Learning algorithms seem to be replacing the traditional notion of completely pre-written software programs.

The third trend has to do with the path from information to knowledge. The first period of the digital age was characterized by an explosive increase in the transmission and storage of information, and the dissemination of related technological solutions. Since the technological options for processing this flow of information did not keep pace with needs, information societies became saturated with an excess of data. The coming period of the digital age will centre on processing information and turning it into knowledge, and technological progress is expected to be based on using cognitive approaches to create intelligence-generating solutions, rather than on producing infrastructure for information transmission and storage. Artificial intelligence has to help us to sort out the overload of information that we have created by enabling us to swim through and not drown in the sea of digital information.

Finally, the current digital paradigm appears to be maturing. It is not yet clear what form the next paradigm might take. While some are calling for a revolution in the energy producing sector, others point to the growing influence of molecular technologies, such as nanotechnology, biotechnology and genetic technology. It seems that these and potentially other upcoming technologies constitute the basis for adding a new and sixth technological revolution to table I.1. This does not mean that the digital paradigm will disappear, just as the previous electricity and mobility paradigms have not disappeared. We use electricity and transportation systems more than ever, and they still advance, but technological progress in these sectors (in terms of improvement per dollar) has slowed down and their sectoral productivity with it. The same destiny awaits the digital paradigm: it will not stop evolving and it will continue to dazzle us with new devices and applications, but it will become a basic building block of our socio-economic fabric, just as electronic household appliances, cars and aeroplanes and other products of previous techno-economic paradigms have done. One crucial element in the evolution of ICT will be the innovations that emerge to integrate new technologies in a symbiotic manner.

Although this scenario presents opportunities for leapfrogging, the fact that waves of technological progress are cumulative means that, to a great extent, future opportunities will be defined based on today's processes (the phenomenon of path dependency). Thus, appropriate management of the digital paradigm today is an indispensable condition for economic and social progress in the long term. Hence the vital importance of the assessment presented in the succeeding chapters of this book regarding the current position —and ongoing progress— of Latin American and Caribbean societies as they move towards the digital age.

Chapter II

The spread of the digital paradigm in the region

As the preceding chapter shows, economic dynamics are increasingly contingent on the rapid progress of science and technology and, increasingly nowadays, on the dominant digital paradigm of information and communications technologies (ICT). Thus, it is particularly important in the context of the present work to analyse the spread of these technologies in Latin America and the Caribbean (LAC). In the countries of the region, these technological trajectories are defined outside the context of their innovation systems, and are therefore considered exogenous (ECLAC, 2005a). Under these conditions, the spread of technological advances is "slow and irregular" and occurs "from the centre towards the periphery", creating a divide between those using the latest technologies and those still excluded from them (Prebisch, 1950).

The nature of the diffusion process of the related innovations resembles a well-known S-curve from centre-periphery, whereby the centre can be characterized as being more developed and the periphery as underdeveloped (e.g., Rogers, 2003). The unfolding of the diffusion processinevitably creates a divide between those that can first benefit from the innovation and those excluded. The logic of the diffusion of innovations follows the logic of social networks (e.g. Valente, 1995), whereas the process can be characterized by the attributes of the nodes of the network (income, educational level, geographic location, etc.), and by the nature of the network ties that link the members of the social network. The combination and interplay of both lead to recognizable diffusion patterns. In the case of

ICT diffusion patterns the term "digital divide" has been coined to describe the fact that some already use digital tools, while others are still deprived of access and the potential opportunities that follow from it.

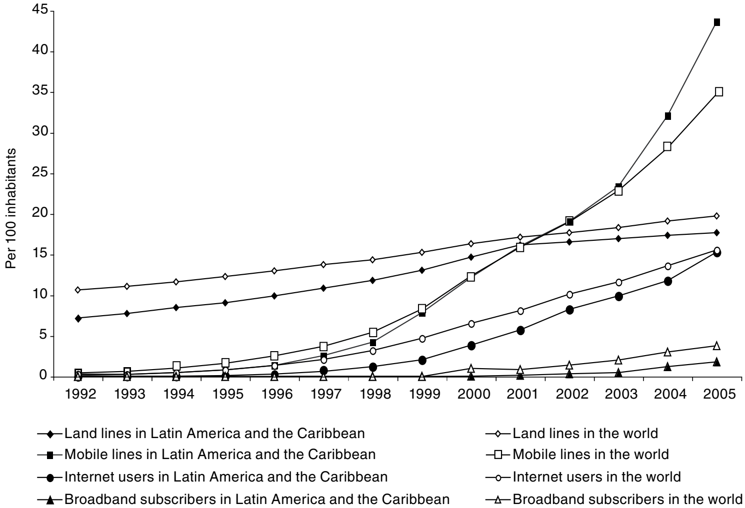
The digital divide has been subject to much debate over the past ten years, starting with research in the United States (NTIA, 1995). The most straightforward definitions of the digital divide focus on a specific group of users (population segments for the domestic digital divide or countries for the international divide), on a particular technology or their combination (Internet, computers, fixed and mobile telephone, etc.) and various stages of adoption. Much ink has been spilled over quarrels about how to conceptualize this last aspect. In his traditional work on the "diffusion of innovations", Rogers (2003) originally distinguished among five stages of adoption: initial exposition to an innovation; persuasion and the development of positive or negative attitude; decision to access or reject the innovation; implementation and actual usage; and confirmation of its utility to continue and improve. Statistical practitioners interested in measuring the nature of the digital divide have merged these stages into three consecutive steps: ICT access, usage and impact (OECD, 2002). It is important to distinguish between these stages. Having access to ICT does not necessarily imply usage and using ICT does not automatically imply an impact. Even if somebody has access, this does not imply that this person makes effective use of the available possibilities. Therefore, the determinants and characteristics of the divide can be assessed in each stage of the adoption process. An analysis of different stages can lead to opposing results. For example, it is often claimed that the access divide among countries is diminishing (Compaine, 2001), while the usage divide, which depends on skills and socio-cultural reorganization, is still widening (van Dijk, 2005).

In the first part of this section, we will look at the diffusion of access to ICT, while we take a preview of usage patterns in the second part of this section. Part III of this book (chapters VIII-XI) goes deeper into the several areas of usage and its specific applications.

A. The international divide: a moving target

Comparing the diffusion of ICT in the region with the rest of the world, it is evident that within the region this is occurring at a slightly slower pace than the world average. The one exception is mobile telephony (figure II.1), which, only slightly more than a decade since its adoption, is used by approximately one out of two inhabitants, making it the most rapidly spreading technology in history. In terms of personal computers and the Internet, the region is close to the world average, although no significant progress is detectable with regard to broadband access. In order to more precisely assess the international disparities in the spread of ICT, the following section compares the capacity of the region's countries in the four basic ICT operations (capture, storage, communication and computing) with that of the Organization for Economic Cooperation and Development (OECD) member countries. It then analyses the pattern of the spread of the digital paradigm throughout the region, examining in depth the nature of the divide at the domestic level (ECLAC, 2003a).

Figure II.1
ACCESS TO ICT IN LATIN AMERICA AND THE REST OF THE WORLD



Source: Author, based on International Telecommunication Union, *World Telecommunications Database*, 2009.

Various studies indicate that the international digital divide is narrowing, and that access in the developing countries is catching up at an unprecedented pace (ITU, 2009; UNCTAD, 2006; WEF/INSEAD, 2006; ITU/UNCTAD, 2007). This often leads to the premature conclusion that the remaining difference would diminish as the markets in the developed countries become saturated. In 1995, the number of Internet users per inhabitant in the OECD member countries was 40 times greater than in the LAC region (4 versus 0.1 users per 100 inhabitants), but had dropped to a factor of only 5 by 2004 (56 versus 11 users per 100 inhabitants). Over a similar period, the mobile telephony divide (cellular phones per inhabitant) between these two groups of countries also declined sharply: from a factor of 14 to a factor of 2.4 (5.5 versus 0.4 cellular phones per 100 inhabitants in 1994; 77 versus 32 in 2004) —a trend that can be expected to eventually eliminate this kind of gap entirely. From this perspective, it would seem that public policy measures to close the digital divide would be unnecessary, because the market seems to take care of the diffusion process.

Although ECLAC in no way minimizes the positive advances of ICT access (e.g., mobile telephony) on individual well-being, it adopts a different perspective, emphasizing the fact that equipment diffusion is not the only dimension of the digital divide. There are also differences in quality[1] —i.e., the capacity to work with information— and this quality gap continues to grow with no visible prospect of changing. Since rapid change and technical innovation always produce qualitative differences, the real digital divide never closes entirely. One hard disk or mobile phone from 1995 is not equal to one from 2005. One computer used by the rich is not automatically equal to one computer used by the poor. Even if both might have the same amount of equipment (by equipment headcount), the "access to digital information" might be very unequal in reality. In this sense, the digital divide is a moving target. While there may be a practical limit to the amount of digital equipment a human being can possess, there is no evidence that there is a limit to the number of bits that a person can process. In the absence of such a limit, the determinant of saturation is the number of bits, not the number of computers.

If one measures the technological capacities of societies to manage information —i.e. their progress towards an information society— one begins to appreciate that premature claims that the digital divide is closing are open to serious question (Hilbert, et al., 2010). This rosy scenario pales considerably when one switches from measuring the amount of equipment to measuring installed capacity per inhabitant for information transmission, processing and storage.[2]

The divide between the LAC countries and the OECD countries is actually increasing with regard to their capacity to exchange information through modern communications networks (Hilbert, et al., 2010). The following estimates of installed capacity take into account the capacity to communicate through fixed and mobile telephone networks, as well as via the Internet, with different combinations of technology and bandwidth capacities being considered for each solution (see figures II.2, II.3 and II.4). In 1996, an average capacity of 62 kibibits per second (Kibps) per inhabitant was available in the OECD countries, compared to the 13 Kibps available to LAC inhabitants (a difference of 49 Kibps), but by 2006 this difference had grown to 577 Kibps (756 versus 179).[3] This expansion in the absolute

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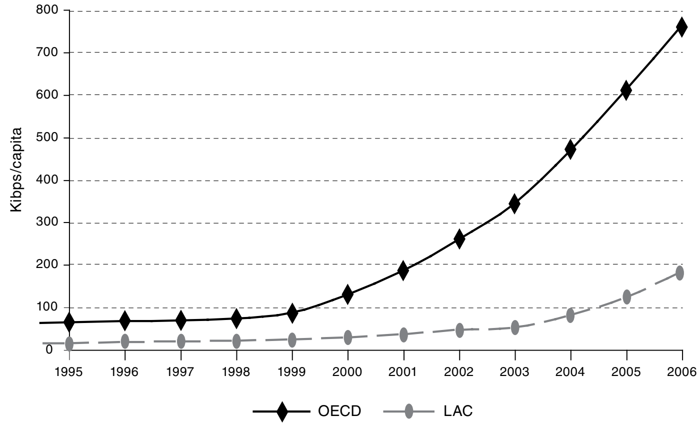
[1] While 256 Kbps is considered synonymous with broadband in the region, levels of 1 Mbps or higher are present in the developed countries, as will be discussed later in the book when examining access within businesses.

[2] This situation could be categorized as a "digital possibilities divide" for members of information societies.

[3] One mebibit (binary megadigit) is a unit of computational information or storage, and is abbreviated as Mibit or Mib. One mebibit = 2^{20} bits = 1,048,576 bits = 1024 kibibits.

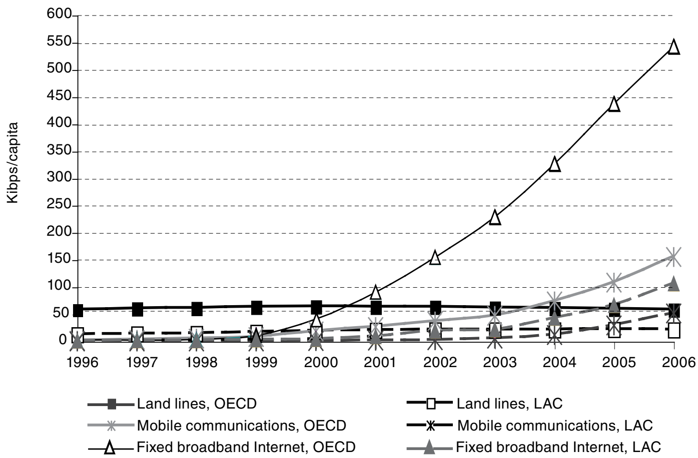
gap was accompanied by a small reduction in the relative gap, since the *ratio* of access between the two groups of countries fell from 4.7 to 4.2.

Figure II.2
CAPACITY TO COMMUNICATE THROUGH FIXED TELEPHONY, MOBILE TELEPHONY AND THE INTERNET
(In kibibits per second [Kibps] per inhabitant)



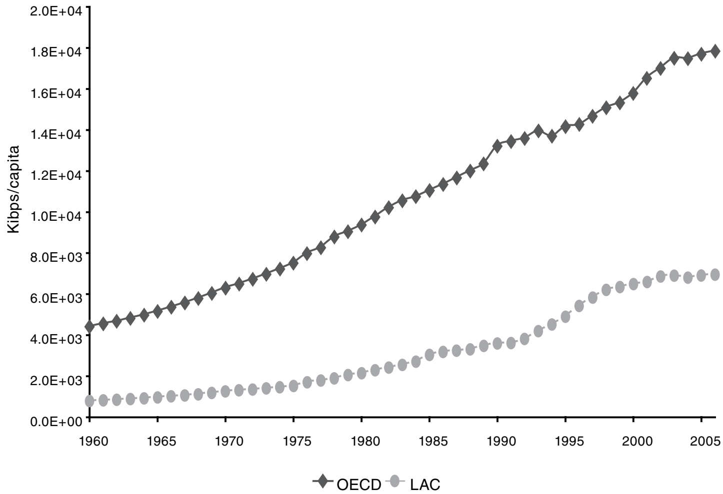
Source: Author, based on Martin Hilbert, Priscila López and Christian Vásquez (2010), "Information Societies or 'ICT equipment societies'? Measuring the digital information processing capacity of a society in bits and bytes", *The Information Society Journal*, Vol. 26, No. 3.

Figure II.3
COMMUNICATION CAPACITY OF DIFFERENT TECHNOLOGIES
(In kibibits per second [Kibps] per inhabitant)



Source: Author, based on Martin Hilbert, Priscila López and Christian Vásquez (2010), "Information Societies or 'ICT equipment societies'? Measuring the digital information processing capacity of a society in bits and bytes", *The Information Society Journal,* Vol. 26, No. 3.

Figure II.4
CAPACITY TO DISSEMINATE INFORMATION THROUGH TERRESTRIAL, SATELLITE AND CABLE BROADCAST MEDIA
(In kibibits per second [Kibps] per inhabitant)



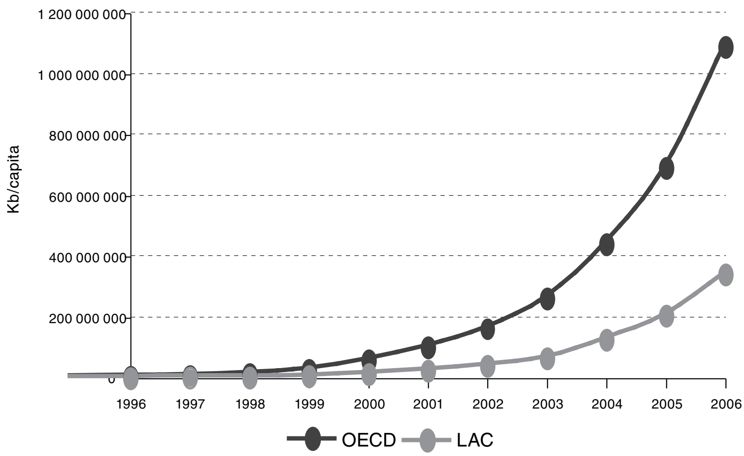
Source: Author, based on Martin Hilbert, Priscila López and Christian Vásquez (2010), "Information Societies or 'ICT equipment societies'? Measuring the digital information processing capacity of a society in bits and bytes", *The Information Society Journal*, Vol. 26, No. 3.

As figure II.3 shows, the dominant form of information exchange in both the OECD countries and Latin America in the first years of the century has been via fixed broadband Internet. Broadband Internet makes much greater capacity available for the communication of multimedia content. In Latin America, broadband access is just starting to expand (see figure below). As can be seen from the figure below, penetration rates are still very low and access is mostly concentrated in metropolitan areas. Access speeds are mainly below 1 MB/s and prices have been identified as the main barrier (CEPAL, 2010).

The gap in the capacity to disseminate information through broadcasting networks has remained relatively stable over the last 40 years, during which time various technological innovations, such as colour and cable television, occurred. In 1960, each inhabitant of the OECD member countries had an average of 3.5 mebibits per second (Mibps) more in reception capacity than did LAC inhabitants (4.3 Mibps versus 0.8 Mibps). The amount of information that could be received by inhabitants of the OECD countries in 1960 did not became available to LAC residents through these types of networks, in terms of average capacity, until 1994, while the region's per capita capacity in 2006 (6,900 Kibps) was equivalent to the capacity available in the OECD in 1973, thus representing a lag of more than three decades. The recent installation of satellite networks and high-capacity cable in the region has helped slow the widening of the relative gap (figure II.4), but the absolute gap nonetheless increased from 8.5 Mibps in 1996 to 10.7 Mibps in 2005 (17.4 Mibps versus 6.7 Mibps).[4]

The capacity to store information on hard discs shows a similar trajectory. In 1996, each inhabitant of the OECD countries could store 3,780 megabits (Mb) more than an inhabitant of LAC (4,552 Mb versus 772 Mb). This difference had increased to 750,000 Mb by 2006 (1,090,000 Mb versus 341,200 Mb) (see figure II.5).

Figure II.5
CAPACITY TO STORE INFORMATION ON HARD DISCS
(In kilobits per inhabitant)



Source: Author, based on Martin Hilbert, Priscila López and Christian Vásquez (2010), "Information Societies or 'ICT equipment societies'? Measuring the digital information processing capacity of a society in bits and bytes", *The Information Society Journal*, Vol. 26, No. 3.

The information-processing divide is also increasing, and the difference is continuing to grow. The "computations per second" indicator[5] reveals that in 1996, the information-processing capacity of an inhabitant

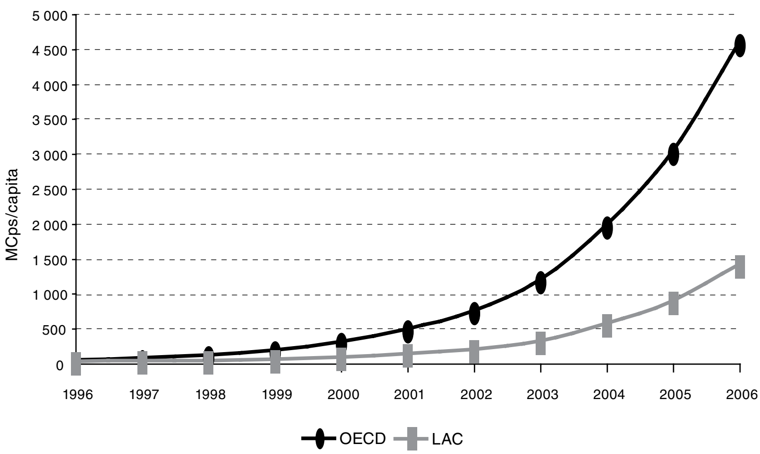
[4] Similar situations arise from the information presented below on per inhabitant information storage and processing capacity. This chapter stresses the importance of the absolute gaps because there are indivisibilities in the handling and use of information that make minimum levels of capacity a prerequisite to effective access to advanced services (e.g., VoIP).

[5] The process of computing information requires operations such as handling information through logic gates, storing it between operations, and writing and reading the stored information. Computing speed is the result of performance combined with all of these activities. There are different indicators to measure the end performance of computers, such as "millions of instructions per second" and SPEC (Standard Performance Evaluation Corporation) tests. Based on the combinations of various basic reference parameters, Nordhaus (2006 and 2002) developed an indicator called "computations per second" (CPS), which is mainly based on the familiar measure of MIPS.

of the OECD countries was 19 MCps (millions of computations per second) greater than that of an inhabitant of LAC, and that the gap had grown to over 2,520 MCPS/capita by 2006 (see figure II.6).

While computing power in 1996 derived entirely from the processors of personal desktop computers and portable computers (notebooks/laptops), by 2004 cell phone processors represented 3.5% of computing capacity in the OECD and LAC countries. Although, in 2006, the average capacity of a personal computer processor was 22 times greater than that of a cell phone, the massive number of cell phones in operation clearly signals an increasing role for that technology in processing the volume of information transmitted over digital networks —a phenomenon that is especially important in Latin America and the Caribbean.

Figure II.6
CAPACITY TO PROCESS INFORMATION THROUGH COMPUTERS AND CELL PHONES
(In millions of computations per second [MCps] per inhabitant)



Source: Author, based on Martin Hilbert, Priscila López and Christian Vásquez (2010), "Information Societies or 'ICT equipment societies'? Measuring the digital information processing capacity of a society in bits and bytes", *The Information Society Journal*, Vol. 26, No. 3.

If an information society is defined by its ability to handle information, and assuming that this definition depends on a technological frontier that is rapidly expanding, the above data show that the countries of Latin America and the Caribbean are ever further from becoming "full-fledged members of the information society with efficiency, equity and sustainability, within the framework of a global economy based on knowledge…" (Florianopolis Declaration, 2000). Although the capacity gaps may have declined in relative terms, they continue growing in absolute terms. Moreover, an ECLAC review of the region's progress as of 2003 concluded that "the internal digital divide in the Latin American and Caribbean countries is even more acute than the international gap". The following section examines the current situation in this regard.

B. The internal divide: digital inclusion

ECLAC (2003a and 2005a) has, on various occasions, described the digital divides between the countries of the region, emphasizing that they are the result of pre-existing economic and social inequalitiesin relation to income level, education, gender, ethnic origin and geographical location, among other factors. For an in-depth understanding of this, it is important to distinguish between the access and connectivity divide on the one hand, and the gap in the effective use of digital tools on the other. As already mentioned, the modernization of an information society's social and productive organization is not a matter of the number of devices installed, but rather of the quantity, quality and the effective usage of the digitized information and communications in the system.

1. The access divide

Table II.1 shows the Gini coefficients for the distribution of digital goods and services as a function of a number of socio-economic variables.[6] As may be seen, recent technologies are more unequally distributed than older ones, except for the case of mobile telephony, which is distributed more equally than fixed telephony. The reason for the fixed/mobile discrepancy in telephony is that it costs less to expand mobile networks than fixed networks, a circumstance that facilitates greater coverage and access. In addition, the prepayment option makes service more accessible, since fewer conditions must be met by the potential user. This particularly facilitates access to service for the poor, although the actual cost of the service under the prepayment method is not necessarily lower.

The socio-economic variable that is least associated with inequality in the distribution of ICT is the age of the head of household. Although it is young people who most quickly adopt new technologies, the technologies spread less in households with younger heads of household whose incomes are lower. Fixed telephony is distributed fairly uniformly between male- and female-headed households. The educational level of

6 The Gini coefficient assumes values between 0 (perfect equality) and 1 (maximum inequality).

the head of household seems not to be a significant determinant of mobile telephony use, since, unlike other ICT, this technology does not require special training. The availability of electrical energy determines access to most ICT —confirming the complementary nature of the components of a technological paradigm.

Table II.1
GINI COEFFICIENTS FOR ICT IN HOUSEHOLDS

	Age of head of household	Years of education of head of household	Gender of head of household	Indigenous group	Occupational category of head of household	Urban/ rural	Size of family	Income	Electricity	Average
Radio	0.18	0.21	0.25	0.14	0.28	0.15	0.25	0.18	0.30	0.22
TV	0.18	0.18	0.24	0.21	0.26	0.27	0.26	0.24	0.42	0.25
Fixed telephony	0.25	0.20	0.18	0.37	0.32	0.41	0.45	0.43	0.50	0.35
Mobile telephony	0.15	0.06	0.25	0.36	0.29	0.34	0.48	0.42	0.48	0.31
Computer	0.17	0.29	0.25	0.34	0.30	0.44	0.44	0.62	0.48	0.37
Internet	0.19	0.35	0.28	0.44	0.40	0.49	0.44	0.66	0.47	0.41
Average	0.19	0.21	0.24	0.31	0.31	0.35	0.39	0.42	0.44	0.36

Source: OSILAC, "*Characteristics of households with ICTs in Latin America and the Caribbean*", Santiago, Chile, ECLAC, 2007.

The above considerations raise the question: What are the most important determinants of the digital divide? For our purposes, discriminant analysis seems to be a good choice among the various alternatives of multivariate analysis.[7] It tests for a linear combination of variables, which —when appropriately weighted— will maximally discriminate between those who have access and those who do not have access to the Internet. It can basically be understood as a multiple regression that "idealizes" the characteristics of those with and without Internet. A value close to 1 shows a very high correlation between the tested variable and Internet access, and a value close to 0 a very low correlation.[8]

The table below presents the results of various household surveys of Latin America (OSILAC). Overall, the resultswere significant ($p < .001$), but not very strong (see Wilks' lambda and Canonical correlation).[9] The weak degree of correlation is proof of the well-known fact that the structure

7 Percentage of households with electricity, average household size, average age of head of household, percentage of economically active heads of household, average monthly income in US dollars and head of household's average years of education. Some of these variables are interrelated.

8 Discriminant analysis goes back to Fisher (1936) and can basically be understood as a multiple regression where the criterion variable is nominal rather than interval or ratio (in our case: access or not) and the aim is to search for a combination of variables that maximally discriminates between those groups (e.g. Williams and Monge, 2001).

9 Despite the low degree of correlation, reclassification of people on the basis of the newly identified function was quite successful: between 68.5% and 85.7% of the people could be correctly reclassified into the original categories of having or not having home access.

of social networks explains the patterns that arise in the diffusion of innovations (Rogers, 2003; Valente, 1995). Social networks consist of nodes with different attributes (such as education or income), as well as the links between those nodes. As can be seen from the table below, the nodes of the network only explain about half of the story. The nature of the links and the structure of the network ties (as such threshold levels) explain an important part of the other half of the diffusion process. Unfortunately, however, we do not possess network data in that regard.

The results show very clearly the importance of education and income variables as attributes that determine the diffusion of ICT. The weights of the standardized canonical discriminant function tell us how the ten original variables combine to make a new one that maximally discriminates between those who have and those who do not have household Internet access. We can interpret the standardized discriminant function coefficients as a measure of the relative importance of each of the original predictors. In most countries, education is the strongest predictor of Internet access, closely followed by income. In Uruguay and Brazil, income is a more important factor than education. Those two variables are followed by household size and age. The remaining characteristics only seem to contribute marginally, with notable exceptions, for example, there is an urban-rural divide in Chile and a gender dimension to the digital divide in Paraguay and El Salvador. The data from Uruguay and Brazil also show that although diffusion patterns change over time, they are path dependent, being the result of the underlying socio-economic and demographic structure.

It is important to note that the tests carried out indicated a low level of multicollinearity, which means that each of the variables (even though they are related) has a separate effect on Internet access. A breakdown of household survey data makes it possible to carry out a more detailed analysis on the most important variables: education and income levels. One example is a study that compared these variables in two extremely different countries (Brazil and Paraguay),[10] measuring households' access to mobile telephony, computers and Internet in relation to the educational level of the members of the family group and the household's per capita income in 2005.

Figure II.7 shows some common characteristics of the two countries and the separate effects of education and income. In both, for a similar educational level, greater income was associated with more intensive use of ICT, and vice versa.

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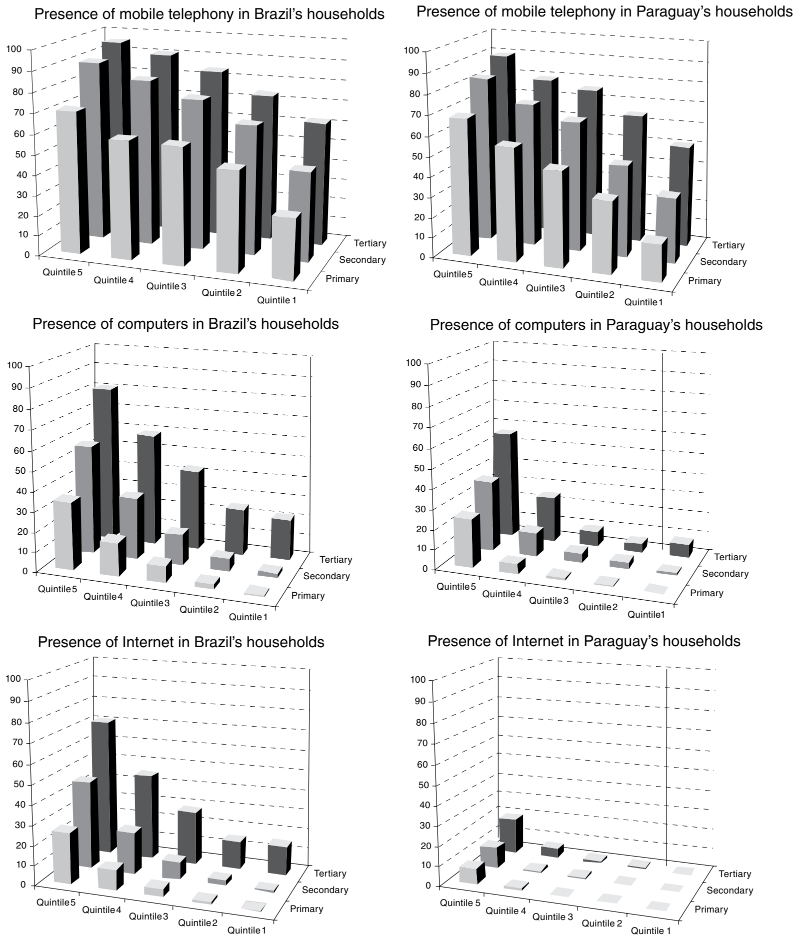
[10] It should be borne in mind that Brazil's per capita income is more than three times that of Paraguay: US$ 4,730 versus US$ 1,400, according to the Atlas method, 2006.

Figure II.7
ICT ACCESS IN THE HOME IN BRAZIL AND PARAGUAY, ACCORDING TO HOUSEHOLD'S PER CAPITA INCOME QUINTILE AND EDUCATIONAL LEVEL OF HOUSEHOLD MEMBERS AGED OVER 10 YEARS, 2005



Source: OSILAC, based on household surveys in Brazil and Paraguay, 2005.

Note: NFE: no formal education; PRI: complete or incomplete primary education; SEC: complete or incomplete secondary education; T/P: complete or incomplete tertiary/post-secondary education.

Within the same income segment, individuals with more formal education have greater access to these technologies. Income and educational differences are correlated with both computer and Internet access,[11] while

[11] The greater role that education seems to play in computer access in Brazil may be explained by the fact that, since Brazil is a more developed country than Paraguay, a proportionally larger percentage of its population has relatively high educational levels and interest in, or need for, more advanced ICT.

mobile telephony is the most common means of communication among all segments. This confirms the findings presented above, showing that a country's internal divide increases as the country advances towards technologies that are more complex and costlier for the user.

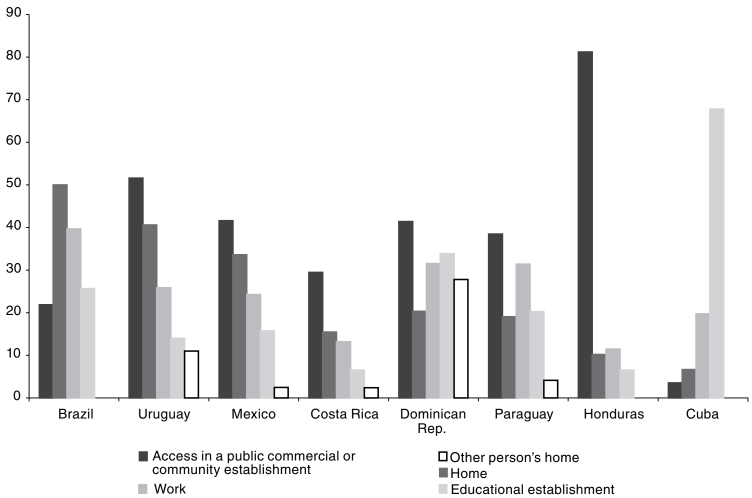
A comparison of the 2005 data with data from the preceding year shows that the greatest growth in access to mobile telephony and computers was in the poorest and least educated segments of the population. The rate of growth of Internet access also shows pronounced differences as a function of socio-economic level. Thus, the highest-income groups seem to be saturated in terms of the less costly and simpler technologies, and the gap between this segment and the poorest quintiles appears to be diminishing gradually, while income and education remain the most important determinants of Internet access, with education also being a major determinant of access to computer use.

Several conclusions can be drawn from the finding that education and income are the most important factors that shape the diffusion of ICT. Regarding education, the results highlight the need for the use of ICT in public educational programmes, in order to prevent the increasing divide between persons of different educational levels from affecting access to the more advanced ICT. The effects of income levels on the digital divide call for a more detailed analysis of this subject. According to ECLAC (2005a), the region has passed through a phase of rapid expansion of networks, and is currently in a complex stage in which low income levels and inequality of income distribution play a major role. According to estimates by Hilbert (2010), in order to bring ICT access into line with current electricity penetration rates, ICT prices would have to be cut to 3% of the current price levels (in Brazil, for example, the poorest 20% of society have only US$ 0.17 per week to spend on ICT), or alternatively, subsidized by an equivalent of up to 6.2% of GDP (as an example, in Uruguay, this would be equivalent to the combined public spending on education and health). Hilbert (2010) also shows that ICT spending per person starts to flatten out only after reaching a threshold of US$ 10 per person per month (or US$ 120 per year). Before reaching this level, consumers spend whatever they have available. In economic terms, this implies that ICT access involving personal expenditure of up to US$ 10 per person per month is considered a "necessity good", while ICT access involving personal expenditure over that amount can be seen as a "luxury good". However, in the countries analysed in Latin America, only roughly half of the population is spending more than US$ 120 per year on ICT (including equipment and traffic/minutes). One in three people in Brazil and Costa Rica (the poorest third) are able to spend only about US$ 35 per year on ICT.

From the above analysis, it becomes clear that objectives such as *One Laptop Per Child* (MIT Media Lab, 2005) are very ambitious. Solutions need to be found that cover the price of equipment (and US$ 100 per laptop remains too expensive to provide "one laptop per child") and the necessary traffic and service provision. In the meantime,a shared access model continues to be the most viable solution . In addition, public access is also seen as one of the most viable options to bridge the broadband divide (see figure on broadband access above), which grows ever wider as bandwidth increases. The shared access model is already widespread in the region, and is recognized around the world. In Latin America, the most important Internet venues are public: cybercafés, and community access points in libraries and other institutions (see figure II.8). The figure shows clearly the importance of public access in Latin America. While in Europe, home access is by far the most common kind of access to the information society (81%), access via commercial cybercafés is the most common way in most Latin American countries (reaching 70% of the population in Ecuador, for example).

Based on a non-exhaustive survey, Maeso and Hilbert (2006) estimated that in 2006 the LAC region had one public Internet access centre per 2,345 inhabitants (see table II.2). Over 50,000 access centres were identified for which public subsidies were received, showing that this access model was the most viable alternative, if not the only one, to reduce the digital divide in the short term.

Figure II.8
INTERNET VENUES, 2005-2008
(In percentages)



Source: OSILAC, based on household surveys.

Table II.2
PUBLIC ICT ACCESS CENTRES (PIAC) IN LATIN AMERICA, 2006

Country	Number of PIAC identified	Potential PIAC users [a]	Users per PIAC
Paraguay	48	5 002 000	104 208
Nicaragua	84	4 449 000	52 964
Uruguay	109	2 043 000	18 743
Bolivia (Plurinational State of)	884	7 384 000	8 353
El Salvador	618	5 119 525	8 284
Brazil [b]	16 722	136 175 000	8 143
Colombia	6 078	34 899 757	5 742
Chile	2 733	9 439 000	3 454
Guatemala [b]	3 869	9 373 000	2 423
Costa Rica	1 199	2 683 000	2 238
Mexico	58 188	75 656 525	1 300
Ecuador	9 577	10 391 421	1 085
Peru	19 936	20 278 000	1 017
Argentina	28 401	25 234 397	889
Total	148 446	348 127 625	2 345

Source: ECLAC, based on Oscar Maeso and Martin Hilbert, *Centros de acceso público a las tecnologías de información y comunicación en América Latina: características y desafíos, 2006*.

[a] In the ITU database, “potential PIAC users” are persons aged between 5 and 64 years , who are not current Internet users.

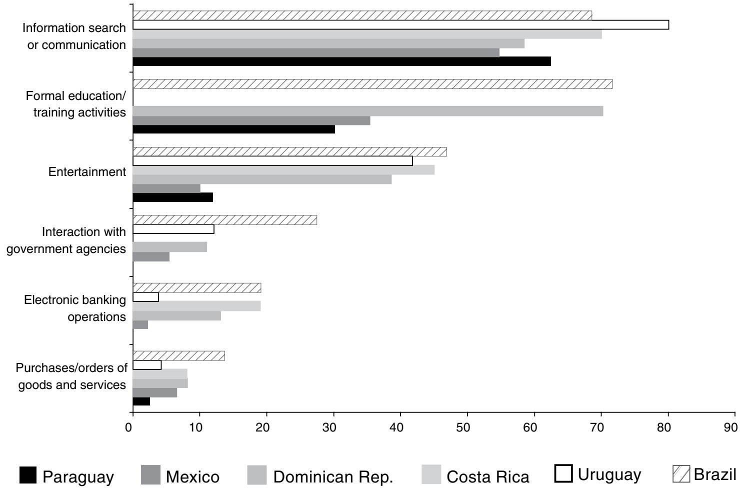
[b] Data for March 2007.

2. The usage divide

Access to ICT is merely the first step towards participation in the information society, and does not reflect the extent to which the possibilities of the information society can be leveraged, or the repercussions of being able to do so. Thus, it is not surprising that the adoption and use of these technologies depend on a learning process, and generally begin with simple activities that have little noticeable effect, later progressing to more sophisticated types of interaction. The learning curves are a function of personal and contextual factors, such as level of training, habits, legal frameworks and the content available on networks (Hilbert and Katz, 2003).

Figure II.9 shows that ICT are used in households principally as a means of accessing information and to communicate, and are still far from being used massively for online transactions. Compared with statistics from the European Union, the level of online transactions is still relatively low. The above-mentioned lack of broadband connectivity in Latin America and the Caribbean might be partly responsible for this finding (see the figure on broadband access above).However, much of the population with Internet access uses it to find information, requiring interactions similar to those required for online education.

Figure II.9
ACTIVITIES CARRIED OUT BY INTERNET USERS, 2005-2008
(In percentages)



Source: OSILAC, based on household surveys.

Interaction with government is an important factor in accelerating the learning process, since the obligation to carry out certain procedures online can assist in breaking a vicious circle, namely, resistance to using ICT and failure to perceive the benefits of doing so (see especially the cases of Brazil and Chile in figure II.9). For this reason, some of the governments in the region have made the Internet mandatory for payment of taxes and/or public procurement, thus making these activities the first online transactions experienced by much of the citizenry. At the same time, as governments digitize their own processes and operations, their employees become familiar with the requirements of digital interaction, for example, the availability of reliable and secure work environments and the need to retrain users. These arrangements also pave the way for the private sector and society to catalyse and promote ICT use.[12]

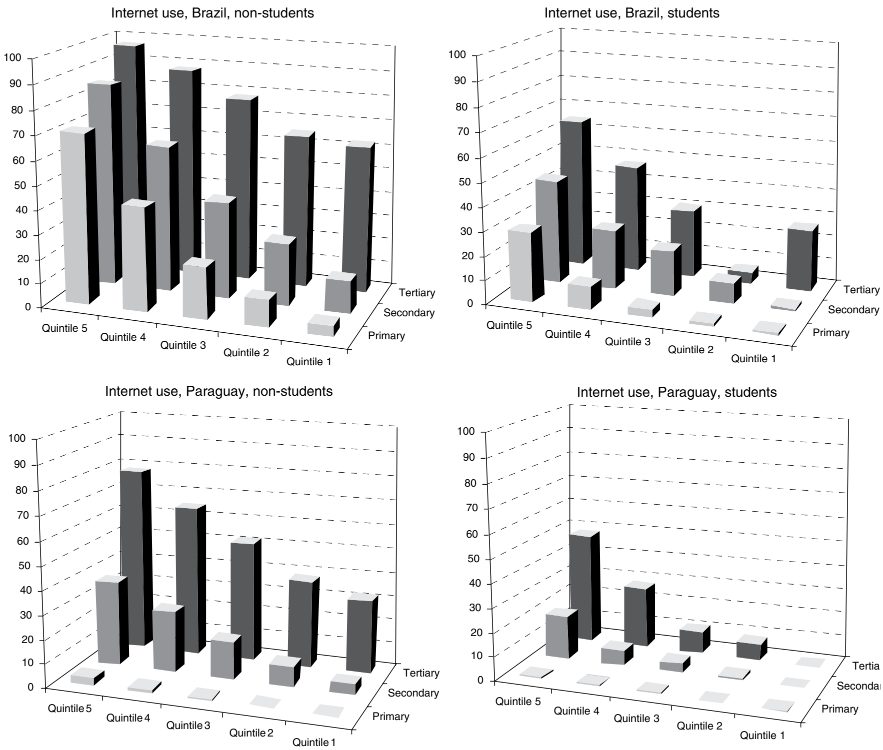
Analysis of use patterns, as a function of social and demographic factors, shows the same patterns found with respect to ICT access: income and education are the decisive factors. In particular, as figure II.10[13] indicates, there is significantly higher Internet use among students. Use among those who are no longer in school depends on the extent to which they have reached secondary or post-secondary levels of education, a fact that again underlines the close relationship between strengthening of capacities and

[12] For more detail, see the chapter, below, on e-government.

[13] As indicated above, comparisons of data between countries as different as Brazil and Paraguay should be taken with appropriate caution.

use of ICT. If the data on Internet use from figure II.10 are compared with the data from figure II.7 on the presence of Internet in the home, it is clear that the higher figures in the former are attributable to the use of the technology in educational establishments, at work, and at public access centres. This difference is very pronounced among students, while among non-students only those from higher income brackets use the Internet outside the home. The lack of Internet use by individuals with only a primary school education indicates that their activities do not require use of the technology. Analogously, an analysis of data from different countries reveals that in the lowest per capita income country, there is a wider gap between technology presence and technology use, especially among the lower income quintiles, than in the other countries. These circumstances, taken together, confirm the importance of the shared access model as a means of compensating, at least partially, for the limitations imposed by low income.

Figure II.10
INTERNET USERS OVER 10 YEARS OF AGE, STUDENTS AND NON-STUDENTS



Source: OSILAC, based on household surveys in Brazil and Paraguay, 2005.

Note: NFE: no formal education; PRI: complete or incomplete primary education; SEC: complete or incomplete secondary education; T/P: complete or incomplete tertiary/post-secondary education.

Chapter III

The economic impact of ICT

A. ICT contribution to growth

The debate on the extent to which ICT affect economic growth is ongoing. There is no consensus regarding positive and statistically significant effects from these technologies (Campos, 2007b). Today, most economists maintain that they do have positive effects— whether widespread or concentrated in the developed countries and dependent on the local environment.[1] Others, however, are still sceptical about the existence of such effects[2] or have doubts about the direction of causality, since countries with high per capita GDP growth are likely to invest heavily in ICT, and countries that invest

[1] Among the former are Jorgenson and Vu (2007). Their hypothesis, based on data regarding the effect of the rapid decline in ICT input and investment costs (or prices), proposes that ICT have a positive effect on growth. Röller and Waverman (2001) posit that ICT investment is an important variable in explaining long-term economic growth in a group of OECD countries selected as a sample. Sridhar and Sridhar (2004), extending their previous work to the less developed countries, conclude that the effect of ICT in such countries is considerably less pronounced than in the advanced economies. Waverman, Meschi and Fuss (2005), working with a wide sample of developed and developing countries, also conclude that the effect of ICT on growth is greater in the developed countries.

[2] Levine and Renelt (1992) present an econometric analysis showing that ICT should not be considered one of the determinants of growth at the global level. More recently, a less restrictive statistical exercise by Doppelhofer, Miller and Sala-i-Martin (2004) reached a similar conclusion, also shared by Durlauf, Johnson and Temple (2005). According to Stiroh (2004, p. 2), "information technologies do matter", although the results of the analysis are weak.

heavily in ICT are likely to attain higher rates of growth.[3] This section will examine measurements of the phenomenon in Latin America based on two different methodologies: growth accounting and the analysis of technological trajectories in the context of national systems of innovation.

Growth accounting has been used for exhaustive analysis of the effects of ICT on the dynamics of the United States economy. According to Jorgenson (2001), the pronounced decline in the price of ICT equipment has been the key to the renewed growth in the United States that began in 1995. Citing similar data, Jorgenson and Vu (2007) stress that ICT investment has been driving the world economy since that time. The rapid decline of prices for ICT equipment is a strong incentive for incorporating new technologies, and for using them to replace other forms of capital and labour.

In the seven regions of the world economy considered in table III.1, investment in ICT equipment and software increased beginning in 1995. The effect of these investments on growth was most pronounced in the Group of 7, and especially in the United States.[4] The total contribution of capital (both ICT and non-ICT) was the most important component of the growth of those economies. Prior to 1995, it generated 44% of the growth (1.28% and 2.19%, respectively), subsequently increasing to 52% between 1995 and 2000 (1.69% and 3.25%), then falling slightly, to 48% (1.05% and 2.18%), after 2000.

The large increase in ICT investment in the United States that began in 1995 was paralleled throughout the Group of 7. The contribution of ICT capital to growth in the G7 more than doubled from 1989-1995 to 1995-2000 (from 39% to 82%), although it fell to 47% after 2000. In the three periods considered here, the contribution of non-ICT capital was greater than that of ICT capital, though it diminished in each of the periods. This translated into more rapid replacement of non-ICT capital by ICT capital in response to the marked reduction in the price of equipment and software starting in 1995.

3 Included among these is the work of Cronin and others (1991), one of the first studies to consider the possibility of inverse causality from an econometric perspective. This study used annual country data, and concluded that inverse causality probably does exist.

4 Timmer, O'Mahony and van Ark (2007) confirm that the contribution of ICT capital to growth increased in the majority of the developed economies.

Table III.1

SOURCES OF GROWTH IN PRODUCTION, BY PERIOD

Economy	1989-1995						1995-2000						2000-2004					
	GDP growth	Sources of growth (in annual percentage points)					GDP growth	Sources of growth (in annual percentage points)					GDP growth	Sources of growth (in annual percentage points)				
		ICT capital	Non-ICT capital	Work hours	Work quality	TFP		ICT capital	Non-ICT capital	Work hours	Work quality	TFP		ICT capital	Non-ICT capital	Work hours	Work quality	TFP
Summaries by group																		
Group of 7 (G7)	2.19	0.39	0.89	0.07	0.43	0.41	3.25	0.82	0.87	0.63	0.25	0.68	2.18	0.47	0.58	0.08	0.17	0.88
Asian developing countries	7.54	0.14	1.67	1.80	0.53	3.41	5.91	0.33	1.89	1.17	0.47	2.04	6.51	0.44	1.83	1.20	0.48	2.57
Non-G7 countries	2.08	0.14	0.41	0.40	0.28	0.85	2.89	0.31	0.50	1.60	0.26	0.23	2.91	0.27	0.52	1.48	0.26	0.37
Latin America	2.86	0.14	0.51	1.24	0.46	0.52	1.97	0.28	0.65	1.25	0.41	-0.62	2.89	0.27	0.51	1.36	0.41	0.34
Eastern Europe	-6.38	0.09	-0.15	-1.75	0.45	-5.01	2.27	0.23	-0.85	-0.31	0.43	2.77	4.79	0.31	-0.50	-0.12	0.46	4.65
Sub-Saharan Africa	1.57	0.10	0.20	2.19	0.70	-1.62	3.26	0.23	0.43	1.86	0.51	0.24	3.74	0.27	0.54	1.54	0.51	0.88
North Africa & Middle East	3.97	0.15	0.65	1.99	0.68	0.51	3.91	0.30	0.78	1.85	0.60	0.37	4.30	0.42	0.72	2.22	0.60	0.34
G7 (7 economies)																		
Canada	1.39	0.49	0.27	0.08	0.55	0.00	3.67	0.94	0.77	1.08	0.21	0.66	2.76	0.45	0.67	1.29	0.15	0.20
France	1.30	0.20	0.92	-0.17	0.61	-0.26	2.38	0.39	0.81	0.45	0.35	0.37	2.18	0.37	0.29	0.64	-0.08	0.97
Germany	2.34	0.28	1.03	-0.41	0.33	1.12	1.80	0.44	0.92	-0.03	0.21	0.25	0.51	0.34	-0.20	0.09	0.18	0.10
Italy	1.52	0.26	0.85	-0.35	0.38	0.37	1.92	0.48	1.00	0.55	0.46	-0.58	1.39	0.36	0.66	0.75	0.21	-0.58
Japan	2.56	0.31	1.16	-0.39	0.54	0.94	2.09	0.78	0.38	-0.42	0.26	1.10	1.48	0.31	0.21	-0.32	0.21	1.06
United Kingdom	1.62	0.29	1.67	-0.72	0.49	-0.11	2.85	0.79	0.20	0.61	0.33	0.93	2.63	0.57	0.54	0.65	0.27	0.59
United States	2.44	0.49	0.71	0.57	0.38	0.29	4.29	1.02	1.11	1.12	0.21	0.82	2.71	0.57	0.86	-0.16	0.17	1.27
Entire group	2.19	0.39	0.89	0.07	0.43	0.41	3.25	0.82	0.87	0.63	0.25	0.68	2.18	0.47	0.58	0.08	0.17	0.88
Principal Latin America economies (7 economies)																		
Argentina	4.84	0.11	0.15	0.02	0.39	4.17	0.61	0.23	0.58	1.32	0.34	-1.85	2.64	0.13	-0.07	1.96	0.35	0.28
Brazil	1.82	0.07	0.22	0.94	0.53	0.06	1.74	0.25	0.21	0.96	0.50	-0.18	2.48	0.27	0.05	1.01	0.49	0.64
Chile	7.53	0.26	1.42	1.92	0.32	3.60	3.69	0.42	1.79	1.66	0.30	-0.48	4.26	0.39	1.24	1.87	0.30	0.46
Colombia	4.34	0.11	0.79	2.51	0.50	0.42	1.46	0.39	0.45	1.25	0.46	-1.10	2.10	0.44	0.04	1.06	0.46	0.10
Mexico	2.04	0.25	1.03	1.56	0.38	-1.18	3.52	0.29	1.32	1.52	0.31	0.08	3.67	0.28	1.63	1.67	0.32	-0.23
Peru	3.56	0.10	0.45	2.22	0.54	0.24	2.62	0.16	0.65	1.92	0.44	-0.55	3.14	0.19	0.61	1.47	0.44	0.44
Venezuela (Bolivarian Republic of)	3.86	0.17	0.16	2.09	0.45	1.00	-1.71	0.40	0.15	1.12	0.39	-3.77	2.78	0.32	-0.04	0.84	0.39	1.26
Entire group	2.86	0.14	0.51	1.24	0.46	0.52	1.97	0.28	0.65	1.25	0.41	-0.62	2.89	0.27	0.51	1.36	0.41	0.34

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Dale Jorgenson and Khuong Vu, “Latin America and the world economy”, Information Society Project, 2007.

As growth declined in Latin America between 1989-1995 and 1995-2000 (2.86% in the former period and 1.97% in the latter —with a rise to 2.89% in 2000-2004), the contribution of labour fluctuated in the neighbourhood of 1.7%, and was the most important factor in the region's growth. As a proportion of total capital, ICT doubled in the former period, from 14% before 1995 to 28% for 1995-2000, then stabilizing at 27% after 2000. This might suggest that the phenomenon known as "Solow's paradox"[5] did not apply here. Latin America's problem, in this regard, is the low total level of investment, not the small role, in relative terms, of ICT.[6]

In the 1989-2004 period, Chile was the only Latin American economy with a growth rate higher than the world average, while the region's two largest economies, Brazil and Mexico, were far below the average. Labour was the principal factor of production driving growth in Brazil, Chile and Mexico, although the contribution of ICT capital in the latter two was significant. In all three countries, the contribution of ICT capital increased markedly starting in 1995,[7] though it varied significantly between countries and from one period to another.

For the region as a whole, the contribution of ICT capital to GDP growth during the three periods in question was below the world average, and far below the average for the G7 countries. From a growth accounting perspective, this provides empirical support for the thesis that ICT have a positive impact on growth, with the greatest effect being in the developed countries (see table III.2).

In a similar analytical framework, Campos (2007b) examines the effect of a particular type of ICT capital on per capita GDP growth, focusing on the penetration of telephony.[8] In this model, fixed capital, population,

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5 This is an allusion to the well-known statement by Robert Solow to the effect that he saw computers everywhere except in productivity statistics (Solow, 1987). That statement highlighted our inability to immediately detect the benefits of the ongoing technological revolution. If one considers the existence of strong lag factors, the paradox ceases to exist (David, 1990). The dissemination of the benefits of technical progress between countries and sectors is a long and difficult process that requires adapting economic activities and institutional frameworks to the new paradigm. Thus, in today's environment, only recently have the benefits of the ICT paradigm become visible.

6 Jorgenson and Vu (2007) maintain that ICT capital plays a more important role in Latin America than in other regions. Although ICT capital represents less than 1% of the region's GDP, it represents a greater share of total capital than in other parts of the world, because the region's total capital is relatively small. This leads to the phenomenon of ICT capital being more productive that non-ICT capital.

7 A complementary work that improves the quality of the investment series for Latin America (de Vries, dal Borgo and Hofman, 2007) also identifies a similar trend in the contribution of ICT capital to the region's growth, even at the level of sub-periods.

8 The sample used in Campos (2007b) includes the OECD (25 countries), Latin America and the Caribbean (24 countries), Asia (21 countries), Sub-Saharan Africa (43 countries), North Africa and the Middle East (15 countries) and the transitional economies (26 countries).

the effectiveness of legal provisions, regional dummy variables (belonging to OECD, Latin America, Asia, Africa or transitional economies) and the penetration of fixed and mobile telephony are independent variables.

Table III.2
CONTRIBUTION OF ICT CAPITAL TO GDP GROWTH
(In percentages)

Groups of countries	1989-1995	1995-2000	2000-2004
World (110 economies)	9.6	14.7	11.2
Group of Seven	17.8	25.2	21.6
Asian developing countries	1.9	5.6	6.8
Non-G7 countries	6.7	10.7	9.3
Latin America	4.9	14.2	9.3
Eastern Europe	1.4	10.1	6.5
Sub-Saharan Africa	6.4	7.1	7.2
North Africa and Middle East	3.8	7.7	9.8

Source: Author, based on the data in table III.1.

The coefficients for the penetration of telephony are always positive and statistically significant. Among the non-ICT variables, the fixed capital coefficient is positive, as expected, although it only becomes statistically important in the absence of the fixed telephony variable, while the population coefficient is negative, as expected, and is statistically significant in all cases. As regards the regional dummy variables, only those for OECD and Africa, which are positive and negative, respectively, are statistically significant in all of the periods. The Latin American dummy variable is never statistically significant.

If this model is applied to the Latin American countries, the coefficients of the ICT variables remain positive and statistically significant, indicating that these technologies are important in explaining growth. In the Asian countries, the effects of ICT appear to be even more pronounced than in Latin America and the Caribbean, and the corresponding coefficients are higher, positive and statistically significant.

B. The efficiency of ICT investment

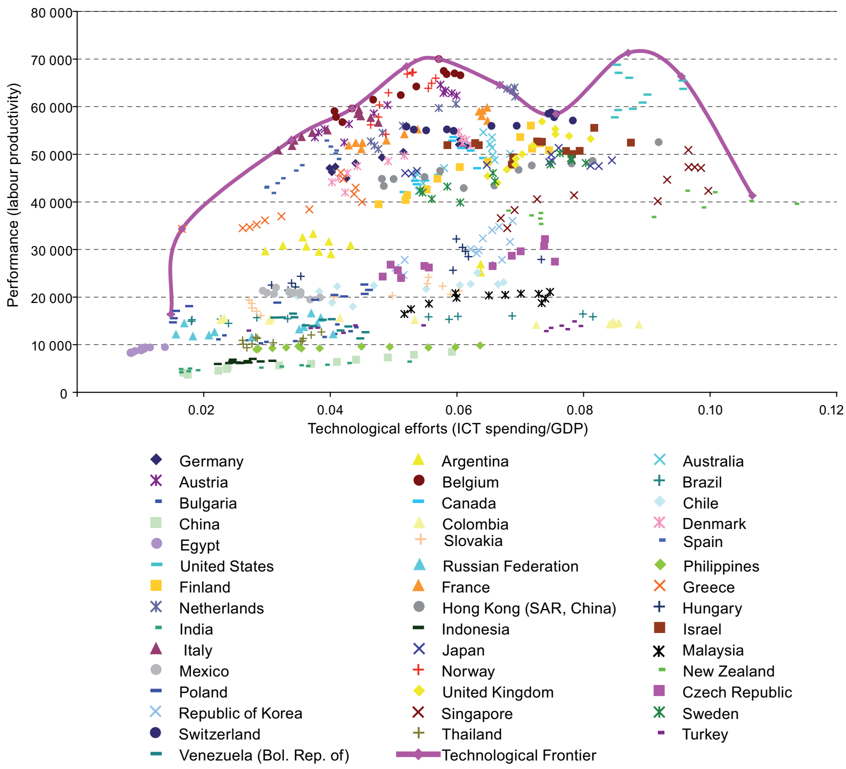
This section takes an evolutionary approach to analysing, in detail, the influence of ICT on productivity,[9] seeking to determine patterns of

The period studied is 1960-2004, and the observations were calculated on the basis of five-year periods. The temporal scope of this study represents an extension of previous studies, which tended to concentrate on the period subsequent to 1980.

9 There are more methodological approaches to ICT and growth than the growth accounting and evolutionary economics presented here. For example, using a methodology different

behaviour by identifying the different technological trajectories for the spread of ICT in countries with different levels of development (Cimoli and Correa, 2007). This model considers two variables: ICT expenditure as a percentage of GDP, which represents a country's technological efforts (x-axis in figure III.1) and labour productivity (y-axis).

Figure III.1
EFFICIENCY OF ICT INVESTMENT IN 44 COUNTRIES, 1993-2004



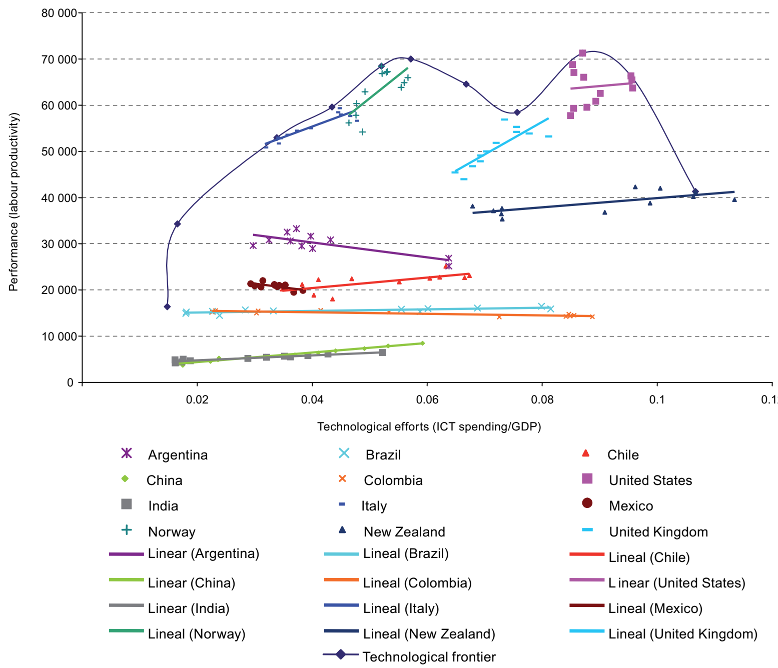
Source: ECLAC, Information Society Project, based on Cimoli and Correa, *ICT, Learning and Growth: An evolutionary perspective*, 2007.

Note: Each point represents an annual datum for a country.

from that used in this section, Aravena and others (2007) calculate the dynamic of total factor productivity (TFP) in the region's countries in the 1960-2005 period, using a Cobb-Douglas production function, which includes capital and labour as factors. The results indicate that the variability of the exchange rate, macroeconomic instability, and (particularly) economic reforms, are the most important variables explaining the dynamic of that productivity. In this analysis, ICT have relatively little effect on total factor productivity.

Each point in the plane represents, for a given year, a country's position in terms of ICT expenditure and labour productivity. In each of the 44 countries covered in the figure, the relation between ICT expenditure and labour productivity represents a certain technological trajectory within the period considered —in this case 1993-2004. The graph is based on the observed performance of combinations of technologies. In other words, the effects of ICT expenditure presented here are real, not hypothetical. (For the sake of clarity, figure III.2 presents the same data for a group of ten countries: four in the region, four developed countries and two large emerging economies. The smaller number of countries here makes it possible to show the trend lines for each).

Figure III.2
EFFICIENCY OF ICT INVESTMENT, SELECTED COUNTRIES, 1993-2004



Source: ECLAC, Information Society Project, based on Cimoli and Correa, *ICT, Learning and Growth: An evolutionary perspective*, 2007.

Note: Each point represents an annual datum for a country.

In both graphs, the "sinuous" curve represents the frontier of technological development reached by the ICT techno-economic paradigm during the period in question, with the frontier being defined as that reached by countries that attained the highest productivity levels in relation to ICT expenditure. The curve representing this trajectory supports the hypothesis that there is no monotonically rising relationship between productivity and expenditure for these technologies. In short, there are points after which increased spending has no positive effect on productivity; thus, different levels of spending can produce similar performance levels. This also applies to countries that have not reached the technological frontier.

Two groups of countries may be identified on the basis of this model. The first is composed of those that define the technological frontier, among which there is a rather small variance in terms of labour productivity (United States, Belgium, Norway, Netherlands and Italy, among others). These countries have the highest level of productivity. They show an increasing relationship between ICT spending and productivity, and their technological trajectory has a positive slope.

The second group includes the countries furthest from the technological frontier, which have the lowest productivity levels. In these countries, increased expenditure does not translate into higher productivity, thus making the slope of the technological trajectory close to zero. This group includes the Latin American countries selected for this exercise.

Between these two groups are a number of countries that improved their capacity and accelerated the closing of the gap that separates them from the technological frontier (Republic of Korea, Singapore, New Zealand, Australia and Portugal). The majority of these countries are well known for their efforts to improve and develop their innovation systems.

The foregoing perspective can be complemented by a scheme that plots the slopes of the technological trajectories (or "ICT effect") for each of the 44 countries on the x-axis and the median labour productivity on the y-axis (see figure III.3).[10] The positive slope of the trend line suggests that the higher-productivity countries benefit more from ICT, since the effects of these technologies on productivity is greater for them. The points at the extreme lower left represent the Latin American economies.

To identify the possible causes of the relationship revealed between ICT and productivity, work by Capasso and Correa (2007), which assesses the effects of ICT growth and evaluates a vector of variables measuring a country's knowledge base (publications in technical and scientific journals, registration in tertiary education programmes and spending on R&D), concludes that these technologies should be considered an asset complementary to the creation and dissemination of knowledge. This means that the differences in the structure of national innovation systems

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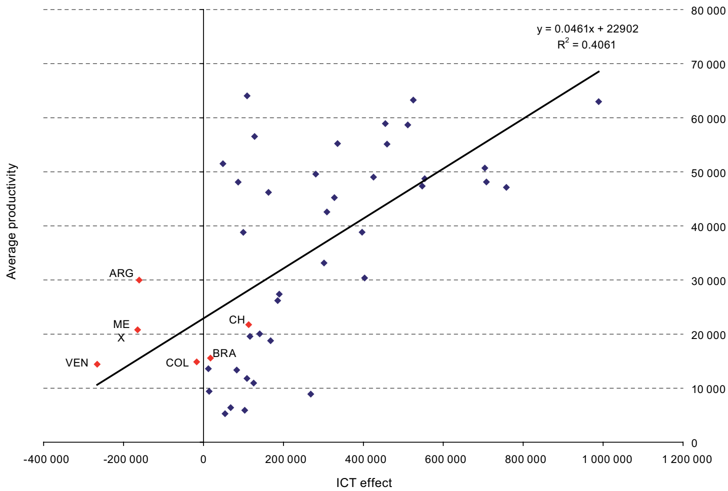
10 The "ICT effect" is measured as change in labour productivity with respect to a change in ICT spending as a proportion of GDP.

and their corresponding capacities to create and disseminate knowledge are important in explaining the variety of economic effects that ICT have on different countries.

Figure III.3
EFFECTS OF ICT ON LABOUR PRODUCTIVITY IN 44 COUNTRIES, 1993-2004



Source: ECLAC, Information Society Project, based on Cimoli and Correa, *ICT, Learning and Growth: An evolutionary perspective*, 2007.

In fact, there proves to be complementarity among all of the variables that are components of the knowledge vector. In this framework, more intense use of ICT has a positive effect on GDP growth because it increases the dissemination of knowledge. A particularly important result is that the magnitude of the effect depends, to a great degree, on the balance between ICT and the other components of the vector. The greatest effect on knowledge is generated only by a particular, ideal or optimal, combination of these variables.

It shows that in the case of Latin American economies, more intensive ICT usage leads to proportionally positive effects on growth, but that these effects are not optimal. Its magnitude depends on the form and proportion in which ICT are combined with the other knowledge-vector variables. If ICT use is relatively high in relation to the other variables, its marginal effects diminish as usage increases.

This confirms the thesis that technological success or failure can be explained by the specific features of national innovation systems, i.e., the institutions and organizations providing education, scientific research and dissemination of knowledge, and their mutual interaction (Freeman, 1994 and 2001, Cimoli and Dosi, 1995). The synergies between these complementary factors lead to the often mentioned "complementarities", which turn out to be essential to attain a positive impact from ICT. It shows that a modern ICT infrastructure provides new and very efficient channels, but that the content of these channels does not come with the installation of this infrastructure alone. From this perspective, it is not surprising that the positive impact of ICT on productivity depends on the complementing innovation system, and that both reinforce each other mutually. Well organized innovation systems function as engines of technical progress, while poorly organized ones can seriously inhibit technological development in a dynamic that is closely related to each country's productive structure.[11] The strengthening of local capacities depends on knowledge spillovers, complementarities and externalities that contribute to the organizational and technological environment in which economic activity takes place.

In the developing economies, the growth process depends significantly on imitating and adapting technologies coming from more advanced economies. In this context, it is impossible to maintain adequate technological dynamism without introducing structural changes and developing a productive apparatus that generates local capacities for handling the fundamental general purpose technologies —ones that require basic infrastructure and networks which serve a wide range of activities. General purpose technologies (see table I.1) are technologies whose areas of application are so broad that each country's specific type of technical change will depend on its capacity to produce, innovate and imitate in fundamental areas of knowledge. In the past, electricity and mechanical engineering were the fundamental areas of knowledge; today ICT represent a new and inevitable general purpose technology.

In conclusion, analysis of the persistent differences in countries' ability to use ICT to improve their productivity shows that (i) countries can be classified according to the efficiency of their technological efforts over time; and (ii) there is no linear relationship between productivity gaps and differences in ICT spending.

Furthermore, the findings of two methodologies as different as those presented in this section indicate that ICT have positive effects on growth and productivity. However, the magnitude of the effects varies considerably from country to country, since it depends on complementary factors which, under different names, are associated with the capacity to create efficient innovation systems, given a set of productive structures that make it possible to take full advantage of these technologies.

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11 Informality, a deeply-rooted characteristic of Latin American economies, adversely impacts the economy, not only in terms of income distribution and ICT access, but also because it directly affects overall productivity and the lower average productivity of the economy also affects growth.

Part two

The development of ICT

This part of the book analyses the regional production of ICT-related goods and services, which are linked with creating the technological conditions fundamental to the digital paradigm. The analysis begins with a review of the hardware and software industries (chapter IV), continuing with a study of telecommunications services and their regulation (chapters V and VI), which play an essential role in the sector's development. In terms of the development of information societies, one of the most important differences between these sectors is the tradability of their goods and services: hardware and software are internationally tradable, while a telecommunications infrastructure is installed to serve a particular location. This difference has important policy implications. Finally, chapter VII details the debate on intellectual property in the region's countries —a debate whose outcome will impact one of basic regulatory tools governing the production and use of digital goods and services, particularly software.

Chapter IV

The ICT industries

A. Hardware production

1. Introduction

Recognizing the extent to which the electronics industry contributed to the growth of some Asian economies, various Latin American and Caribbean governments sought to implement policies to encourage development of the industry.[1] Although these initiatives attracted foreign direct investment (FDI), increased exports, created jobs and even stimulated research and development, the sector's strength was not comparable to that of Asia. To understand this phenomenon and its implications, the present section analyses the ICT hardware industry,[2] which includes the production of equipment and components for the transmission, processing and storage of information and data.[3] It first describes the principal changes in the industry at the international level, then outlines the regional scenario, focusing on the countries within the region that play the largest roles in

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[1] The Asian experience has been extensively studied, e.g., by Schipper and de Haan (2005), Ernst (2004), Cassen and Lall (1996), Rodrik (1995) and Krugman (1994).

[2] The term ICT "hardware" or "goods" refers to the products of the ICT hardware industry, also referred to here simply as "the industry" or "the sector". The term "segment" refers to the industry's subsectors.

[3] At a greater level of disaggregation, this includes equipment for telecommunications networks, personal computers, telephone equipment and televisions, as well as their basic active components (semiconductors, integrated circuits, microprocessors, memories), passive components (printed circuits) and monitors.

the industry —Mexico and Brazil. Having presented this background, it then analyses the main challenges related to growth.

2. The status and dynamics of the global industry

In 2006, ICT hardware was a US$ 954 billion market worldwide. Between 2003 and 2006, the industry's regional sales structure was stable, with over 85% of sales concentrated in Europe, the United States and the Asia-Pacific region. Latin America and the "rest of the world", though accounting for a small share of the total, experienced the greatest growth (Fundación Telefónica/IDATE/ENTER, 2007). The market was split equally between Asia and North America (each with 35%), with the United States accounting for 85% of the North American market. Within this total, consumer electronics and telecommunications and computer equipment all registered strong growth. Latin America's share of each of these segments parallels its weight in the world economy (6%), with industry growth in the region steady in all three segments (see table IV.1).[4]

Table IV.1
ICT HARDWARE SALES IN THE WORLD AND IN LATIN AMERICA, BY SEGMENT, 2003-2006
(In billions of dollars)

	2003	2004	2005	2006
World				
Telecommunications equipment	191	217	234	242
Computer hardware	367	366	377	393
Consumer electronics	229	257	293	319
World total	787	840	904	954
Latin America				
Telecommunications equipment	9	11	12	13
Computer hardware	18	20	22	24
Consumer electronics	9	12	15	18
Latin America total	36	43	49	55

Source: Fundación Telefónica, IDATE and ENTER, *DigiWorld América Latina 2007*, Editorial Ariel, 2007.

Asia accounts for roughly half of total ICT hardware production, followed by North America with 30% and Europe with 19%. In terms of types of products, 36% of the world total consists of components (of which 19% are semiconductors), 29% computers and peripherals, 18% communications equipment, 11% audiovisual equipment and 6% other (JEITA, 2007).

[4] In 2006, Mexico's and Brazil's shares of the world market (measured as a function of their apparent consumption) were 2.2% and 2.0%, respectively. In production of equipment (excluding components), the relationship is reversed: the Brazilian market remained at 2.0% of the world market, while the Mexican market declined to 1.6% (*Electronics Industry Year Book*).

China is a special case in the international ICT-goods trade. Its electronics industry grew at an annual rate of 15% starting in 2001, and it is the major global producer, attracting large amounts of FDI with its low production costs, government support, infrastructure and large domestic market (Amighini, 2005; Lazonick, 2004). A different pattern is seen in the largest producers in Latin America and the Caribbean —Mexico and Brazil. Mexico is a major exporter of products assembled for the United States market, while Brazil's production targets the domestic market, though some is exported to other countries in the region (see table IV.2).

Table IV.2
EXPORTS AND IMPORTS OF ICT GOODS
(In billions of dollars)

	1996	2000	2001	2002	2003	2004	2005	2006
Exports								
China	17.2	43.5	52.3	75.5	117.9	171.8	226.0	287.3
Japan	93.9	108.2	82.8	81.2	90.1	102.4	98.0	99.5
United States	104.6	153.4	126.7	109.1	112.5	121.3	125.7	136.8
European Union	63.8	81.3	73.9	68.3	75.7	89.2	130.6	116.8
Latin America and the Caribbean	15.5	38.0	37.7	35.4	35.0	37.1	43.8	52.8
Mexico	14.4	34.0	34.4	32.2	31.2	36.2	38.0	46.6
Brazil	0.9	2.3	2.4	2.2	2.1	2.0	3.7	4.0
Imports								
China	13.9	44.4	49.6	66.4	96.3	128.7	160.5	197.9
Japan	43.4	60.9	52.6	49.3	54.5	64.3	67.0	68.7
United States	140.7	215.5	172.8	173.2	180.5	212.9	233.1	253.7
European Union	100.2	162.3	130.5	140.2	145.2	169.3	190.6	210.8
Latin America and the Caribbean	25.6	45.5	45.8	39.9	30.9	39.6	63.0	64.1
Mexico	11.5	29.0	29.8	28.3	28.0	34.4	36.1	42.4
Brazil	6.1	7.6	7.0	4.8	4.9	6.9	8.8	11.0

Source: International Merchandise Trade Statistics (COMTRADE) database.

Note: European Union data do not include intraregional trade.

The relevant segments that constitute the hardware sector include: networks, computation equipment, telecommunications equipment, broadcast equipment and semiconductors. The ongoing dynamics in ICT convergence, such as discussed in chapter I, are currently leading to a profound reorganization of these more traditional segments, with countless and ongoing mergers and acquisitions. In general, there are two types of manufacturers of final goods: original equipment manufacturers (OEMs) and contract manufacturers (CMs). While OEMs work with their own brands, CMs produce for them, sometimes providing related services. CMs operate under two regimes: (i) electronic manufacturing services (EMS) for the OEMs, based on designs provided by the OEMs; and (ii) original design manufacturing (ODM), in which, in addition to carrying out manufacturing, they design equipment, retaining intellectual property rights.

The great majority of OEMs are United States and Japanese firms, though the Chinese firm Lenovo, in purchasing computer production operations from IBM in 2005, became one of the world's major producers. A large proportion of CMs are based in the United States or Canada, with Asian firms playing a steadily increasing role.

According to Arensman (2007), nearly half of the 50 largest producers are United States firms, while the other half is divided by around 20% of the producers from Japan, 10% from Europe, another 10% from the Chinese province of Taiwan, and the remaining 10% from the Republic of Korea, Singapore and China. This geographical distribution points up certain patterns that are characteristic of the industry. First, the number of firms is fairly well balanced between the United States and Asia, despite Asia's rapid advance. Second, Asian production is markedly specialized in semiconductor commodities (which have lower technological content), while the United States and European enterprises focus more on proprietary technologies.[5] Third, United States firms have historically shown a great capacity for innovation in computer technology, while Japan holds undisputed leadership in the entertainment segment (Edwards, 2006).

In the semiconductor industry, the foundry model describes how firms have separated the processes of design and manufacture to reduce costs and increase their efficiency. These companies fall into three groups: fabless firms, which have no manufacturing capacity and focus on design and R&D; firms that produce under manufacturing contracts (known as chip contract manufacturers or merchant foundries), which confine themselves to manufacturing and testing services;[6] and integrated device manufacturers (IDMs), which design and also have production facilities.

Digital convergence and changes in production chains —combined with China's growth— have brought about major changes in the world industry during the last few years and the economic turmoil of 2008-2009 has added more dynamics, mainly mergers and acquisitions, which have been based on considerations endogenous to the industry per se, but were often the effect of external pressure (such as liquidity, governmental subsidies and financial considerations).

5 For example, Hynix and Samsung specialize in producing memories, while Intel specializes in processors (Edwards, 2006).

6 The largest semiconductor producers are usually IDMs. The only large one producing in Latin America is Intel, at its Costa Rican plant. The best known foundries are UMC (Chinese province of Taiwan), IBM, SMIC (China) and Chartered (Singapore) (Ernst and Luthje, 2006). Typical fabless firms include companies like Qualcomm, NVidia and Sandisk, and Marvell and Xilinx, all in the United States.

These ongoing financial dynamics do not change the general tendencies. The trend towards the converging of networks, terminals and services leads to changes in product design and development, along with changes in corporate strategies, which in turn generated greater product diversity and more rapid cycles of obsolescence. Accelerating technical change, with a consequent increase in R&D expenditure and a shrinking product life-cycle, brought an increase in the minimum scales of production, thus increasing the cost of entry and making it more difficult to reach —and remain at— the technological frontier. There is, moreover, considerable uncertainty as to how technology will evolve upon reaching the limits imposed by the physical properties of silicone, signalling an end to the application of Moore's law, as discussed in Chapter I.[7]

The transformations described above led to a change in the amount of value added by the different links in the ICT hardware production chain, as shown in figure IV.1. The relationship is U-shaped: the aggregate value is high in research and development, as well as in the design and manufacture of strategic inputs; it reaches its low point in the assembly of components; finally, it rises for post-sale services and development of brands and markets. In general, industrial activity in the developing countries centres on the lower value added links of the chain: manufacture of generic inputs, assembly and packaging, and distribution and logistics.

The growth of China's industry makes it the most dynamic player in the market. Since 2001, China's exports have been greater than Mexico's or Eastern Europe's, and since 2004 they have even exceeded those of Japan, the European Union and the United States (OECD, 2006). Although China's activity continues to focus on assembly, due to the country's low labour costs and good infrastructure,[8] many of its firms are increasingly oriented to research and development, as they seek to pursue a path of endogenous innovation (Lazonick, 2004).[9] Transnational firms played a decisive role in the transition from assembly/imitation to innovation. At the same time, the pattern of specialization in Chinese industry underwent a process of upgrading, with an increase in the technological content of the components that it exports (Luthje, 2004; Amighini, 2005).

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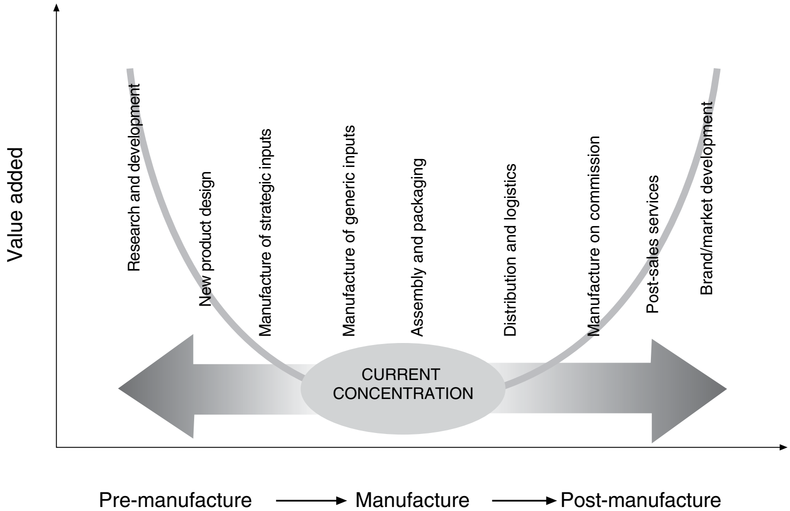
7 Sperling and Mutscher (2007) describe the situation that the ICT hardware industry has reached, in particular the semiconductor industry, and the uncertainty about means of transcending the apparently insuperable 22-nanometer limitation in reducing the size of microprocessor circuits.

8 The sector's share of industrial value added (23.4%) in the region is lower than the world average of nearly 36% (a figure calculated on the basis of data from ONUDI) and also is strongly dependent on imported components, with a large trade deficit in integrated circuits, semiconductors and components (OECD, 2006).

9 In 2006, 23 of China's largest ICT hardware companies invested 5% of their revenue in research and development, and some spent as much as 10% (Jin, 2006).

Figure IV.1
VALUE ADDED IN AN ICT HARDWARE PRODUCTION CHAIN



Source: PRODUCEN-Centro de Inteligencia Estratégica, presentation on electronics cluster, Baja California, Mexico, November 2006.

China's spectacular growth and its drive to invest in human capital and R&D limit other countries' opportunities. Producing low value added goods requires low-cost, large-scale operations, whereas developing higher value added products (advanced components) requires the technological capacity to reach the technological frontier and remain there. For countries that cannot operate at the required scale and that are not making comparable efforts to strengthen their capacities, the emergence of China —and the consolidation of its position— increases the difficulty of gaining entry to the industry or maintaining competitiveness, as the case may be.

Since the 1990s, the restructuring of the industry went through a number of phases, driven by the rapid growth in demand for ICT goods: the trend of OEMs to outsource their low-profitability operations to CMs and the following growth of CMs and vertical disintegration of the OEMs' value chains, the reorganization and concentration of some of the larger firms, and the increased cooperation between firms to generate and acquire knowledge, vertical specialization, new vertical integration of these chains as CMs acquired production capacities from OEMs, and the linkage of global production chains (Sturgeon, 2002; Ernst, 2001).[10]

[10] Dedrik and others (2007) call this process "massive coordination for global knowledge networks".

This outsourcing permitted OEMs to reduce their production and logistics costs and increase their revenue, as they focused on research and development, marketing and sales. At the same time, it gave CMs the opportunity to establish a global footprint, producing simultaneously in different geographical regions to gain more rapid access to markets and meet local demand (Schipper and de Haan, 2005).

The extensive tendency of outsourcing in the ICT hardware sector occurred in only two years, between 2004 and 2006. The proportion of productive activity outsourced in 2006 was 73%, compared with 27% in 2004.[11] The strategy of each CM, in terms of choice of location, depends on the technological intensity of its products: North America and Europe specialize in high-tech services, while Asia offers low production costs.

At the same time, OEMs employed various strategies, depending on their objectives and market positions. Some, shifted their orientation towards services and solutions, while others turned to specific segments of these markets. Other firms have established agreements with content producers as a means of diversifying their production to respond to demand that has been intensified by convergence. Finally, some firms engaged in mergers and acquisitions to provide greater market concentration.

The set of transformations experienced by the industry worldwide had repercussions in Latin America that affected decisions on where to locate facilities, and shaped the strategies of the major producers with a presence in the region, particularly in Brazil and Mexico.

3. The ICT hardware industry in Brazil and Mexico

The ICT hardware industry in Latin America and the Caribbean is concentrated in Brazil and Mexico, which account for approximately 95% of the industry's value added.[12] Large world producers —as well as local firms and conglomerates, and clusters of smaller firms in certain market niches— operate in these two countries. In other countries of the region, there are smaller operations that share some of the features of Mexico's and Brazil's industry, such as a specialization in components assembly.[13]

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[11] The 10 largest CMs account for 71% of the total market in these types of activities (Pick, 2007).

[12] The value added of the ICT industry in Brazil and Mexico is on the order of US$ 6 billion to US$ 7 billion in each case, followed, far behind, by Argentina (US$ 200 million) and Colombia (US$ 140 million). There is significant lack of precision in determining the sector's economic variables. For example, the estimate of the annual value added of INTEL in Costa Rica varies between US$ 90 million and US$ 500 million, depending on the methodology used (World Bank/MIGA, 2006, p. 16).

[13] Costa Rica stands out among these countries. It implemented policy to attract foreign firms to the sector as early as the 1990s, culminating in the creation of a plant by Intel, the world's largest microprocessor producer. Basic factors in Intel's choice of Costa Rica

(a) ICT hardware in Brazil

(i) Historical evolution

The ICT hardware industry in Brazil developed on the basis of two systems of incentives: those provided in the Manaus Free Zone (MFZ) as part of the development policy for the Amazon Region, and the incentives regime covering information and telecommunications products. Between 1967 and 1976, the MFZ operated without import restrictions and with fiscal incentives for the assembly of imported kits or semi-knocked down (SKD) manufacture, thus impeding the development of a more integrated industry with domestic technological content in other parts of the country. In 1977, MFZ imports were restricted by import quotas and minimum nationalization indexes. This led to including local components in imported kits, and permitted the firms to move to completely knocked-down (CKD) manufacture. Despite the creation of some components-producing firms, the predominant pattern continued to be assembly of foreign-technology components (Baptista, 1988, quoted in Ariffin and Figueiredo, 2003).

In the rest of the country, until the late 1980s, the industry's development was affected by a combination of protectionist policies, support for domestically financed firms, government procurement, fiscal incentives and direct State support for research and development. In 1984, the Information Technology Act reserved a share of the market for domestically financed firms, while providing tax, fiscal and credit incentives. In exchange, certain levels of domestic content were mandated. Although these measures propelled the industry's development, a combination of high profit margins, lack of price and quality competition from foreign producers, and an incentives structure that led to horizontal diversification and vertical integration, produced an excessively diversified, fragmented and inefficient system in terms of quality and price (Nassif, 2002; Frischtak, 1990).

These deficiencies became clear in the early 1990s, when trade liberalization caused a number of firms, principally domestic ones, to close or be acquired by transnational companies. Those that survived reduced their number of production lines and models, abandoning some products, especially the high-end and portable ones. They also increased importation of inputs, introducing innovations involving greater automation and the digitization of processes. Initially, they outsourced support activities, then

included the country's low-cost skilled labour force, the near-absence of bureaucratic obstacles —a result of the Government's commitment to promoting the industry— and easy access to the United States market. In 2005, there were 55 electronics firms operating in the country, of which 42 were foreign. They were responsible for 12,000 jobs and over US$ 1.65 billion in annual exports. Despite these achievements, Costa Rica did not succeed in creating clusters on the same scale as, for example, Shanghai, Malaysia, Singapore or Ireland, because of the difficulty of developing investor-provider networks and the lack of incentives for providers (World Bank/MIGA, 2006 and Ciarli and Giuliani, 2005).

increasingly outsourced the various phases of the production process to small firms. Although these changes led to higher productivity and quality, and lower final-product prices, the 1993 prices were still higher than international reference prices (MCT/FINEP/PADCT, 1993).

The components industry was particularly affected by competition from more inexpensive Asian imports. While, in 1990, local providers supplied over 80% of the inputs for the Manaus electronics industry, by the end of the decade that figure had dropped to 37% (SUFRAMA, 2007). The decline of the components industry, added to process automation, resulted in a loss of jobs (Ariffin and Figueiredo, 2003).

The Information Technology Act was renewed and modified periodically. In 1991, the provision reserving a share of the market was eliminated, and tax incentives were incorporated. In exchange —and in lieu of the previous nationalization indexes— the firms receiving benefits were required to commit themselves to developing, within the country, certain phases of the so-called "basic production process", along with a commitment to invest 5% of their informatics and microelectronics-products sales in research and development —including 2% in partnerships with universities or research institutions in which they had no financial stake.[14] The production of components ceased to be considered a policy priority for the sector (MCT/FINEP/PADCT, 1993).

Beginning in the mid-1990s, monetary stability, greater access to credit, privatization and regulatory reform in telecommunications, along with mass access to cellular telephony, Internet and IT, strengthened the domestic market. This, accompanied by tax incentives, energized the ICT hardware industry, which continued to concentrate on developing end products.

Between 2001 and 2006 changes were made to the Information Technology Act, extending the incentives until 2019 and modifying the commitments that the firms were required to make. The innovation legislation of 2004, and the so-called *Lei do Bem* of 2005, provided new incentives for firms to invest in research and development, although

[14] Between 1993 and 2005, over US$ 5.37 billion was invested in research and development under the Information Technology Act. Up until September of 2006, investment under the Act had benefited 251 research institutions and universities, with various indicators —including those associated with training and the development of solutions, exported, in some cases, to parent firms— pointing to positive results. The R&D activity, however, has focused on adapting and developing applications and firmware (software incorporated within hardware), with little effort to enhance the capacity to develop projects and produce electronic hardware (ABINEE, SBMicro, Fundação CERTI, 2006). Moreover, this activity has had no significant effect on production (MCT, 2003; García and Roselino, 2004). The research programme HardwareBR, which is a high-priority area for investments made under the Information Technology Act, seeks to correct some of these deficiencies by strengthening local capacities.

it is unclear whether those receiving benefits under the Information Technology Act were also entitled to benefit from provisions of the innovation law. The *Lei do Bem* also reduced sales tax on computers. According to data from the Brazilian Electrical and Electronics Industry Association (Associação Brasileira da Indústria Elétrica e Eletrônica, or ABINEE), this initiative, along with oversight measures, drastically reduced the so-called grey market, from 70% of the total in 2003 to 30% by 2007. In 2007, a policy package of new support measures to accelerate growth was formulated. This consisted primarily of sales tax reductions on computers, semiconductors and digital TV equipment (radio frequency signal transmitters).

(ii) Ongoing dynamics

The incentives structure that began with the MFZ and the Information Technology Act solidified an industry based on the local assembly of imported components,[15] oriented principally to the local market and only secondarily to export —the latter limited primarily to Latin America.

In 2006, sales of Brazil's ICT hardware industry totalled US$ 24.4 billion (data from ABINEE and SUFRAMA), with a reduced share in aggregate economic indicators. Informatics and electronics represented 0.1% of total value added, while the telecommunications industry accounted for 0.3% (MDIC, 2007). The two segments together represented 1.4% of manufacturing jobs, a percentage that varied only slightly in the 2000-2006 period (MDIC, 2007). In 2006, these areas of activity accounted for 1.5% of the country's foreign direct investment (4% of manufacturing FDI), compared to maximum amounts of 4%-6% between 1999 and 2001 (16%-17% of manufacturing FDI).

The sector's trade balance has been consistently negative, due to the weight of component imports and the priority placed on the domestic market as the target for production. Final telecommunications products are the only segment showing a surplus—although this balance is also negative if one includes components. In informatics goods, the trade balance is negative, even for end products (see table IV.3).

Brazil accounts for only a marginal share of world trade in ICT hardware, and does not stand out as a low-cost production venue. The country's taxes and logistical and bureaucratic costs are relatively high, and it does not offer easy access to the principal markets, lacking the advantages of geographical proximity to such markets enjoyed by Mexico.

15 Tax incentives are supported through import taxes which, although lower than in the past, are maintained at levels that give local production (primarily production of goods for final consumption) a significant advantage.

The exchange rate is often also not strengthening the country's ability to compete. Despite the reduction in the cost of imported inputs, the net effect was an increase in the dollar cost of end products.

Table IV.3
BRAZIL: ICT HARDWARE TRADE BALANCE, 2006
(In millions of dollars)

	Exports	Imports	Net
Televisions	69.4	41.8	27.5
Telecommunications	3 109.5	1 234.0	1 875.5
Mobile telephones	2 663.3	281.6	2 381.8
IT	407.0	1 389.3	-982.3
Components	561.3	9 491.7	-8 930.4
IT components	92.6	2 177.5	-2 084.9
Telecommunications components	188.7	2 420.4	-2 231.6
Passive components	103.3	431.1	-327.9
Semiconductors	96.5	3 330.6	-3 234.1

Source: Associação Brasileira da Indústria Elétrica e Eletrônica (ABINEE).

The major global OEMs and CMs have a presence in Brazil, although in some segments they face local competitors that lead (or are near the top of) their respective markets. The global firms operating in this market fall into five categories:

(i) Large cell phone manufacturers (for example Nokia and Motorola).

(ii) Manufacturers of products for operators of telecommunications infrastructure or fixed business telephony (such as Ericsson), as well as firms that have production operations in Brazil through CMs (Alcatel-Lucent) or that import equipment for use in their networks.

(iii) Highly diversified manufacturers of consumer electronics —primarily televisions, but also cell phones and computer monitors (such as Samsung Electronics, LG Electronics, Philips, Gradiente, Sony, Panasonic, Thompson Multimedia, CCE, Semp Toshiba).

(iv) Computer manufacturers (such as HP, Dell, Itautec, Positivo and a large number of local assembly firms).

(v) CMs (such as Foxconn, Flextronics/Solectron, Celestica, Jabil, Huawei, Benchmark, JHT, Sanmina) whose activities range from producing plastic parts and surface mountings to complete assembly of cell phones, computers and other products.

These firms are largely concentrated in Manaus and in the state of São Paulo. In addition to the fact that the tax incentives they enjoy for producing in the MFZ are greater than what the Information Technology

Act provides as incentives for production in other parts of the country (thus partially compensating for the region's higher logistical and labour costs), these benefits also apply to a wider range of products, including televisions. This explains why the production of televisions and related equipment, such as set-top boxes, is concentrated in Manaus, while the production of other types of ICT hardware is distributed throughout the rest of the country, with a particular concentration in São Paulo, which offers logistical advantages and access to labour and markets. For a number of products, including cell phones, the balance is not clearly weighted in favour of either the MFZ or of the rest of the country: Nokia, for example, has been traditionally located in Manaus, while Motorola has operations in the state of São Paulo. Thus, the regions compete for investment in the manufacture of certain products.

In terms of the components industry, the Information Technology Act and the conditions for production in the MFZ make it mandatory for all phases of production, starting with assembly of the circuit boards, to be carried out domestically. The obligation to use domestic inputs is limited to products with low technological content, such as batteries and battery chargers. Both foreign and domestic firms rarely go beyond what the basic production process (BPP) requires. In addition to the Asian competition, the import tariffs on some basic inputs for the manufacture of electronic components, such as aluminium and polypropylene film used in making capacitors,[16] are higher than the tariffs on components, thus making local production difficult (Becker, 2007).

The factors limiting export competitiveness also make it difficult to produce strategic components on an efficient scale, which is generally beyond the needs of the domestic market. There are very few semiconductor manufacturers that have sited the encapsulation phase of the production process in the country. There are several initiatives to foster microelectronics, like the Centre of Excellence in Advanced Electronic Technology (CEITEC), which has been launched in the state of Rio Grande do Sul.

(iii) Effects of changes in the global industry

Technological and organizational changes in the global industry expanded the model of assembly of imported components destined for the local market and largely dependent on fiscal incentives and tariff protections. The shortening life-cycles of electronic components and products, the increasing research and development costs involved in remaining competitive, the proliferation of low-cost producers, and the growing innovation capacity of Asia (particularly China) created obstacles for Brazil's components industry. The country's audio and video segment

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16 A capacitor is composed of two conductors separated by an insulating material that acquires a particular electrical charge when subjected to a difference in voltage.

has already ceased manufacturing of a number of low value added electronic products.

The convergence of services has created demand for new multi-functional products, e.g., the so-called smart phones, as well as the hardware associated with digital television. The introduction of digital TV presents an important opportunity for Brazil. Brazil has decided to opt for a modified version of the Japanese standard ISDB-T (Integrated Services Digital Broadcasting), which is competing with the North American standard ATSC and the European standard DVB (which is the most popular standard in the rest of Asia and Africa as well). Other countries in the region, such as Argentina, Chile and Peru, have followed Brazil's lead, and the demand for ISDB equipment could lead to important effects on Brazil's TV production segment.[17]

The deverticalization of production has had greater effect on the ownership of assets and the types of actors in the field than on the nature of production, which is determined by the BPP. CMs increased their presence in some markets by acquiring plants from OEMs and continuing the same lines of production.[18] Another factor in Brazil was that declining profitability forced OEMs to refocus their activities on services or on specific segments. The country has demonstrated its potential as a centre for business process outsourcing (BPO), and it was for that reason that IBM chose Brazil, the Russian Federation, India and China (known collectively by the acronym "BRIC") as locations for investment when it decided to concentrate on corporate services and solutions.

In short, despite the presence of the largest global ICT hardware producers, the size of the Brazilian industry is limited, due to the size of the domestic market, constraints on export capacity, and poor local production quality in the various production stages —a result of deficiencies in the country's electronics components industry. These constraints account for the relatively low proportion of value added and job creation of Brazil's industry in relation to the industry worldwide, as well as for its negative trade balance. The absence of a components industry —particularly semiconductors— limits local value added and impedes the development of

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[17] Independent of equipment production, Brazil's adoption of the Japanese digital TV standard created an opportunity for Brazilian firms to develop and export video coding technology and to produce software and middleware, i.e., software that permits connection and data exchange between components or applications (Augusto Gadelha, Ministry of Science and Technology, at the ABINEE TEC 2007 seminar).

[18] OEMs have various strategies for making use of CMs in Brazil. Some firms outsource the entire manufacture of all or almost all of their products, while others use CMs only for certain products. Still others use them for particular phases of the production process, such as surface mounting of circuit boards. CMs also provide a means of meeting the requirements of the Information Technology Act (BPP and R&D investment), as reflected in the tax management services that some of them offer their clients.

innovation capacity (FINEP/MCT, 2004). As a consequence, there is a large gap between the country's potential and what it has actually achieved —a gap that has increased due to technological and organizational changes in the global industry.

(b) ICT hardware in Mexico

(i) Historical evolution

Mexico's ICT hardware industry grew significantly in the past two decades. A major portion of the country's FDI flowed to this sector, and major production clusters emerged. Although the Mexican industry became integrated with global ICT hardware production networks, especially those targeting the North American market, it is currently facing serious problems due to the sluggishness of its transition to higher value added activities, as well as to deficiencies in its parts and components production. Three types of actors stand out in the industry dynamic: domestic firms, subsidiaries of foreign firms, and maquila plants located in the northern part of the country (Padilla, 2005).

The domestic firms began production in the 1950s, manufacturing radios and black and white televisions, switching to colour televisions two decades later. At the same time, Mexico's industrialization policy attracted firms with foreign capital seeking access to the growing Mexican market, via the production of consumer electronics and components. In this context, the rules of origin imposed by the government promoted a high level of integration of national components, and around 1970 local production accounted for approximately 90% of the value of televisions (Lowe and Kenney, 1999).

Production grew sharply until the trend changed direction in the 1980s. As a result of excessive protectionism, an emphasis on locally-produced components and a failure to recognize the importance of technological development, the consumer electronics industry remained on the sidelines of global industrial progress. A complex set of factors was to blame: lack of competitive pricing, quality and product types; insufficient scales of production, particularly in parts and components; lack of innovation; and inability to gain access to international markets (Warman, 1987; Peres, 1990).

With the crisis of the 1980s, the government abandoned its industrialization model. At the same time, with the liberalization of trade and foreign direct investment, the domestic industry found itself confronting highly competitive international supply. As a result, a number of domestically financed firms were acquired by transnational firms or reoriented their commercial activities (Padilla, 2005).

In 1981, shortly before the transition to the new model began, a programme was approved to promote the manufacture of informatics systems and of computer hardware and peripherals,[19] through tax incentives and trade protections covering both end products and components. During the first years of the programme, IBM and HP located computer manufacturing plants in the state of Jalisco.[20] Although the programme had some success in stimulating local production and reducing the importation of equipment, the trade balance remained negative, and in the 1986-87 biennium domestic components represented less than 10% of the total (Peres, 1990).

At the beginning of the 1980s, foreign firms (Ericsson, the Alcatel subsidiary Indetel, and NEC) accounted for 95% of telecommunications equipment production. However, the difficulties involved in manufacturing advanced components prevented the degree of integration that had been achieved in consumer electronics (Peres, 1990). As of the middle of that decade, there began to be a sharp increase of investment in the segment, particularly by AT&T, NEC and Mittel. In the second half of the 1990s, with the help of investment from CM firms such as Solectron, Flextronics, Jabil, Universal Scientific Industrial, Benchmark Electronics and VOGT, Mexico began to play an important role in world production networks (Padilla, 2005).

The industrialization of Mexico's northern border area was an important factor driving integration with global networks, for two reasons. One was the competitive pressure of the Asian industry, headed by Japan; the other was the presence of the Border Industrialization Programme (Programa de Industrialización Fronteriza, or PIF). United States companies were having difficulty maintaining their share of the colour television market in the face of increasing Asian competition —particularly from Japan (Porter, 1983; Porter, 1986)— and were forced to shift some productive activities to low labour-cost countries. The providers of television parts and components were the first to move to Mexico (Lowe and Kenney, 1999).

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[19] Flowing from the national industrial development plan (1979-1982), its goals included developing a sector capable of supplying a major portion of the local computer market (70% by 1986) and driving technical training and technological development. The programme was not based solely on import substitution, but also emphasized access to international markets.

[20] IBM located facilities in Mexico City in 1957, and moved to Guadalajara in 1975. Only in 1985, however, after modifications were made to the provisions of the 1981 programme, was it able to install a plant totally financed by foreign capital, as part of the transition from typewriter assembly to production of equipment and machines. HP installed a PC assembly plant in 1982, focused essentially on the domestic market, as well as an R&D centre that designed its computer memories and controllers (Ordoñez, 2005).

With the termination of the *braceros* programme in 1964,[21] the Mexican government implemented the PIF (also known as the maquila programme) in 1965 to attract United States investment for assembly operations. Under this scheme, the firms locating within a strip extending 10 miles from the United States border would be exempt from import taxes if they re-exported their entire production.

Although the PIF attracted investment, it was not enough to create backward chains to drive the domestic components industry and strengthen domestic firms. The weakness of the links between foreign industry and the domestic industry, the poor reputation of Mexican companies, bias in favour of Asian parts, and the centralized purchasing structure of United States firms prevented even the most competitive Mexican firms from entering the supply chains (Lowe and Kenney, 1999).

Moreover, the closing of some maquila plants during the 1974-1975 recession intensified the perception among Mexican businesses that United States investment was unstable, and that being a provider to the United States firms was a risky proposition (Sklair, 1993). The subsequent overvaluation of the national currency created a sharp increase in labour costs, and thus in production costs, at a time when televisions and components could be assembled more cheaply in Asia. This is why, in the late 1970s, the majority of semiconductor assembly operations were located in South-East Asia (Scott, 1987). In the 1980s, United States firms increased their acquisitions of Asian-produced components in order to remain competitive with Japanese production. Thus began a period of decreased electronics parts and components production in Mexico —a trend that persists today.

The maquila programme peaked in the 1980s and 1990s. Various ICT hardware OEMs installed facilities in the border states, principally in the cities of Tijuana, Mexicali, Ciudad Juárez, Chihuahua, Reynosa and Matamoros. The trade liberalization of the 1980s intensified with the implementation of the North American Free Trade Agreement (NAFTA) in 1994, giving rise to the entry of major OEMs such as Sharp, JVC and Thompson. The NAFTA rules of origin established restrictions on the importation of machinery, components and inputs produced outside the NAFTA region, which led some Asian producers to locate in Mexico.[22]

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21 The *braceros* programme, which lasted from 1942 to 1964, provided the United States with short-term migrant workers to compensate for the scarcity of workers during the Second World War and in the immediate post-war period. Approximately 4.5 million Mexican workers participated in the programme.

22 This development is consistent with what occurred in the electronics industry overall. For more detail, see Padilla (2005).

(ii) Ongoing dynamics

The principal ICT hardware clusters are located in the border states of Baja California, Chihuahua, Nuevo León and Tamaulipas, and in areas in the interior of the country, such as Mexico City and the states of Jalisco and Mexico.

In Baja California, where major OEMs are located, production in the cities of Tijuana and Mexicali focuses on televisions for export to the United States and Canadian markets. To move this development forward, it would be necessary to increase local manufacture of components —a prospect made difficult by the competition from China. These industrial groups were also affected by the importation of liquid crystal displays (LCDs) from Asia. Of the few existing semiconductor and integrated circuit firms, a number have set up operations in the area.

The industrial cluster in the state of Jalisco is concentrated in the metropolitan area of the state capital, Guadalajara, and focuses on manufacturing computer hardware and peripherals, along with telecommunications equipment —not necessarily finished products. The world's most important CMs and some OEMs have a major presence there, and their presence has attracted a number of support and supply firms.

The industrial cluster in the state of Chihuahua, which is concentrated in the capital and in Ciudad Juárez, is oriented to the production of televisions, monitors and telecommunications equipment, primarily for export. Major high-tech OEMs have located there, such as for televisions, telephone switchboards, cable TV decoders and mobile phones.

The industrial clusters in the states of Nuevo León and Tamaulipas produce consumer electronics, telecommunications equipment and industrial equipment, without any particular specialization. These states also have OEMs such as Northern Telecom in Nuevo León (telephones and communications equipment), and LG Electronics (televisions), Key Tronic (printers) and Nokia (cell phones) in Tamaulipas. Both states have major CMs: Celestica, Elcoteq, Sanmina and Jabil. Finally, the cluster in Mexico City and the state of Mexico includes OEMs such as Acer and Dell (computers) and Siemens, Alcatel-Lucent and Ericsson (for computers and telecommunications equipment), but CM firms are noticeably absent.

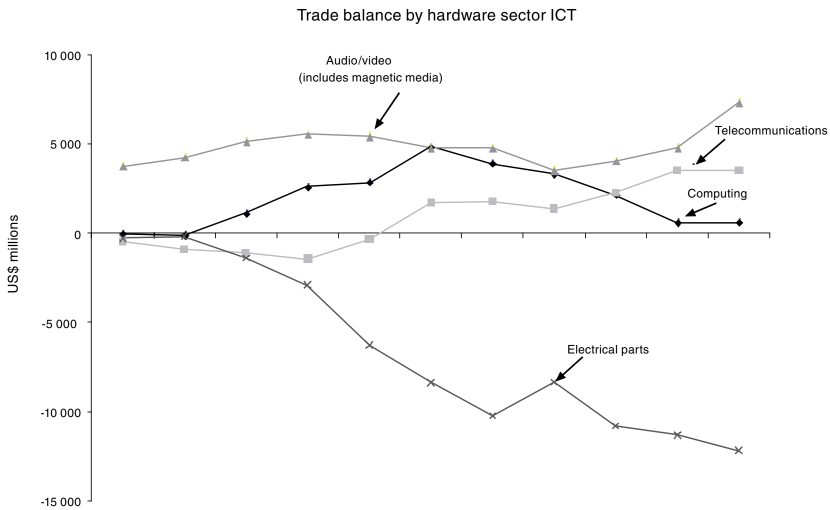
In summary, the ICT hardware industry has a major presence in Mexico, as reflected in the fact that its industrial clusters include a number of the principal OEMs in screen, television, computing and telecommunications technology, as well as some of the major CMs. However, the absence of major global producers of advanced components for the sector is striking.

Foreign direct investment and the trade balance

Between 1999 and 2006, Mexico's electrical and electronics equipment sector received US$ 13.415 billion in foreign direct investment (FDI), representing 18.8% of all industrial FDI. Of this amount, 44% was for the production of ICT hardware (18% for computers, 15% for telecommunications equipment and 11% for the manufacture of televisions, radios and components for both).

There was a positive trade balance for 1996-2006, due to the fact that exports of finished or partially assembled ICT hardware products grew faster than imports. The components sector, however, showed a negative balance, as a result of the country's deficiencies in that segment (see figure IV.2), leading to a low percentage of domestic value added as a proportion of the value of total exports.

Figure IV.2
MEXICO: TRADE BALANCE OF THE ICT HARDWARE INDUSTRY BY SEGMENTS



Source: Author, based on information from the Mexican Secretariat of Economy, Directorate of Foreign Investment.

Note: The audio/video category includes televisions.

Firms with differing technological and production characteristics exist side by side in the industry. Some of the these, such as Intel, Sony and Plantronics, have design and R&D departments, while others, such as HP, have shifted from manufacturing to high value added services. Although investment in automated equipment and robotics plays an important role, the industry focuses on labour-intensive operations in manufacturing, assembly and sub-assembly.

(iii) Effects of global changes in the industry

Liberalization, digital convergence and competition led to the emergence of worldwide production networks (Ernst, 2003). The major global CM firms with operations in Mexico, principally in the specialized computing and telecommunications clusters in Jalisco and Chihuahua, play an important role in the activity of those networks in the North American market. In terms of the transfer of knowledge concerning process design, logistics and management of supply chains, the effect of those CMs is different from that of traditional printed circuit assembly plants, or "board stuffers". While the latter assemble products under the direct supervision of the OEMs, CMs can develop and oversee more complex products and processes, and even directly serve the clients of OEMs (Sturgeon, 1999; Luthje, 2003). These knowledge transfers give rise to significant knowledge spillovers in the area of operations management.

The deverticalization of the production chains made it possible for some firms to change their focus of activity and move into links of the chain that generate greater value added. Examples are IBM and HP in Jalisco, an Intel plant that was installed as a design centre but later moved towards research and development, and Plantronics, which replaced its manufacture of wired and wireless headphones with research and development, design of equipment and packaging, and a technical support centre for its clients.

The modularization of networks not only created opportunities for large firms, but also led to the emergence of smaller "design houses" (in reality, CMs devoted to design and R&D), which operate under contracts with large firms such as HP. This modularization, combined with the digitization of products, led to the opening of an important area of development: the production of firmware or embedded software).[23]

The presence of worldwide production networks led to the international dissemination of knowledge, offering local providers opportunities to strengthen their capacities (Ernst, 2003), and the Mexican industry was no exception.[24] In addition to reinforcing the importance of the networks, the convergence affected firms' strategies and operations,

[23] This type of software permits interaction with devices such as: hard drives; industrial plant processes and equipment such as motors and valves; automobile parts; airplanes; telephone equipment; printers; and toys.

[24] The transition to higher value added stages of production required the firms to invest in training. In many cases, it was necessary to modify the personnel profile, raising the minimum academic requirement to a college degree, which entailed a corresponding increase in salaries.

while stimulating demand. Specifically, it led to the emergence of products whose final assembly involved significantly stricter quality criteria —a situation which, combined with a shortening of the product life-cycle, required organizational and logistical changes. In this environment, the OEMs and CMs in Mexico became major suppliers of the demand for convergent products in the North American market.[25]

Digital convergence also increased the efficiency of business process outsourcing (management of payroll, human resources and accounts payable), since the new systems allow for more rapid and efficient management of the supply chain, with greater information available online, while increasing the ability to respond rapidly to clients. This facilitates, or reduces the obstacles to, outsourcing, making it possible to reorient the products and services offered by some firms.

4. Policy issues

The ICT hardware industries in Mexico and Brazil created jobs, disseminated knowledge and offered opportunities for local business capacities to expand, in addition to providing domestic markets a broad range of products close to the technological frontier. Despite their different market orientations, however, these two countries face the same challenge of transitioning to activities with higher value added. In terms of production, this means developing an advanced electronic components industry, particularly for semiconductors, but also to take advantage of the upcoming transition to digital television. During the coming decade, the foreseeable change of paradigm in the basic hardware production technology, although it will create much uncertainty, offers opportunities to take advantage of a new paradigm in the evolution of the post-silicon era of computing.

Despite the presence of the major transnational producers of ICT hardware, the absence of large components producers limits local value added and is a barrier to developing the industry's innovative capacity (FINEP/MCT, 2004). This situation tends to be aggravated by recent global transformations in the sector's industrial organization and by the emergence of new technologies, since technical progress, shorter product life-cycles and larger scales of production are creating growing obstacles to accessing the world market.

25 For example, the advent of digital television led to changes in the strategies of the major OEMs, which invested in industrial plants for the assembly of new components, such as circuit cards. The plants were designed to be flexible and to permit the assembly of circuit boards for other products as well, e.g., digital cameras and video players.

International experience shows that developing an advanced electronic components industry (primarily semiconductors) requires export competitiveness and sectoral policies (Gutiérrez and Leal, 2004; FINEP/MCT, 2004). Thus, improving the factors that define export competitiveness —infrastructure, productivity, technological capacities, availability of skilled labour, efficiency of management processes and tax costs— becomes a necessary condition for the development of this industry, since it makes it possible to increase the scale of production and the world market share of end products. To date, the incentives in place have favoured the production of these types of products. In terms of sectoral policy, the essential point is to determine whether domestic production of advanced components and finished products can be supported without increasing their costs or impairing the competitiveness of other links in the production chain —or of the other economic activities that consume these products. Such a loss of competitiveness would jeopardize existing investment in the manufacture of end products, with negative effects on the components segment itself, moving the countries even further from the technological frontier.

While other countries in the region have staked their attempts at international insertion on investing in services such as design, post-sales services, business process outsourcing, and software and middleware production, Mexico and Brazil have kept ICT hardware production among their policy priorities. While Mexico seeks to strengthen its position in international production chains in hopes of becoming a world centre for electronics manufacture, Brazil is attempting to strengthen its industrial structure by supporting the semiconductor industry.[26] In both countries, the implementation of specific sectoral policies could produce results in the medium term. However, unless the structural factors that are impeding the sector's growth are improved, the most probable outcome is more intense specialization in applications for specific market niches or in design activities, but not in the large-scale production that would make it possible to substantially change the nature of the ICT hardware industry in these countries.

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[26] The reference documents in the policy realm are the 2001 Mexican programme for the competitiveness of the electronics industry and high technology, and Brazil's 2003 guidelines on industrial, technological and foreign trade policy, which served as a framework for the May 2007 implementation of the programme to support the technological development of the semiconductor industry (PADIS) (Law 11484). Both countries also place priority on the software production sector (Peres, 2006).

B. Software and related services

1. Introduction

The software and services industry (SSI) can be a source of economic growth for two reasons. First, in an economy increasingly based on information and knowledge, software is an essential tool for increasing productivity in other sectors. As discussed in chapter III, it is the digitization of processes that increases productivity, but this process is path dependent and often requires local support and tailor-made attention. Second, the industry is in a phase of strong expansion, and offers great export opportunities. Specifically, technological advances in communications and systems architecture generate skilled jobs and opportunities for exporting remotely produced goods and services. In the face of new possibilities for decentralizing services and software production, the major transnational firms are locating their bases of operation outside their countries of origin to reduce costs and to gain access to skilled human resources.

This section analyses the SSI in six countries (Argentina, Brazil, Colombia, Chile, Mexico and Uruguay), in order to: (i) identify the opportunities and problems created by the industry trend of moving operations to other countries through offshore outsourcing; (ii) assess the factors influencing international competitiveness; and (iii) analyse the business strategies being implemented in the region.[27] The section has four parts. The initial part examines the performance and evolution of the SSI in the region's countries based on indicators of sales, exports and employment. The second identifies the principal transnational corporations in the region's SSI, while the third examines their strategies, distinguishing those that use the industry as an outsourcing platform from those that do it only as a means of distributing their products. The fourth part describes in detail the major domestically financed firms and their strategies.

2. Performance and evolution

Latin America's role in the global SSI is more limited than might be expected, although its share has gradually increased, due to a growing domestic market and expanded export opportunities. The share of global offshore operations accounted for by the firms operating in 14 Latin American

[27] ICT outsourcing can be divided into two types, with increasing levels of complexity. The first is information technology outsourcing (ITO), in which a specific activity (hardware and equipment production, or application management and maintenance) is outsourced. The second is business process outsourcing (BPO), in which a firm signs a contract with an outside organization, which assumes the responsibility for managing the firm's business processes. BPO is an information technology enabled service (ITES) associated with advances in information and communications technology (Gutierrez and Alexandre, 2004).

countries increased from 1.9% in 2001 to 2.7% in 2005 (WITSA, 2006).[28] These operations are concentrated in the six countries analysed in this chapter, which account for approximately 90% of the region's total SSI revenues.

Among the countries studied, the weight of the SSI as a percentage of total production is greatest in Uruguay, Chile and Brazil, whose respective sales-to-GDP ratios are between 1% and 2%. In Mexico and Colombia, in contrast, the industry represents less than 0.5% of GDP, which indicates that there is still ample opportunity for growth. The figure for Argentina, 0.8% of GDP, lies in the middle of the range (see table IV.4).

Table IV.4
SOFTWARE AND SERVICES INDUSTRY SALES AND EXPORTS, 2004
(In millions of dollars and percentages)

	Sales	Exports	Sales/GDP coefficient	Export coefficient
Argentina	1 173	191.6	0.77	16.3
Brazil	8 213	314.0	1.36	3.8
Chile	1 385	68.8	1.46	5.0
Colombia	340 [a]	10.3 [b]	0.35	3.0
Mexico	2 871	125.0	0.42	4.4
Uruguay	226	88.7	1.70	39.3
Total	14 208	798.4	0.85	5.7

Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

[a] Does not include local service firms. Estimated, based on the sales of 561 firms: 542 local software development firms (US$ 150 million in sales) and 19 subsidiaries of multinational firms (US$ 190 million in sales).

[b] Exports of 542 local software development firms.

The relative weight of the SSI depends not only on level of economic development, but also on patterns of specialization in a country's economy. In Uruguay, the importance of the SSI is a function of its role in exports, which represent 40% of total SSI sales; in Brazil, the spread of information technology is particularly important in banking; in Chile, the SSI's horizontal distribution across different economic areas is more even.

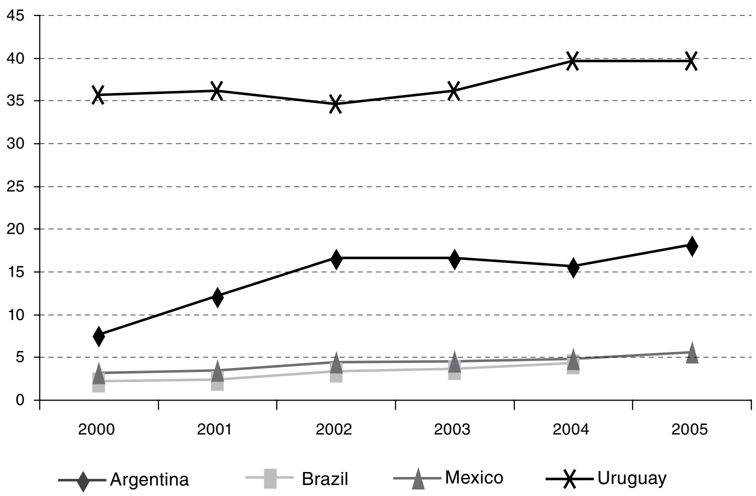
Starting in 2000, SSI sales became relatively stable as a proportion of GDP moving in parallel with the growth of the regional economy as a whole. In Uruguay from 2000 to 2002, the sector's relative weight grew from 1.1% to 1.9% of GDP and finally dropped back to 1.6%. In Brazil, the pattern was similar, with an increase from 1.2% to 1.7% between 2000 and 2002, and a subsequent drop to 1.3% in 2005. In Argentina, the sector's

[28] Bolivia, Costa Rica, Ecuador, Honduras, Jamaica, Panama, Peru and the Bolivarian Republic of Venezuela, in addition to the six countries examined in detail in this chapter.

share did not vary greatly, fluctuating between 0.7% and 0.8%. The pattern in Mexico was also stable, hovering around 0.4%.

SSI firms gradually increased their exports, especially within the region. Given the major differences in size among the countries examined, it is important to analyse SSI exports in relative, as well as absolute, terms. In this context, Uruguay stands out for its high export coefficient (around 40%), although its foreign sales have increased rather slowly in recent years (5.6% annually) (see figure IV.3).

Figure IV.3
EXPORT COEFFICIENTS FOR THE SOFTWARE AND SERVICES INDUSTRY, BY COUNTRY, 2000-2005
(In percentages)



Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Note: In the case of Argentina, the indicator for 2001 is estimated, based on linear growth in the 2000-2002 period. With regard to Brazil, the indicators for 2002 and 2003 are estimates, based on linear growth in the 2001-2004 period.

The great export boom occurred between 1993 and 1998, when exports increased from US$ 4.5 million to US$ 60 million, for average annual growth of 68%. SSI exports represent between 2% and 3% of the country's total goods and services exports, while the figures for other countries in the region do not exceed 0.5%. Over 60% of the Uruguayan sector's exports consist of software development, where value added is higher than in services (González, 2007).

Argentina is the second largest exporter in relative terms, with an export coefficient of 18.5% in 2005. Between 2000 and 2005, despite the economic crisis in 2000-2002, exports grew at an annual rate of 11%. After the devaluation of the peso, there was a recovery, with annual growth of 24%, bringing the value of exports to US$ 245 million in 2005. The data on Uruguay and Argentina show that the countries with higher export coefficients are those with the highest indicators for education.[29]

SSI firms in Brazil, Chile, Colombia and Mexico are essentially oriented to their domestic markets. In Brazil and Colombia, exports represented only 3% of sales in 2004 (the last year for which information is available), while in Chile and Mexico sales to the foreign market accounted for 5% of billings in 2005. However, exports showed gradual but steady growth, especially in Mexico and Brazil, where domestic competition intensified, making it difficult to sustain strategies based exclusively on the domestic market.[30]

Not surprisingly, the region's three largest countries have the greatest amount of exports in absolute terms. Brazil's SSI sector tripled its foreign sales between 2000 and 2004, reaching US$ 314 million in that year. Two notable increases in export performance occurred in Mexico between 2003 and 2005, with annual growth of 29%, for a 2005 sales figure of US$ 164 million.

The growth in foreign sales has also meant a larger share of the world market. Brazil, Argentina and Mexico significantly increased their shares (see figure IV.4), and Brazil's doubled, rising from 0.17% to 0.35%. Among the other countries studied, only Uruguay's market share failed to increase (stagnating at around 0.1%).

The spread of ICT in the region increased the demand for skilled professionals, not only in the SSI but also in user firms.[31] In 2005, SSI firms operating in Latin America employed 337,000 workers (0.2% of the economically active population, see table IV.5), not counting informal employment and workers employed by user firms.[32] López and Ramos (2007) estimate that ICT workers represent approximately 1.9% of the total workforce. This is close to

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29 This conclusion is confirmed by the fact that Costa Rica's SSI export coefficient was 46% in 2004.

30 Ecuador exports US$ 10 million (11.6%) of its sales. Because of the small domestic market, the country's firms are making efforts to gain foreign clients. Signum is the most successful firm, because of its development of a Spanish version of the Microsoft Word spellchecker.

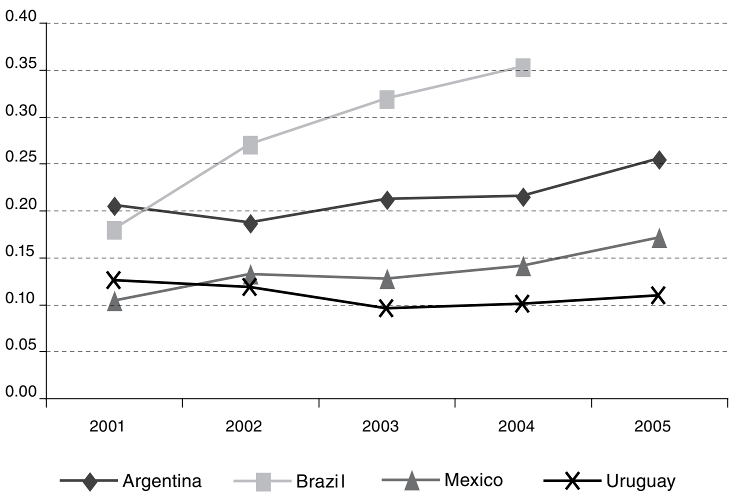
31 In 2005, for example, domestic software development by user firms employed 269,000 workers in Mexico, nearly five times more than the 54,000 workers employed directly in the SSI (Mochi and Hualde, 2007).

32 For example, the Federación Nacional de las Empresas de Informática (FENAINFO) estimates that the software sector employs one million workers in Brazil, 70% without formal employment arrangements.

half the figure for OECD countries, where activities directly associated with ICT employ 4% of all workers (who work either in ICT-sector firms or in user firms). In other words, in Latin America only 1 out of 500 employed persons in the region works in the SSI, in contrast to developed countries, where one out of 250 workers is dedicated to developing and producing software goods and services and in sharper contrast to countries like Canada, where the ratio is 1 out of 50 (figures based on OECD). In addition to ICT workers as such, it is estimated that in OECD countries approximately 20% of urban workers use ICT in their work to some degree, even if these technologies are not the primary focus of their work (OECD, 2006).

In the region, the country where the greatest proportion of the active population is employed in the SSI is Chile (0.4%), followed by Uruguay (0.3%) and Brazil (0.2%). Ecuador, at 0.07%, generates the least employment in the sector, in relative terms (see table IV.5 and figure IV.5). In the four countries for which historical series on SSI employment are available, figures show an upward trend. One of these is Argentina, where the sector's share of jobs among the active population has doubled (from 0.1% to 0.2%). In Brazil, Mexico and Uruguay, this increase does not exceed 0.05%.

Figure IV.4
MARKET SHARE OF GLOBAL SOFTWARE AND SERVICES INDUSTRY EXPORTS, BY COUNTRY, 2001-2005
(In percentages)



Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

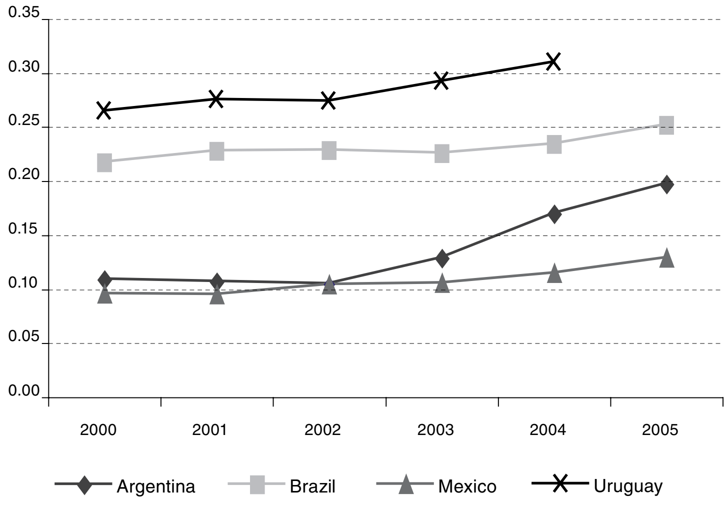
Note: The 2002 and 2003 indicators for Brazil are estimates based on linear growth in the 2001-2004 period.

Table IV.5
SOFTWARE AND SERVICES INDUSTRY EMPLOYMENT, 2004

	Jobs (thousands of persons)	Percentage of total jobs
Argentina	26.3	0.17
Brazil	197.3	0.23
Chile	24.9	0.44
Colombia	31.7	0.17
Ecuador	4.5	0.07
Mexico	47.6	0.11
Uruguay	4.9	0.31
Total	337.2	0.19

Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Figure IV.5
SOFTWARE AND SERVICES INDUSTRY EMPLOYMENT AS A PROPORTION OF ALL EMPLOYED PERSONS, BY COUNTRY, 2000-2005
(In percentages)



Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Note: The 2001 indicator for Argentina is an estimate, based on linear growth during the 2000-2002 period.

3. Transnational firms

Despite the fact that it offers opportunities for small and medium-sized firms, SSI globally is highly concentrated in specific markets. The industry is subject to very large economies of scale in the production of digital goods and is increasingly globalized, as a result of advances in communications technologies that permit geographical redistributions of operations. The nine transnational SSI firms, analysed in this chapter, with the largest presences in the region can be classified in three groups, according to the type of market that they target (see table IV.6): (i) those that are active only in the services segment; (ii) those that are active in equipment and systems as well as services; and (iii) those whose end product is software. In 2005, at the world level, these nine firms employed nearly one million persons and had billings on the order of US$ 300 billion, representing approximately 30% of the world software and services market (WITSA, 2006). As will be seen further on, the various combinations of products and services have clear effects on the creation of jobs and on generating exports.

Table IV.6
CLASSIFICATION OF NINE TRANSNATIONAL FIRMS BY GROUP OF ACTIVITY

	Group I Services only	Group II Services, equipment & systems	Group III Software as an end product
Firms	Accenture EDS TCS	HP IBM Unisys	Microsoft Oracle SAP
Examples of activities	Outsourcing, systems integration, data centres, consulting	Projects, systems integration, data centres, call centres, applications, outsourcing	Operating systems, data banks, ERP

Source: Tigre and Marques (2007).

The central subject of this section is the region's role in the competitive strategies of these large transnational SSI firms, whether as a consumption market or as a production pole. In 2005, the nine firms had sales of US$ 7.3 billion in the region (2.5% of their world revenues). Not surprisingly, Brazil was the largest market, with sales of US$ 5 billion, followed by Mexico with US$ 1 billion, and Argentina and Colombia each with US$ 500 million (see table IV.7). These firms account for nearly half of the Latin American SSI market, representing 55% of the market in Argentina, 48% in Brazil, 44% in Ecuador and 34% in Mexico.

Table IV.7
SALES OF TRANSNATIONAL SOFTWARE AND SERVICES FIRMS IN LATIN AMERICA, 2005
(In millions of dollars)

Firm	Argentina	Brazil	Chile	Colombia	Ecuador	Mexico	Uruguay	Total (countries) [a]	Total (world) [b]	Ratio [a b]
Group I										
Accenture	60 [a]	281	...	...	...	59	...	400	17 094	2.3
EDS	25 [a]	501	...	...	...	233	...	758	20 377	3.7
TCS	< 5	15	50	...	...	...	...	65	2 900	2.3
Total Group I	85	797	50	0	0	292	0	1 224	40 371	3.0
Group II										
HP	263	1 100	...	218	5	183	...	1 769	85 172	2.1
IBM	252	1 722	...	120	21	220	...	2 336	96 068	2.4
Unisys	17	377	...	36	...	59	...	489	5 772	8.5
Total Group II	531	3 199	0	374	26	463	0	4 593	187 012	2.5
Group III										
Microsoft	22	526	53	80	5	217	...	904	39 788	2.3
Oracle	31 [a]	317	...	35	4	51	...	438	11 799	3.7
SAP	70	167	...	33	5	39	...	315	9 563	3.3
Total Group III	123	1 010	53	148	14	308	0	1 656	61 150	2.7
Total for firms	740	5 006	103	522	40	1 062	0	7 474	288 533	2.6
Total for domestic market	1 342	10 347	1 385 [a]	- [b]	90 [a]	3 128	265	19 973	-	-
Total for firms/ country total	55.2	48.4	7.4	- [b]	44.4	34.0	0.0	37.4	-	-

Source: OECD (2006) for world total, author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

[a] 2004 data.

[b] The data presented previously are not consistent with this source.

In terms of employment, the nine firms employed 13% of the region's SSI workers (see table IV.8), with the largest role, proportionally, in Argentina (21.9%). The figures for Brazil, Mexico and Uruguay were close to the regional average of 13%, while the figures for Chile, Ecuador and especially Colombia were below the average. Brazil accounted for 3.5% of global SSI jobs (29,000), followed by Argentina and Mexico with 0.8% (approximately 7,000 each), Chile (2,300), Colombia (1,000) and Uruguay (650).

To assess the relative importance of the region and each of its countries in these firms' global strategies, two indicators were developed: intensity of local labour (ILL) and local productive effort (LPE).[33]

[33] The Local Production Effort indicator (LPE) is calculated according to the following formula: LPE = [LE/GE]/[LS/GS]. Where LPE = local productive effort in country by firm. LE = local employment. GE = global employment of firm. LS = sales in the domestic marketplace. GS = global sales.

Table IV.8
JOB CREATION BY TRANSNATIONAL SOFTWARE AND SERVICES FIRMS IN LATIN AMERICA, 2005
(Number of workers)

Firm	Brazil	Chile	Colombia	Ecuador	Mexico	Uruguay	Brazil	Total (countries)[a]	Total (world)[b]	Ratio[a b]
Group I										
Accenture	1 800[a]	5 000	...	70	...	1 000	...	7 870	100 000	7.9
EDS	1 700	6 800	...	n/a	...	2 000	...	10 500	117 000	9.0
TCS	< 100	500	1 257	n/a	...	550	650	2 957	54 000	5.5
Total Group I	3 500	12 300	1 257	70	0	3 550	650	21 327	271 000	7.9
Group II										
HP	230	1 300	...	400	40	990	...	2 960	151 000	2.0
IBM	2 500	12 000	1 000	350	160	1 686	...	17 696	330 000	5.4
Unisys	< 100	2 100	...	n/a	n/a	128	...	2 228	36 400	6.1
Total Group II	2 730	15 400	1 000	750	200	2 804	0	22 884	517 400	4.4
Group III										
Microsoft	240[a]	400	75	100	37	427	...	1 279	61 000	2.1
Oracle	350[a]	800	...	150	n/a	640	...	1 940	49 872	3.9
SAP	185[a]	350	...	...	180	316	...	1 031	34 095	3.0
Total Group III	775	1 550	75	250	217	1 383	0	4 250	144 967	2.9
Total for 9 firms	7 005	29 250	2 332	1 070	417	7 737	650	48 461	933 367	5.2
Country total	32 000	219 321	24 912[a]	31 665[a]	4 468[a]	53 915	4 902[a]	365 483	-	-
Total for firms/ country total (%)	21.9	13.3	9.4	3.4	9.3	14.4	13.3	13.3	-	-

Source: OECD (2006) for the world total, author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.
[a] 2004 data.
[b] The data presented previously are not consistent with this source.

Intensity of local labour (ILL) indicator

ILL is an indicator representing the number of jobs per millions of dollars in sales that a firm creates in a country. It quantifies the intensity of local labour in relation to the world as a whole, as well as facilitating comparisons with other firms in the sector. It also makes it possible to assess employment levels, normalized according to the sales of specific segments of the SSI.

Proportionally, services firms create many more jobs than software development firms (see table IV.9). While the firms in group I employ 16.4 workers per million of dollars of sales in the region, those in group III employ only 2.6 workers. The products sold by group III firms in the region are packages prepared elsewhere. Not only do these companies do practically no local software development, they also do not export.

Table IV.9
INTENSITY OF LOCAL LABOUR (ILL), 2005
(In number of jobs per millions of dollars in sales)

Firm	Argentina	Brazil	Chile	Colombia	Ecuador	Mexico	Uruguay	Total (Latin America)	Total (world)
Group I									
Accenture	29.8	17.8	...	...	...	17.0	...	19.5	5.9
EDS	68.1	13.6	...	...	...	8.6	...	13.8	5.7
TCS	...	32.3	25.1	...	...	...	...	26.8	18.6
Total Group I	41.0	15.4	25.1	...	...	10.3	...	16.4	6.7
Group II									
HP	0.9	1.2	...	1.8	8.0	5.4	...	1.7	1.8
IBM	9.9	7.0	...	2.9	7.6	7.7	...	7.1	3.4
Unisys	...	5.6	...	...	...	2.2	...	5.1	6.3
Total Group II	5.1	4.8	...	2.2	7.7	6.1	...	4.8	2.8
Group III									
Microsoft	10.8	0.8	1.4	1.3	7.4	2.0	...	1.4	1.5
Oracle	11.3	2.5	...	4.3	...	12.6	...	4.5	4.2
SAP	2.6	2.1	...	...	36.0	8.0	...	3.7	3.6
Total Group III	6.3	1.5	1.4	2.2	21.7	4.5	...	2.6	2.4
Total for the 9 firms	9.7	5.8	12.9	2.2	6.8	6.8	n/a	6.3	3.2
Country total	23.8	21.2	18.0 [a]	- [b]	49.6 [a]	17.2	18.5 [a]	18.8	-

Source: OECD (2006) for world total, author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Note: Firms for which only sales data or only employment data were available were excluded from the analysis.

[a] 2004 data.

[b] The data presented previously are not consistent with this source.

Indicators of the relationship between sales and employment are traditionally associated with the concept of productivity. A higher index of sales per person employed implies the use of more advanced technologies and superior forms of work organization. However, the technologies used in the SSI, in terms of both hardware and software, are fairly similar around the world, leading to relatively uniform productivity rates. The computers and programmes used in the SSI are not a major part of production costs, and therefore do not lead to differences in productivity. Between 60% and 80% of the costs of these SSI firms are estimated to be directly related to labour, indicating that the sector is not highly capital intensive. This shows the importance of the jobs/sales in millions of dollars ratio as an indicator of the intensity of local labour. In addition, a higher ILL ratio can indicate which subsidiary firm's activities are most labour intensive in the context of world SSI operations. Examples of such labour intensive activities are call centres, writing of code and other activities with relatively little technological content. The trend is for countries with high labour costs to absorb higher value added activities that entail higher-level skills, such as advanced research and new product development.

World and regional calculation of ILL shows that service firms in Latin America employ 2.5 times more workers than the world average (16.4 jobs per million of dollars in sales, versus 6.7), indicating that the region is a global production pole that attracts labour-intensive activities. In firms that develop software as an end product, however, there is practically no difference between the region's ILL and the world figure. Only the more service-oriented companies (Accenture, EDS, TCS and IBM) have ILL above the average for the sample (6.3). From the point of view of economic activity and job creation, these firms are the most beneficial ones for the region's countries.

Local production effort (LPE) indicator

LPE represents the relationship between employment and sales in a given country, or worldwide. It is a useful indicator for the SSI, since this industry is labour-intensive, has relatively homogeneous technical coefficients, and produces tradable services that can be managed remotely. The LPE indicator makes it possible to assess the relative importance of the region in the global production and marketing strategies of the major transnational SSI firms. For the nine firms studied here, the region accounted for 5.2% of their workforce and 2.6% of their billings. The result is an LPE of 2.0, indicating that Latin America serves not only as a market, but also as a centre of production for software and services (see table IV.10). The production processes that the transnational firms in question carry out in the region are the relatively labour-intensive ones that take advantage of fairly inexpensive skilled human resources. An analysis of the indicators by groups of firms and countries, however, produces heterogeneous findings.

Table IV.10
LOCAL PRODUCTION EFFORT (LPE), 2005

Firm	Argentina	Brazil	Chile	Colombia	Ecuador	Mexico	Total (countries)	Total (world)
Group I								
Accenture	5.1	3.0	...	...	...	2.9	3.3	1.0
EDS	11.9	2.4	...	...	...	1.5	2.4	1.0
TCS	...	1.7	1.4	...	...	...	1.4	1.0
Subtotal	6.1	2.3	3.7	...	...	1.8	2.4	1.0
Group II								
HP	0.5	0.7	...	1.0	4.5	3.0	0.9	1.0
IBM	2.9	2.0	...	0.8	2.2	2.2	2.1	1.0
Unisys	...	0.9	...	...	...	0.3	0.8	1.0
Subtotal	1.9	1.7	...	0.8	2.8	2.2	1.7	1.0
Group III								
Microsoft	7.1	0.5	0.9	0.8	4.8	1.3	0.9	1.0
Oracle	2.7	0.6	...	1.0	...	3.0	1.1	1.0
SAP	0.7	0.6	...	...	10.1	2.3	1.0	1.0
Subtotal	2.6	0.6	0.6	0.9	9.2	1.9	1.1	1.0
Total for 9 firms	3.0	1.8	4.0 [a]	0.7 [a]	3.6 [a]	2.1	2.0	1.0

Source: OECD (2006) for world total, author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), "Desafios y oportunidades de la industria del software en América Latina", Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Note: Firms for which only sales data or only employment data were available were excluded from the analysis.

[a] 2004 data.

4. Production strategies of transnational firms in the region

Group I. Services firms

The firms in this group are exclusively providers of services, including global outsourcing. In general, they provide service through operations centres located near their major world clients. Like global providers of automobile parts, which have production units near major automobile factories throughout the world, transnational services firms decentralize their operations to support clients wherever needed. The flexibility of these operations makes it possible for outsourcing to be distributed in different localities to take advantage of available human resources. In some cases, these firms have regional hubs for coordinated management of operations and infrastructure, and distribute their tasks among different outsourcing centres. Thus, they decide where to operate based on a hierarchy of regional centres, and define geographical groupings according to each region's position in the firm's global strategy (Arcibugi and Lammarino, 2001, p. 117).

To offer outsourced services, providers must be trained in the different technologies used by their clients. Therefore, different outsourcing centres specialize in specific types of operations. Figure IV.9 shows the relationship between management or infrastructure centres and specialized operations centres. Given this form of organization, firms no longer need to organize at the national level; rather, they require a series of operations or modules located at pertinent places anywhere in the world.[34]

An analysis of the ILL index shows that the group I firms in the region are labour intensive. This is confirmed by an LPE index of 2.4, which indicates that the jobs/sales ratio in the region is more than double what it is in the industry overall (see table IV.10). The main firms in this group, with a major presence in the region, are the United States firms EDS and Accenture, and the Indian firm Tata Consultancy Services (TCS).[35] Taken

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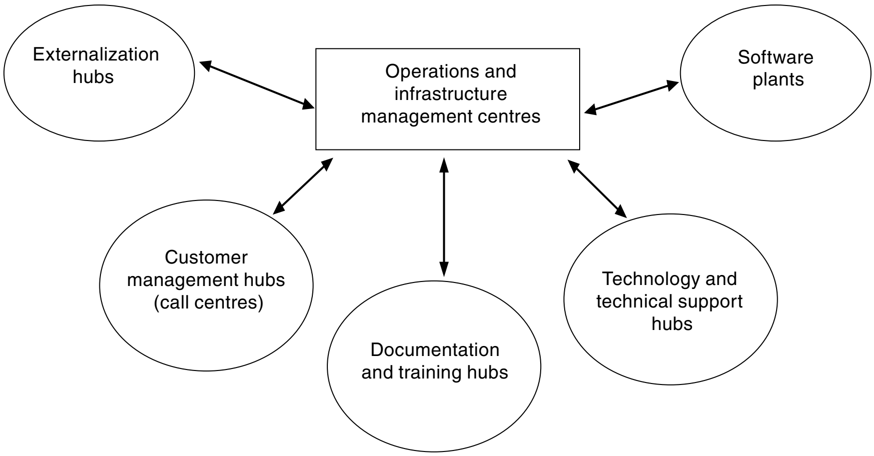
[34] For example, IBM, a Group II firm, uses a model of globally integrated operations carried out by workers in competence centres (groups of workers with specific skills) distributed around the globe. Under this model, when a business unit needs to solve a problem, it does not need to have human resources covering all skills, but can instead call on the people with the necessary skills from the centres where they work.

[35] EDS: Specializing in outsourced services, EDS has a strong presence in Latin America, where it employs 9% of its international work force. It has 10,500 employees in the region, primarily in Brazil, Mexico and Argentina. It accounts for 14 jobs per million of dollars of sales in Latin America. The case of Argentina stands out, with an ILL of 68.1, and approximately 400 employees dedicated entirely to service exports. Its 2.4 LPE index indicates that the region is a centre of production for such exports.

Accenture: This traditional systems consulting firm has 7,800 employees in the region, representing approximately 8% of its global work force. Accenture developed the concept of together, 8% of the workforce of these firms (21,300 workers) is located the region, compared with 4.4% for transnational systems and services firms (group II) and 2.9% for firms that develop software as an end product (group III).

Figure IV.6
DISTRIBUTION OF SERVICE IN MODULES



Source: Tigre and Marques (2007).

Group II. Systems and service providers

These firms initially developed as hardware providers, but due to the commoditization of their hardware products, which began in 1990, they began shifting their attention to services as a source of revenue. Their commercial strategy is based on offering complete solutions for business clients, including hardware, software and operational services, such as business process outsourcing (BPO). The group's ILL index is 4.8, placing

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IT service delivery centres integrated with global operations. Its 3.4 LPE index is the highest of the nine firms studied, thus indicating solid local production efforts in comparison with its efforts in the rest of the world. Its ILL index in the region is 19.7, which demonstrates positive job creation, principally in Argentina, where the indicator's value is 30 jobs per million of dollars in sales, of which approximately 50% are foreign sales.

Tata Consultancy Systems: This firm reflects India's incorporation in the international SSI market. Its presence in the region addresses the need of its worldwide clients for local support. Two thirds of its personnel are located in Chile and Uruguay, apparently reflecting a strategy that emphasizes access to skilled human resources, independent of the size of the local market. Tata is the most labour intensive of the firms studied. Its global ILL index is 18.6, and its ILL in the region is 27. Its LPE indicator, by contrast, is only 1.4, indicating that its production initiatives in Latin America are still on a small scale.

it in an intermediate position between the other two groups. Its LPE index reflects a similar position.

IBM is notable in this group because of its size and its recent rapid growth in the region, principally in the area of customer service —an activity that accounts for approximately 60% of its sales, and in which it stands out from the other firms in group II. While IBM employs 17,700 workers in the region (ILL = 7.1), HP employs 3,000 (ILL = 1.7) and Unisys 2,200 (ILL = 5.1). The importance of Latin America as a production base also varies from firm to firm. IBM has an LPE of 2.1, while the index for the other firms is below 1, showing that for HP and Unisys the region is more important as a consumer market than as a production pole.[36]

Group III. Firms that develop software as an end product

Group III is composed of firms that sell licenses for software packages developed through a centralized process, thus exploiting economies of scale and seeking greater scope for their research and development activities in the world market. Centralization allows them to maintain control over innovations, guaranteeing the compatibility and consistency of their technology between different modules. As a result, their productive efforts outside their countries of origin are generally minimal, and are limited to translating and adapting their generic packages to the needs of local

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[36] IBM: Established in the early twentieth century as an accounting equipment manufacturer, IBM directly employs 17,700 workers in Latin America (5.3% of its global labour force), with the region accounting for 2.4% of its total sales. Its LPE of 2.1 indicates a positive contribution slightly above the general average (1.9). Traditionally, IBM's activity was focused on large users, and thus it has a greater presence in countries with large firms. Although it focuses primarily on domestic markets, it is also seeing an increase in service exports that are based on offshore outsourcing. In the course of becoming a service provider, it has diversified geographically, seeking skilled human resources. Its ILL in the region (7.1) is more than double its global average (3.4), indicating that it uses the region more as a centre of production than as a centre of consumption.
Unisys: Among the various firms, Unisys assigns the greatest priority to the region in terms of sales, with 8.3% of its global sales occurring in the region. In terms of jobs, the region's share of the firm's global total is 6.1%, for a PLE of 0.8 (the lowest of the nine companies). Unisys centres its operations in Brazil (6.5% of global sales), where it is primarily oriented to the domestic market. There are historical reasons for Unisys's major presence in Brazil. In the 1960s, when its name was still Burroughs, it located a plant in Veleiros (São Paulo), and was the second most important firm in the domestic market for a number of decades (second to IBM). In Mexico, Unisys bills on the order of US$ 60 million (1% of its global billings). In Colombia, it has revenue of US$ 36 million (0.6% of the total). In Argentina and Mexico, it employs less than 150 workers. Its ILL index of 5.1, although higher than that of HP and of firms selling software as an end product, is lower than the company's global average (6.3).
Hewlett Packard: Although HP continues to focus on hardware production, its services area is growing rapidly as a share of its world sales. The company's LPE of 0.9 indicates that the region serves more as a consumption market than as a base of production for the firm. Because of the nature of its activities, it creates relatively few jobs in relation to its sales, as reflected in its ILL of 1.7 (global average: 1.8). Within the region, its largest role (in relative terms) is in Ecuador and Mexico.

users. The three principal firms in this segment —the United States firms Microsoft and Oracle and the German firm SAP (OECD, 2006, p. 53)— employ 4,300 workers in the region, where their revenues total US$ 1.7 billion. Their average ILL index is 2.6 (the lowest of the three groups) and their LPE indicator is 1, practically identical to the world average.

In terms of local job creation, there are differences between firms that sell packages for general use (sometimes to individuals as well as businesses), requiring practically no adaptation, and firms specialising in business products, such as enterprise resource planning (ERP) systems. In the latter case, users operate with systems that depend on the provider, and that cannot easily be replaced. This means that programming services must be included, and that interfaces must be created to integrate the systems, both among themselves and with the rest of the client organization. Thus, although these firms are included in the category of software firms, they tend to employ a relatively greater number of human resources, either directly or indirectly, as is the case of local distributors and firms authorized to provide service to customers.[37]

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[37] Microsoft: As world leader in software products, Microsoft markets operating systems and applications for microcomputers practically without local content. The software can be reproduced at low marginal cost, and thus local labour is unnecessary except for commercial and administrative activities. It employs close to 1,300 workers in the region (2% of its world total) and has an LPE of 0.9. For this firm, Latin America is basically a market for sales of closed packages. Despite the fact that it maintains a network of local distributors and makes efforts to foster its workers' skills regarding the operation of its systems, it has little technological interaction with local agents, because of the closed nature of its products, and its global strategy of application-oriented vertical integration. Due to the nature of its products, and its strategy of technological centralization, Microsoft has the lowest ILL in the Latin American SSI (1.4). Within the region, the greatest number of jobs is in Argentina and Ecuador.
SAP: World leader in ERP (Enterprise Resource Planning) systems for business clients, SAP maintains a strong presence vis-à-vis the region's major users. Its operations are primarily commercial operations, since it develops its products centrally. However, it recently began to decentralize its development operations to respond to the differing needs of its global clients, installing nine service centres (SAP Global Service Centres) around the world, one in São Leopoldo (Brazil), as well as an SAP Shared Service Centre in Buenos Aires. In order to integrate its products with the systems already being used by its clients, it requires consulting services, which it generally outsources to authorized local firms. Within the region, Mexico and Ecuador (where it acquired the local firm Maint) are countries in which SAP has a stronger presence. Its rate of local job creation is double that of Microsoft (an ILL of 3.7 versus 1.4), but its local productive effort barely equals the world average.
Oracle: This company is the principal competitor of SAP in the field of business management software. It operates with databases, tools and software for vertical segments such as finance, retail trade and telecommunications. Because of the diversification of its operations and its need to maintain contact with its business clients, it creates more jobs than the other two firms that produce software as an end product. Its ILL index is 4.5, as compared with SAP 3.7 and Microsoft's 1.4, and it employs 1,900 workers in the region, as compared with Microsoft's 1,200 and SAP 1,000. However, its productive effort in the region (1.1) is barely 0.1 above the world average.

In short, the multinational SSI firms adopt different operational models according to the market segment in which they operate. The service firms have much higher job creation indices than those of product providers. Locally, the former (group I) registers productive performance that is 2.4 times the world average, indicating that the region is indeed a production pole. In the group III firms, there are no evident differences between regional and global performance. Group II is in an intermediate position. Given its characteristics, the principal firm in the group (IBM) more closely resembles firms in group I, while its other indicators place it closer to group III.

5. Principal domestic firms

The locally financed SSI firms in Latin America are primarily oriented towards their respective domestic markets, although they make attempts to strengthen their foreign operations. Their principal limitation is their size, which is relatively small compared to the major international firms whose billings are at least ten times greater.[38] Though the largest domestic firms may be considered important in their countries of origin, they are of medium or small size in the global context. Another problem is their low visibility outside their base countries, which limits their competitiveness for outsourcing, where reputation is a highly important intangible asset.

Table IV.11 shows data on the three largest SSI firms financed primarily by local capital in five of the region's countries.[39] In 2005, total sales of these 15 firms represented over US$ 1.4 billion, and they employed 24,000 workers. This means that they billed approximately one fifth of what the nine transnational subsidiaries of transnationals billed, and employed one half the number of workers. In other words, they create relatively more jobs, as their ILL indices reflect. While the ILL index for the domestic firms as a group is 16.8, it is barely 6.5 for the transnationals. The explanation for the difference may be that the domestic firms develop most of their products and services in the region. For example, the Brazilian firm Microsiga, which provides ERP systems, has an ILL index of 11, compared to barely 3.3 for its direct domestic competitor, SAP.

Argentina is the country in which the transnational firms have the greatest relative presence, representing 55% of sales and 22% of jobs. Among the 15 largest SSI firms, only three draw on national capital. Among these is the retail firm Anectic (seventh in billings), which specializes in the sale of software to third parties. The other two, Grupo ASSA (ninth) and DATCO (fourteenth), specialize in services (López and Ramos, 2006).

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38 While the Chilean firm Sonda, which is the region's largest software and services company, billed US$ 350 million in 2005, Tata billed US$ 2.9 billion, and EDS billed US$ 20.4 billion.

39 Argentina, Brazil, Chile, Mexico and Uruguay.

Table IV.11
PRINCIPAL DOMESTIC SOFTWARE AND SERVICES FIRMS, 2005

Firm	Country of origin	Total revenue (millions of dollars) (A)	Number of persons employed (B)	ILL (jobs per millions of dollars in sales) (B) (A)	Main segments of activity
Anectis	Argentina	28	-	-	Marketing of third-party software
Grupo ASSA	Argentina	24 [a]	600	24.9	Professional services
DATCO	Argentina	19 [a]	280 [a]	14.7	Professional services
CPM	Brazil	255	2 600	10.2	Systems integration, outsourcing
Politec	Brazil	196	6 500	33.2	Professional services, outsourcing
Microsiga	Brazil	162	1 779	11.0	Software as end product (ERP)
Sonda	Chile	350	4 500	12.9	Integration, development, consulting
Coasin	Chile	60	950	15.8	Consulting, development, software as end product
Adexus	Chile	50	400	8.0	Consulting, development, marketing
Softtek	Mexico	140	4 000	28.6	Professional services, outsourcing
Hildebrando	Mexico	94	> 1 300	> 13.8	Professional services
Aspel	Mexico	7	200	28.6	Software as end product (administrative)
Grupo Quanam	Uruguay	20	446	22.3	Professional services
ARTech	Uruguay	> 15	100	< 6.7	Software as end product (tool)
Infocorp	Uruguay	6	197	32.8	Solutions on Microsoft platforms
Total		> 1 420	> 23 852	~ 16.8	

Source: Author, based on Paulo Bastos Tigre and Felipe Silveira Marques (2009), “Desafios y oportunidades de la industria del software en América Latina”, Mayol and UN-ECLAC, http://www.cepal.org/socinfo/publicaciones.

Note: Firms in order of country of origin and total revenues.

[a] 2004 data.

In Brazil, the firm CPM, which specializes in services for financial activities, is the largest national SSI player in terms of billings. Politec, with 6,500 employees, is the most labour-intensive domestic SSI firm in the region. It is responsible for 33 jobs per million of dollars in sales, and occupies sixth place in the Brazilian services market, after IBM, EDS, Unisys, Accenture and HP. It is also present in markets in the United States, France, Belgium, Germany, Japan, China and India. Microsiga is the fourth largest software firm, after Microsoft, IBM and Oracle. Since acquiring two firms (Sistemas RM and Logocenter), it has topped sales in the Brazilian ERP market, surpassing the world leader, SAP (Marques, 2007).

In Chile, Sonda stands out as the largest Latin American SSI company, with billings of US$ 350 million in 2005, of which US$ 54 million was in Brazil and US$ 8 million was in Mexico and Ecuador. In its country of origin it heads sales, outselling even Microsoft and Tata, and it occupies third place in Ecuador, with 9% of the market.[40] It also operates in Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Peru, Uruguay and the Bolivarian Republic of Venezuela. With 4,500 employees, it is second in job creation among the 15 Latin American firms analysed. Sonda is six times larger than the other two major domestic firms, Coasin and Adexus, which also specialize in services (Álvarez, 2007).

In Mexico, the domestic firms Hildebrando and Softtek lead the on-demand software market, with market shares of 23.6% and 16.7%, respectively. Hildebrando focuses on software development, which accounts for over half of its income, while Softtek is intensely active in other outsourced services, principally for the United States, under the near-shore model.[41] This firm is third in job creation among Latin America's domestic firms, with nearly 4,000 employees in Argentina, Brazil, Chile, Colombia, Spain, United States, Mexico, Peru, Puerto Rico and the Bolivarian Republic of Venezuela. Aspel is the largest domestic firm specializing in software as an end product, and occupies tenth place in Mexico. Its sales are concentrated in software for administrative tasks (Mochi and Hualde, 2007).

In Uruguay, Grupo Quanam, with 7.5% of SSI sales, is the principal domestic firm. Specializing in services, it is present in nine of the region's countries and exports over two thirds of its production. ARtech produces the software development tool GeneXus, which it exports to over 30 markets around the world. Infocorp is a consulting firm that is increasingly active internationally (González, 2007).

In conclusion, Latin America has a series of domestic firms that not only compete in their domestic markets, but also are seeking to internationalize, primarily within the region. They have the advantage of providing more jobs in relative terms than the transnationals, and of fostering strong relationships between providers and users in their countries of origin.

6. Policy considerations

In Latin America, the development of the software and related services industry occurred nearly spontaneously, and only in the last few years have public policies for the sector begun to appear. As will no doubt continue to be the case, the policies have varying economic and social

[40] In terms of services, it ranks 38th in Brazil and 39th in Mexico.

[41] This model is based on the presence of different cost structures, and on the advantages offered by the free trade agreements with nearby countries, in this case the North American Free Trade Agreement (NAFTA). These factors lead to lower indirect costs, facilitate management of contracts, and strengthen legal protections for intellectual property and other rights.

objectives. The creation of a critical mass of skilled workers is the basic element needed to supply and integrate appropriate software in domestic economic processes. From the perspective of creating jobs and generating exports, investment must be drawn from large firms. In this regard, there are two decisive factors that govern decisions on where to locate their operations: costs (subject to exchange rates, wages and tax treatment) and the availability of skilled human resources.

Exchange rates play a decisive role in firms' decisions to invest in offshore outsourcing, because of their impact on production costs. For example, the devaluation of the Argentine peso in 2002 was a strong incentive for SSI exports, while, beginning in 2003, the exchange rate of the *real* in Brazil made it difficult for domestic SSI firms to increase their foreign sales.

Taxation of SSI activities is rather ineffective because of the intangible nature of the products involved and the difficulty of monitoring their operations. Moreover, in countries with excessive social burdens, the informal sector tends to play a greater role in professional activity. Firms in general, and small firms in particular, tend to develop ways of avoiding taxes in commercial transactions involving any type of indirect tax. In international transactions, pricing for the transfer of software and services between firms and countries escapes the controls of national tax authorities. The services that different subsidiaries provide to a single firm can be managed in such a way that the revenues and profits are concentrated in countries with more favourable tax regimes. As a result, export and import figures underestimate the operations actually carried out. In this context, the rationalization of tax structures that directly or indirectly affect software exports would contribute to stimulating these activities and bringing them into the formal sector, without significant fiscal costs.

Training and the development of technical and scientific infrastructure are probably the areas in which policy has the greatest medium- and long-term potential to stimulate growth in the sector. No country can hope to play a major role in the world software industry without first making heavy investments in the training of human resources. These policies should not be based only on increasing the supply and quality of advanced technical training, but should also make serious efforts to prepare and stimulate young people to study ICT-related fields, thus enlarging the available supply of professionals.[42] This means

[42] Workers with skills in ICT are able to find formal employment in the labour market, create new firms or work independently. Thus, there is a guaranteed return on investment in training them, although there is always the possibility that they will emigrate, producing a brain drain, which might then also lead to a brain circulation, such as happened with Indian immigrants from Silicon Valley who constructed local software production clusters in India after return (Saxenian, 2006).

improving secondary education in disciplines such as mathematics, information technology and English.

Finally, educational programmes for the SSI must be linked to national strategies for the sector's development. In the more populous countries, the availability of human resources can be the basis for strategies designed to attract labour-intensive operations. To achieve this goal, it is important to motivate students so that they take advantage of technical education opportunities, bring the social burden to realistic levels, and offer different forms of training, including distance learning, to provide a more extensive professional work force. The development strategy of countries with more limited supply capacity and an already relatively high software export coefficient should stress the incorporation of value added, which involves training high-level human resources, investing in research and encouraging international cooperation.

Chapter V

Telecommunications operators

A. Introduction

Following a period of rapid expansion due to the proliferation of mobile services and broadband access, the global telecommunications services industry lost strength. This was particularly evident in the fixed telephony segment, where declining traffic, rates and number of lines affected the revenues of operators.[1] An additional factor was the high saturation rates for mobile telephony in the industrialized economies —particularly Europe and Japan. The forces driving global growth in telecommunications services today are data transmission and Internet access services —a phenomenon seen throughout both developed and developing countries, though there is a strong trend, among the latter, towards replacing wired services with mobile systems (Wohlers and Garcia-Murillo, 2009).

Investment in the sector continues to grow, and consumers generally pay less for more and better services. However, technological progress creates new challenges for providers. For example, the increased traffic resulting from expanded broadband access is not only a major area of growth for operators, but also represents one of their major challenges. The situation has produced, in the market, a proliferation of convergent

1 The term "operators" refers to telecommunications providers, which fall into two groups: the industry's traditional operators (or "incumbents"), and the challengers —the newer firms in the industry that are challenging the dominance of, or potentially competing with, the older ones. The terms "industry" and "sector" refer to the entire telecommunications industry, while the components of the industry are termed "segments".

services in the form of bundled services, or multi-packs,[2] erasing the traditional boundaries between the industry's different segments. These changes are also being experienced in the countries of Latin America and the Caribbean. The region's largest operators have begun to position themselves to pursue this global trend, and are extending their activities to new market segments. The region is still in transition in this regard, but is moving in the same direction as the world industry: towards convergent services (Wohlers and Garcia-Murillo, 2009).

B. The global market

1. The erosion of traditional sources of revenue

The sector underwent major changes in the 1990s as a result of technological innovation, increased competition (particularly for new services) and international expansion by the major operators. The explosive growth of the Internet provoked an unprecedented boom, but it was short-lived, and its abrupt decline as the new century began[3] affected most of the economic agents associated with ICT, triggering major changes. Technological change and the development of new services are at the core of telecommunications activities, challenging operators to shift their attention to emerging high value added services that require significant investment in new network technologies.

During the decade since the telecom collapse in 2001, voice services continue to be the main component in the telecommunications market, but that segment, as well as the industry's overall revenue structure, are changing —initially because of the stellar growth of mobile telephony, and more recently because of the development of the Internet. In 2006, mobile telephony represented approximately half of the telecommunications industry's revenues worldwide, and had twice as many subscribers as fixed telephony. Although the developed countries represent a smaller proportion of the globe's activity than they did previously, they still dominate the world telecommunications services market. Between 2002 and 2006, the three largest markets (United States, the European Union and Japan) diminished in relative terms, from 72% to 64% of the sector worldwide. Meanwhile, the developing countries' markets increased from 20% to nearly 30% of the world total, and in 2006 accounted for close to 80% of revenue growth in the sector (IDATE, 2007).

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2 The term "multi-pack" refers to both the triple-pack (cable television, Internet access and fixed telephony) and the quadruple-pack (the foregoing plus mobile telephony) combinations of services.

3 The collapse of the sector in 2001 resulted in bankruptcies, fraud, and investor losses on the order of US$ 1 trillion (*The Economist*, 2006a).

The telecommunications services markets in the developed countries became less dynamic with the decline of fixed telephony and the saturation of mobile telephony markets. An underlying cause of the decline in fixed telephony was the decrease in number of lines, traffic and rates. These developments were due essentially to the growing replacement of landlines by mobile service, and to the expansion of broadband Internet access. The spread of ADSL[4] and cable modem technologies led to a systematic elimination of landlines, while the advance of VoIP (voice over Internet protocol) services has exerted strong downward pressure on the price of basic voice services. The effects of VoIP were especially intense in long distance telephony and in the corporate sector. At the same time, mobile telephony rates declined, and the result was a tendency for mobile service to replace fixed telephony. This, in turn, led to an erosion of average revenue per user (ARPU[5]) for voice services in the developed economies, particularly those in which there has been the most intense adoption of the new technologies, such as Japan (see figure V.1).

In the developing countries, the number of fixed telephony subscribers continues to increase, although it is levelling off. Moreover, basic infrastructure limitations accentuate the need to substitute mobile service for fixed service. Between 2002 and 2009, the penetration of telephony (fixed and mobile) in these markets tripled, from 20% to 60%, with mobile service accounting for over 80% of that increase.

In terms of mobile telephony, the major portion of the growth in the subscriber base occurred in the developing countries between 2003 and 2006, where over two thirds of the world's subscribers were located as of the end of 2006 (as compared with 50% only in 2003). At the end of the decade, these countries generated approximately 85% of the net increase in the global subscriber base, with the large emerging economies in Asia (China, India, Indonesia and Pakistan) and Latin America (Brazil, Mexico and Colombia) accounting for a major portion of the growth. Among the developed countries, the United States and the European Union differ from each other in two respects: first, prepaid service plays a greater role in the European Union; second, the European Union countries have high penetration rates —among the highest in the world, registering above 100% in many cases.

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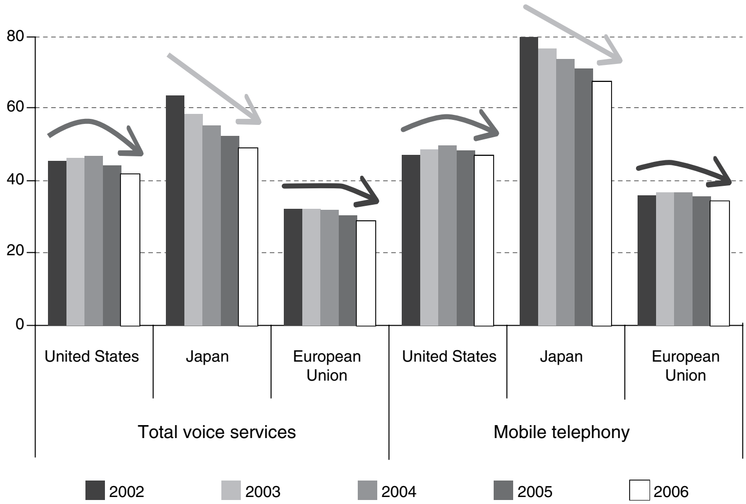
[4] ADSL (Asymmetric Digital Subscriber Line) technology consists of broadband Internet access that provides high-speed digital connections through the symmetrical "copper pairs" of wire used in conventional telephony. The term "asymmetric" reflects the fact that the speed with which data are downloaded is greater than the speed with which they are uploaded. ADSL lines include three channels of communication: data sending, data receiving and normal telephone service.

[5] ARPU (Average Revenue per User) is an indicator frequently used by telecommunications providers. It reflects the average revenue per user obtained by a service provider with a wide subscriber base in a given period of time, and is calculated by dividing total revenue for the period by the number of the company's active clients.

Figure V.1
AVERAGE REVENUE PER USER (ARPU) FOR VOICE SERVICES AND MOBILE TELEPHONY IN THE UNITED STATES, JAPAN AND THE EUROPEAN UNION, 2002-2006
(In dollars per month)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the *Institut de l'Audiovisuel et des Télécommunications en Europe* (IDATE).

With the rapid expansion of broadband services, stimulated by the increasing user base and expanding supply of services, there was strong global growth in data services and Internet access. This dynamic was particularly notable in the industrialized economies, especially the United States, certain Asian countries (Japan, Republic of Korea) and Northern Europe (Netherlands, Denmark and Germany). Among developing regions, Latin America is the most advanced in this segment, with Chile, Brazil, Mexico and Argentina being examples. During 2005-2009, the segment represents between 15% and 20% of total telecommunications revenues (IDATE, 2007).

Increased traffic in the data transmission segment is balanced by constant price declines and effects from the migration to broadband solutions. The growing number of high- speed Internet connections is one of the principal reasons for the strong market effect of technologies such as VoIP. In addition, transmission technologies are becoming more efficient every day, making it possible to improve the quality of voice services. Currently, the most widespread technology is ADSL, which has become the main factor driving the growing number of broadband subscribers at the global level, and even in the United States, where cable television providers play a major role.

In short, the global telecommunications services market continues to expand, although signs of levelling off have begun to appear, especially in the industrialized economies. While mobile services continue to drive the overall growth of the market, the new revenues generated by broadband services have helped compensate for the decline in fixed telephony. In an industry dominated by a small group of large operators, the spread of VoIP services and the massive expansion of mobile telephony —both driven by convergence (voice/data, fixed/mobile)— have called into question the business model of these providers and created new challenges.

2. An end to the industry's segmentation and the emergence of new competitors

Operators have played the leading role in transforming the industry. In just over twenty years, local telephone service monopolies, often controlled by the State, have been transformed into integrated private companies providing a wide range of telecommunications and multimedia services, some with a strong international presence. The transformation of the industry was marked by major regulatory changes and intense geographical and sectoral consolidation, through an unprecedented wave of mergers and acquisitions. Today, a small group of United States, European and Asian firms account for a major portion of the industry's revenues, profits, clients and innovation. In 2006, the ten largest providers generated approximately half of the sector's global revenues (table V.1).

However, the explosion of the Internet and its transformation into the basic medium for providing these services weakened the industry's traditional segmentation, in which different networks provided different services. This change was caused by a gradual transition from circuit-switched telecommunications to networks operating over the Internet. Thus, with the emergence of other actors involved in activities that were similar but, until recently, entirely separate, the dominance of the incumbents has been thrown into doubt. The first to shift course were the cable television providers, who anticipated the changes in the industry and invested in the infrastructure needed to simultaneously provide television, Internet access and, more recently, voice services —a process that was particularly intense in the United States.[6]

In a short period of time, the principal providers of content and Internet-based applications, such as Google, Yahoo!, Microsoft's MSN, America Online (AOL), eBay and Amazon, became the leading players in the telecommunications industries. United States firms are particularly strong

6 In the United States, the two principal cable television providers, *Comcast* (which merged with *AT&T Broadband* in 2002) and *Time Warner Cable* dominate over 50% of the cable modem high-speed access market.

in this segment (Fransman, 2009a), since, in addition to the reputations of their brands, they were the first to develop a significant advantage in content, adding technological value to the services and applications offered via the Internet. In order to grow rapidly, these firms had to offer new services, which they either developed internally or acquired from third parties. Since totally new and exclusive services are few and far between, some companies imitated their competitors' strategies, thus obtaining some of their market,[7] while forming partnerships to protect those segments in which they were already active.[8]

Table V.1
LARGEST TELECOMMUNICATIONS COMPANIES, BY SALES, 2000-2006
(In millions of dollars)

		Country	2000	2002	2004	2006
1	Verizon Communications	United States	64 707	67 625	71 563	93 221
2	Nippon Telegraph and Telephone (NTT)	Japan	103 235	97 340	100 545	91 998
3	Deutsche Telekom	Germany	37 834	56 282	71 989	76 969
4	Telefónica	Spain	26 325	28 783	38 188	66 372
5	France Télécom	France	31 122	48 882	58 652	65 899
6	AT&T Inc.	United States	51 476	43 138	41 098	63 055
7	Vodafone	United Kingdom	22 196	36 653	62 971	59 811
8	Sprint Nextel	United States	23 613	27 180	27 428	43 531
9	Telecom Italia	Italy	27 832	31 868	39 228	40 150
10	British Telecom (BT)	United Kingdom	30 799	32 985	34 673	38 248
11	China Mobile Comm.	China	15 045	18 551	23 958	35 914
12	KDDI	Japan	20 519	23 914	27 170	28 515
13	China Telecom.	China	20 813	…	21 562	24 791
14	América Móvil	Mexico	3 125	5 510	12 364	21 487
15	Korea Telecom (KT)	Republic of Korea	8 173	13 711	14 901	18 598
16	Telstra	Australia	12 477	11 411	15 193	17 257
17	Bell Canada Enterprises	Canada	14 859	12 541	14 842	116 483
18	Telmex	Mexico	13 079	10 823	12 737	16 054

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on various editions of *Fortune Global 500*.

As part of the convergence process, the Internet giants attempted to expand their areas of activity by entering segments dominated by traditional telephone and broadcast providers. They thus became an increasingly significant threat to these voice service providers.[9] They are also positioning themselves in the television segment (another component of the convergent multi-pack services) by developing video search engines

7 MSN and Yahoo! invested in search engines to compete with Google, which in turn launched a messaging service with greater capacity than that of its competitors (Gmail). Similarly, MSN and Google began to compete with eBay in the classified advertising segment.

8 MSN and Yahoo! in electronic messaging, and Google and AOL in search engines.

9 Notable in this context is the acquisition of Skype (the leading VoIP firm) by eBay for US$ 2.6 billion.

and video on demand (VoD) services.[10] Thus, they are becoming direct competitors of the incumbent providers (through VoD) or —through VoIP— are eroding the value provided by the incumbents, as they take advantage of the providers' own infrastructure to offer services.

As a result, the incumbents have been forced to form partnerships with these large firms in order to limit their own investments and take advantage of the dominant positions that their partners hold in segments where they are pioneers (Yahoo! and SBC; MSN and Vodafone; iTunes/Apple and AT&T; Google and T-Mobile, Skype and Eplus). The Internet companies benefited from these partnerships, obtaining advantages vis-à-vis their competitors through access to new segments of the market. A partial division of labour was thus created between the telecommunications providers and the Internet giants, with the former focusing on access and profiting from that market, with the latter adding value to Internet content and profiting from advertising (Fundación Telefónica/IDATE/ENTER, 2007).

In summary, the progressive transition to networks operating over IP has invalidated many traditional market definitions. In the past, providers offered only fixed telephony. Today they are obliged to offer new integrated services, of which voice transmission is but one, and to do so in an increasingly competitive environment. The new scenario poses new challenges for the industry's principal players, including providers, regulatory agencies and national policy-makers, as well as users.

C. The response of the global providers

In the first decade of the twenty-first century, it was believed that the crisis demanded a reorganization of the sector, and the oligopolistic structure of the market was expected to intensify, bringing greater revenues to the traditional providers (Fransman, 2009b). However, the difficult financial situation in which they found themselves as a result of their risky pre-crisis investments,[11] as well as the changes in the structure of the market, led to different results.

Given an environment in which it was difficult to obtain fresh funds, primarily because of lack of confidence in the securities markets, providers adopted debt-reduction measures, including operational improvements, reduced investment and the sale of non-strategic assets. In this way, most of them succeeded, in a relatively brief period, in significantly reducing their debt, while the integrated providers were supported by their mobile telephony subsidiaries, whose revenues and profits were still rising rapidly.

10 One example is the acquisition of YouTube by Google for US$ 1.65 billion.

11 Primarily associated with large mergers and acquisitions, and with the cost of positioning in new market segments, as in the case of the onerous process of obtaining third generation (3G) mobile telephony licenses in Europe.

However, changes in the market, along with technological advances, rendered these benefits short-lived. The growth of mobile telephony sales and the decline of prices for mobile services led to a drop in fixed telephony revenues, and to a process in which fixed services were replaced by mobile service. Technological change had a negative effect on fixed telephony revenues for other reasons, as well, including the following:

- VoIP made it possible for consumers to obtain voice service at lower prices. Although the first commercial version of VoIP appeared in 1995, its spread required a complementary technological development: broadband Internet access. Faster connections made real time communication possible, and VoIP acquired a quality advantage over fixed telephony.
- The continuing convergence of networks and services led to the interconnection of various types of networks, telecommunications and television and other broadcast media. Thus, consumers had access to the same services on different platforms. Telecommunications providers, cable TV companies, content providers and Internet companies quickly began to offer combined (multi-pack) services. This convergence intensified competition, further eroding revenues and profits among the traditional providers.
- A third element working to the detriment of the providers' profitability was regulation —specifically, providers' obligation to allow competitors access to their networks (Fransman, 2009b). In a number of industrialized countries, local loop unbundling[12] changed the competitive environment, allowing different providers to sell telecommunications services on the same network. In addition, competition between different infrastructures —most commonly between cable TV and telecommunications networks— encouraged providers to penetrate their rivals' markets and reduce prices to consumers.

The situation was further complicated when mobile telephony markets in some industrialized countries began to be saturated, with repercussions for the revenues and profits of the traditional providers, which began to develop new strategies to remain in the market, and even strengthen their presence.

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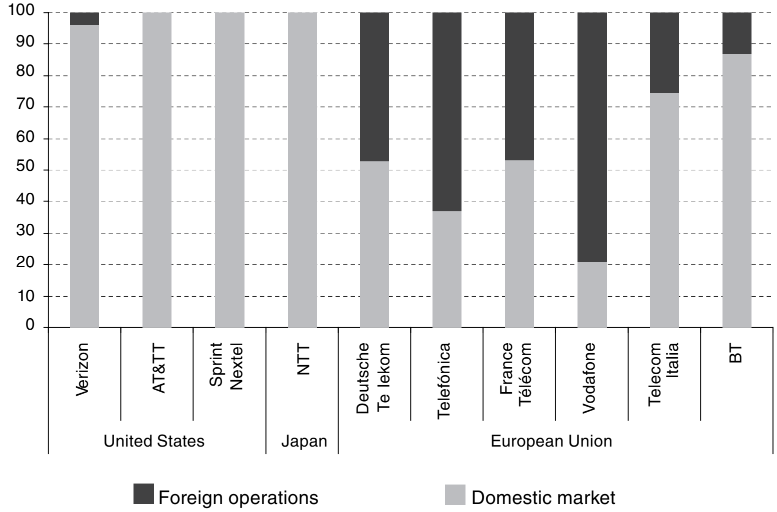
12 The local loop is the wiring between the telephone switchboard and the user. The term "local loop" is often used as a synonym for the "last mile" connection to the user. An unbundled local loop is created by making the dominant providers' copper pair available to competing firms for the provision of different types of telephone service and access to data networks.

1. The exploitation of economies of scale and the search for components of an integrated services offering

Beginning in 2003, taking advantage of an improved financial situation and the market's "amnesia", operators began a new attempt to find economies of scale and fill out the range of services that they offered. This led to a new wave of mergers and acquisitions, primarily affecting the industrialized countries. While companies in the United States and Japan focused on strengthening their domestic positions, European providers tended to think regionally, and thus continued their historical tendency to internationalize their activities (see figure V.2).

Figure V.2
TEN LARGEST GLOBAL PROVIDERS: SALES BY MARKET, 2006
(In percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from firms.

After an intense process of consolidation in the United States, that country's market changed significantly. Large long distance providers disappeared, and the regional Bell operating companies (RBOCs) were revitalized.[13] At the same time, the mobile telephony segment became more concentrated, with the subsidiaries of these two firms controlling over 50% of the market. This reflects the providers' reaction to intense competition

13 The original seven regional telephone service providers created with the break-up of AT&T were Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell and US West.

from cable television providers, which remain leaders in broadband access and triple-pack services. With these initiatives, the providers were able to expand and complete their services offerings. Exploiting synergies and exceeding their competitors' offerings by providing more complex convergent packages (quadruple-pack packages of fixed telephony, broadband access, television and mobile telephony).

The established European providers, meanwhile, facing increased competition in their domestic markets, sought new growth opportunities beyond their borders.[14] Though they followed different trajectories, their strategic objectives were the same: to gain a large share of the market on the European continent.

- Initially, the established Mediterranean providers (Telefónica de España and, to a lesser extent, France Télécom and Telecom Italia) were the most active, developing bold, but essentially defensive strategies, and focusing their attention on fixed assets in emerging markets, principally in Latin America.
- Later, with the wireless telephony revolution, Deutsche Telekom (T-Mobile), Vodafone and France Télécom (Orange) strengthened their presence in Europe, the United States and some African and Asian markets, through their mobile telephony subsidiaries. Deutsche Telekom had the most cautious strategy. It avoided emerging markets outside of continental Europe, focusing on the United States, United Kingdom and most of the new European Union member states in Central and Eastern Europe. After a negative experience in Latin America, France Télécom turned its attention to Spain, the United Kingdom and Poland. The most active company was Vodafone, which became the most highly globalized European telecommunications company, and the largest mobile telephony provider in the world. However, the market's continuing process of convergence has begun to create problems for it, because of the degree to which its activity is concentrated in the mobile telephony segment.
- The incumbent providers are attempting to achieve a more balanced presence on the European continent by combining fixed and mobile telephony assets. Telefónica, for example, despite its large and solid Latin American presence in all segments, had serious problems in the 3G mobile telephony market. It proceeded with an assault on the European market, making large

[14] The degree to which the major European providers are internationalized varies. While Deutsche Telekom, France Télécom and Telefónica obtain over one third of their revenues outside their countries of origin, BT and Telecom Italia continue to concentrate on their local markets (see figure V.2).

acquisitions in the Czech Republic, United Kingdom and Italy. Initiatives are also being made by smaller companies using multi-pack options to compete for the incumbent firms' market shares.

In summary, the United States and Japanese firms have focused on strengthening their domestic market positions, while the major European providers continue to internationalize, with particular emphasis on the European continent. The current wave of mergers and acquisitions brought a resurgence of traditional providers in the local telephone service arena, where they now play a new role as multi-pack bundlers. Telefónica is the only one of these large providers that has a significant Latin American presence, and is currently one of the region's two largest providers.

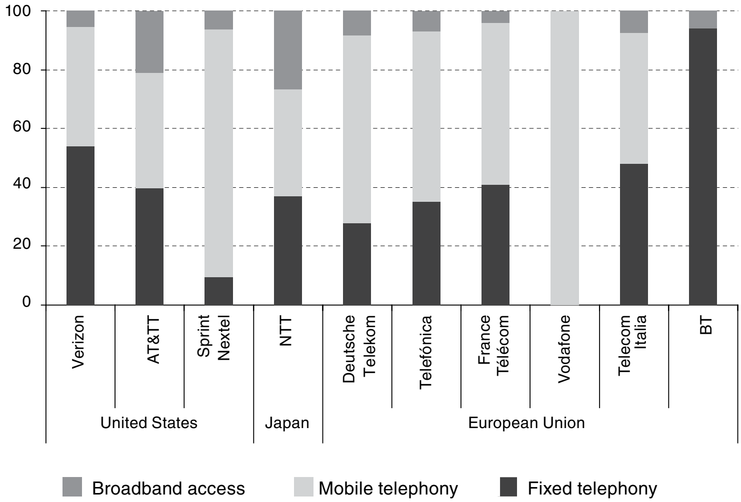
2. Redefining the principal business

Organizationally, the large providers are turning away from the segmentation strategy that they employed in the 1990s, and are moving towards greater integration of their businesses. Under current conditions, it is plausible to speculate that only those firms that can make good use of the available synergies and create a balance among voice, data and video services to meet the increasing demand for multi-pack services will survive (see figure V.3).

Various large providers believe that the industry's future lies in a wide range of value added services on "last-mile" connections, or on wireless networks, with less dependence on revenues from the connections themselves (see diagram V.1). They have therefore begun to regard voice transmission as a commodity, and to recognize that they must find new sources of revenue to replace it. Given the industry trend, what creates value is connection infrastructure and the content that is moved across the networks. The firms opting for this alternative will have to develop their next generation networks (NGNs) quickly, reconfiguring their activities around applications over IP, including voice services, and becoming multi-pack providers.

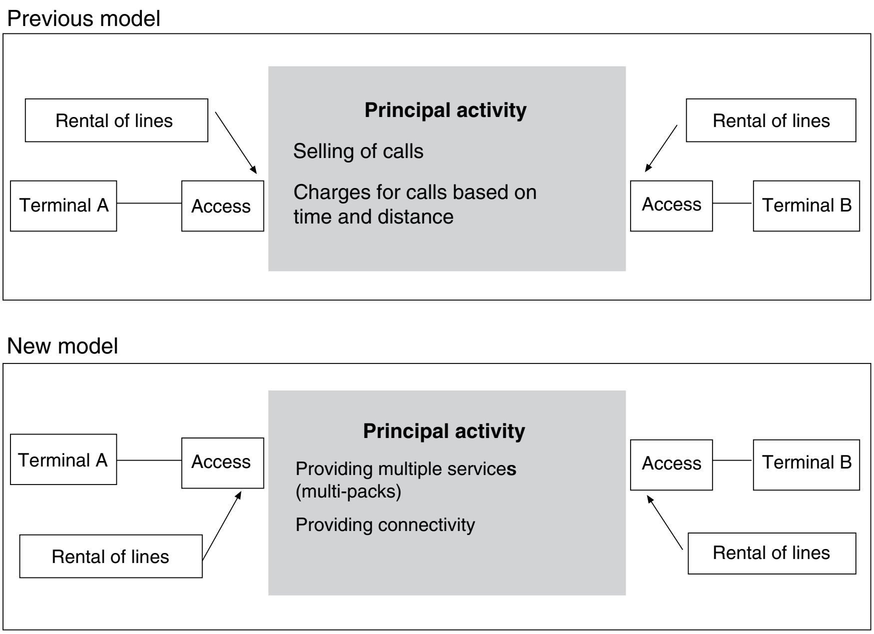
Other providers, in contrast, decided to structure their assets to concentrate on offering connectivity over fixed or mobile networks as a revenue source. This meant abandoning the applications market, including telephony, and limiting themselves to a role as access providers or carriers of packages and applications. This strategy assumes that value can be created by developing high-capacity networks for transmitting content, and by focusing on providing data services at the lowest possible cost. The risks of this strategy include the difficulty of maintaining profitability in environments where access and transmission are subject to strong competitive pressures.

Figure V.3
TEN LARGEST GLOBAL OPERATORS: SALES BY SEGMENT, 2006
(In percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from firms.

Diagram V.1
CHANGING BUSINESS MODEL OF TELECOMMUNICATIONS PROVIDERS



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on John Horrocks's presentation *NGN and Convergence Models, Myths, and Muddle*.

These perspectives on the future of the telecommunications market will lead companies in different directions, with corresponding changes in their investment patterns. The period during which the entire planet had similar telephone services and public telecommunications providers is approaching an end (OECD, 2007a).

(a) Towards multiple services offerings

Broadband Internet access changed the way telecommunications services are accessed and valued. Telephony became just one more Internet application, with any provider of IP applications capable of offering its users VoIP services, regardless of the type of access provided (3G mobile telephony, fixed wireless, like WiFi, ADSL or cable). As a result, providers had to seek new solutions to stop the drain of revenue from their traditional services, and move towards new offerings with higher value added that would generate revenue, while maintaining —and, where possible, increasing— their client base. The first steps in this direction have taken the form of flat-rate packages[15] and fixed-mobile convergence applications.[16]

The greatest successes are being achieved with multi-pack offerings, which are attractive to consumers because of their simplicity: they provide one consolidated account and cost less than purchasing the different services separately. Today, most providers offer such packages, or are preparing to do so, as they attempt to increase the range of services that they offer —initially adding Internet access, and then television.[17] Meanwhile, the cable providers, which primarily focus on television, are moving towards providing Internet access, and then telephone service,[18] while mobile telephony providers are offering quadruple packs. Finally, Internet providers are gradually moving to include television and telephone service. The development of multi-pack services exposes telecommunications and cable TV providers, as well as Internet providers, to strong competition on all fronts. In this environment, alternative providers have begun to emerge, challenging the position of the incumbents.

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15 There are flat rate plans for domestic and international calling from landlines, and unlimited calling for mobile telephone clients to preselected numbers. Flat rate structures are also common in broadband Internet access.

16 Various providers offer telephones that function as mobile telephones while the user is moving, but as landlines in the home. These devices illustrate the closing of the gap between fixed and mobile telephony.

17 The United States providers Verizon and AT&T, under pressure from competition by the cable providers, were the first to offer quadruple-pack services through their mobile telephony subsidiaries.

18 In most of the countries, the cable television providers that offer Internet access evolved more easily towards triple-pack than did those using ADSL, because of the strong role that audiovisual content played in their operations. The incumbents had to make special efforts to obtain content for their television offerings, which slowed both their launching of these services and their gain of market share.

Faced with the need to offer convergent services, the firms adopted measures to reduce costs and ensure the viability of migration between networks, making it possible for them to offer their clients multi-pack alternatives:

- Expanding use of VoIP forced incumbents to offer the service. Although it first seemed to constitute self-cannibalism, the rapid decline in revenue from traditional telephony led these firms to position themselves in the residential VoIP market.
- IP television (IPTV). The alternative providers were the first to put IPTV service on the market, which they did over ADSL networks, generally as part of multi-pack offerings. Starting in 2005, the incumbents deployed more aggressive IPTV strategies.
- Some providers that lacked the capacity to offer traditional mobile telephony developed mobile virtual network operator (MVNO) models[19] in order to compete in the quadruple-pack arena.[20] However, in terms of triple-pack solutions, they face major obstacles in attempting to implement their strategies.
- In relatively uncompetitive markets, incumbent providers attempt to hold back the introduction of VoIP to maintain their profits in circuit-switched voice traffic. As long as VoIP continues to be considered a threat rather than an opportunity, the synergies needed for efficiently connecting local telephony with the Internet will not be forthcoming (Beca, 2007).[21]
- In some segments where there are major obstacles to access, incumbents have not been able to gain a significant presence. For example, BT and Deutsche Telekom did not succeed in preventing the dominance of the cable providers in their domestic markets, thus dimming their prospects for growth in the pay TV market.

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19 A mobile virtual network provider (MVNO) is a firm that lacks its own network infrastructure for mobile telephony, but uses another provider's network under its own brand.

20 At the beginning of the present decade, a number of providers sold their mobile telephony businesses in an effort to deal with the complex financial situation in which they found themselves. This was the case of AT&T in the United States and British Telecom in Europe. The British Telecom case is emblematic, since, when it sold its mobile telephony subsidiary, its share of the broadband Internet access market became significantly smaller than that of the rest of the world's major incumbents. This created problems for its multi-pack operations, which it currently offers through BT Mobile, an MVNO company (Beca, 2007).

21 In this context, Verizon has brought the principal provider of VoIP service, Vonage, to the brink of bankruptcy in a suit over the fraudulent use of software to provide service. It is speculated, moreover, that many other providers of VoIP services are involved in fraudulent activities of the same sort.

- Traditional regulation also imposes constraints. In Europe, regulatory authorities have the authority to limit the ability of providers that have a large share of the market to offer multi-pack solutions. In a number of states in the United States, telecommunications providers are required to obtain a cable television license for each city or municipality in which they wish to offer service. This costly procedure impedes offering packages of services. In Japan, NTT lacks the authorization needed to directly distribute its television offerings, although it can do so on its IP platform.

Multi-packs are the first step towards convergent services. The following step will be to unify the networks on which these services are offered —a difficult task, given the need to guarantee users continuous coverage. Major progress has recently been made in providing continuous coverage and bandwidth, and in solving mobility problems. Providers in the industrialized countries are rapidly expanding their third-generation (3G) mobile telephony networks to offer faster access and navigation.

Finally, the elimination of technological barriers between markets benefits consumers, by allowing them to choose among services offered by a large number of providers, while at the same time forcing regulatory agencies to re-examine ways of regulating specific markets.

(b) The bottleneck: network capacity

As a response to the obsolescence of the dominant Internet access technologies, such as ADSL, and the greater demands of today's traffic, there is a need to move towards the use of fibre optic networks.[22] However, the difficult circumstances in which the telecommunications providers have found themselves in the last few years forced them to postpone further investment, preventing rapid migration to next generation networks. Indeed, infrastructure investment by the ten largest providers in the world, as a percentage of the total volume of their business, fell from 20.5% to 10.9% between 1996 and 2005 (Fundación Telefónica/IDATE/ENTER, 2007).

Recently, this trend seems to have changed, and despite flat revenues, especially in fixed telephony, the providers have increased their investment, which today totals 150 billion euros worldwide (Fundación Telefónica/IDATE/ENTER, 2007). These investments are necessary if companies are to be ready for the advance of fibre optics and develop the infrastructure needed to maintain a competitive position (OECD, 2007a). A fundamental decision is involved here, since next generation networks can transfer a

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[22] The primary problem with copper-based technologies is that the maximum bandwidth is 8 Mbps for download and 4 Mbps for upload, and these speeds fall rapidly with the distance between the user and the switching centre.

much greater volume of information, which is crucial for new uses and services such as high-definition television (HDTV) and VoD. These require much greater bandwidth than is available on today's networks. The majority of providers today are evaluating proposals to launch new high-speed networks, a process in which the Asian and United States providers are pioneers, while Europe has lagged somewhat behind. These new initiatives will change the broadband scene in the coming years.

Their high population density, competitive prices and political resolve contributed to making Japan and the Republic of Korea the leaders in this process.[23] ADSL lost ground due to the deployment of next generation networks, particularly FTTx networks.[24] In Japan, fibre optics have been installed not only in the basic networks, as has occurred in the United States and Europe, but also in the access network, and even in fibre to the home (FTTH) networks (Fransman, 2009b). The major Japanese firms, headed by the traditional NTT, with 67.5% of the market, have invested over 38 billion euros in new network architectures.[25] In 2007, fibre optic networks surpassed ADSL lines as the most widespread form of broadband access in that country.

The Asian countries' major advantage could diminish with decisions of the United States regulatory agency, the Federal Communications Commission (FCC), that exempt the owners of new fibre optic infrastructure from sharing it with competitors (Bauer, 2005). This is a strong force driving that country's providers to invest and implement a variety of FTTx network solutions[26] in order to offer competitive services and confront the cable providers' dominant position in the residential Internet market.

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23 The Republic of Korea's strategy centred on policies aimed at human resources training, competition based on duplication of infrastructure, and reorganization of State services around ICT. This strategy allowed it to achieved one of the highest levels of broadband penetration in the world. It is also a leading innovator in mobile services and cell phones. A fundamental element in these results was the triangle formed by the mobile telephony providers, the equipment manufacturers (Samsung and LG) and the government, which encouraged the development of the mobile telephony industry.

24 FTTx (*Fibre To The x*) is a generic term for any network architecture that uses fibre optic to totally or partially replace the traditional local copper pair loop used for telecommunications.

25 In Japan, fibre optic subscribers can download information at 100 Mbps, ten times faster than the average for developed countries, and at the lowest prices among OECD member countries. They can also upload information at the same speed, which is impossible with ADSL and most cable modem providers (OECD, 2007a).

26 FTTN stands for "Fibre To The Node" (or "Neighbourhood"). VDSL2 (Very High Speed Digital Subscriber Line 2) uses copper pair telephone infrastructure, and is the standard for the most recent and advanced DSL communications. It is designed to support combined services packages, including voice, video, data, HDTV and interactive games. It also makes it possible for firms and providers to gradually update existing xDSL lines fairly inexpensively.

The domestic European markets have advanced at different paces, primarily because of the varying competitive situations in terms of the "last mile" and because of the presence of potential competitors.[27] Given that fibre optics are growing at a moderate pace, FTTN and VDSL2 networks, such as those used by AT&T, are projected to become the most common model in the coming years. The countries using FTTx technology most intensively are Sweden, Denmark, Netherlands and Italy, often in projects implemented by municipal government or local electricity and gas companies.

Europe's largest incumbent providers announced investment plans to build their own FTTx networks as a replacement for their current fixed infrastructure. Some even plan to install fibre optics for household access.

Finally, an important debate is taking place on financing and ownership of the new fibre optic networks. The developed countries have recently witnessed the appearance of municipal networks as an element in the competitive telecommunications picture. Various cities and towns created, or announced that they would create, wireless or fibre optic access networks to improve their connectivity for their inhabitants. These "wired cities" in some cases were created under the free access rules that oblige operators to offer access to any service provider on an even playing field. In other geographical areas, low-cost Wi-Fi networks are being promoted as a way of improving public services and reducing the digital divide.

In summary, operators know that it is essential to move in this direction, since the existing infrastructure will not be able to support the future demand for multimedia services. The major questions are when and how to make the change. Supply and demand for video services will be the principal engine driving the FTTx networks. The providers are aware of the popularity that these services will evoke, but have not yet evaluated the size of the business or the potential profits. This increases their uncertainty, given the extreme difficulty involved in developing a business around fibre optic access. Uncertainty must also be dispelled regarding local loop unbundling regulations, since providers remain reluctant to make the necessary investments. Against this background, regulatory agencies are evaluating the characteristics of the new networks and developing standards that will have decisive effects on the application of the FTTx infrastructure.

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[27] Europe is currently reviewing European Commission guidelines regarding the deregulation of the telecommunications markets. This involves analysing: (a) the proliferation of the new convergent services and the consequent overlap of markets of reference; and (b) the conditions for meeting the obligation to open up networks. This second point is the basis for a model of competition with incentives for investment. The conflict is between a model based on different access infrastructures, or "facilities-based competition", and a model that recognizes the definitive and systematic character of natural monopoly in the access business.

(c) The challenge of unlimited mobility

At the same time, the telecommunications firms improved their wireless platforms and advanced in developing new solutions for providing convergent services. The major providers are focusing their efforts on completing the migration to third generation (3G) technologies,[28] which provide networks of higher quality at lower cost that can support voice services, multimedia and broadband data transmission. One third of the mobile telephony providers in the developed countries currently offer 3G services, and this technology currently represents two thirds of the industry's infrastructure investment, while investment in 2G networks such as GSM[29] continues to decline (IDATE, 2007).

In 2009, there are almost 800 million 3G subscribers worldwide,[30] constituting 20% of all mobile subscribers (the rest being basically 2G GSM). These services are developing most strongly in Asia, particularly Japan and the Republic of Korea,[31] where the number of 3G subscribers rapidly surpassed the number using previous technologies. To improve and expand their services, mobile telephony providers also offer broadband access. With the emergence of 3G telephony, providers are continuing to expand higher value added services offered over the new network (e.g., NTT DoCoMo's i-mode was an early success, while Apple's iPhone popularized 3G in USA and Europe).

After a period of inertia caused by a lack of licences, the United States is becoming one of the most dynamic and competitive markets for advanced wireless services. The principal operators are pursuing aggressive strategies to expand their 3G services. The successful partnership between AT&T and Apple for a joint launch of the iPhone is an example of this and brought 3G to roughly 25 million customers between 2007 and 2009 (7 million of those in the U.S.).

The majority of European providers began to offer 3G mobile telephony in 2004, lagging far behind their original schedule as a result of the uncertainty created by the high cost of licenses. Despite the saturation of the mobile telephony market, migration to 3G technologies could give the market new impetus. The most active country in this respect is Italy

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28 Among the standards used by 3G mobile telephony are CDMA-2000, EV-DO (Evolution Data Optimized), HSDPA (High-Speed Downlink Packet Access) and the standard that preceded it (Universal Mobile Telecommunications System, or UMTS).

29 The Global System for Mobile Communications, previously known as Groupe Spécial Mobile (GSM) is the global standard most widely used for mobile telephones.

30 Some statistics count subscribers who use CDMA 2000 1x technology as 3G users, which would bring the world total to 350 million (CDG, 2007).NO ESTABA EN EL TEXTO

31 In 2001, the incorporation of 3G technology gave the mobile telephony market new impetus. NTT DoCoMo, Japan Telecom and KDDI began to provide 3G services under free licenses, with the goal of providing coverage to 50% of the population within five years.

—where one third of subscribers have already moved to 3G— followed by the United Kingdom, Austria and France. In 2005, France Télécom launched a national EDGE network[32] as a complement to its Wi-Fi networks. The massive adoption of UMTS technology made it possible to increase the bandwidth of the 3G technology, and the standardization of IP service platforms led to more varied offerings of services. However, providers' revenues have not yet benefited greatly, due to the scant use of mobile telephone Internet access, which is expensive (Fundación Telefónica/ IDATE/ENTER, 2007). More recently, a number of providers announced the introduction of 3.5G telephony using HSDPA technology.

Meanwhile, Japan has started experimenting with fourth generation (4G) technologies.[33] Initial tests by NTT DoCoMo, which is at the forefront of development in this area, were successful, and the company plans to launch its first commercial 4G services around 2010. This suggests that they could be operating in the rest of the world around 2020.

Finally, the convergence of fixed and mobile services, and the current replacement of fixed with mobile, led telecommunications providers to seek to exploit existing synergies between the two segments. Unintegrated firms (cable television providers and providers of Internet-based applications and content) wishing to offer mobile services could turn to MVNOs as a response to these structural changes. In this context, regulatory agencies play a basic role in encouraging, and even obligating, mobile providers to grant virtual providers access to their networks. Beyond this, quadruple-pack offerings could be the source of growth and survival for mobile providers in the coming years. In fact, the MVNOs could become a serious threat to the traditional mobile providers.

D. Industry dynamic in Latin America

1. Characteristics of the market

Latin America has not been unaffected by the changes in the world telecommunications market. In the last 20 years, the majority of the region's domestic markets were deregulated, and State-owned providers

32 EDGE (Enhanced Data Rates for GSM Evolution) is a cellular telephone technology that acts as a bridge between second and third generation networks. It works with TDMA and GSM networks, and its advantages are evident in applications that require very fast data transfer or wide bandwidth, such as video and other multimedia services.

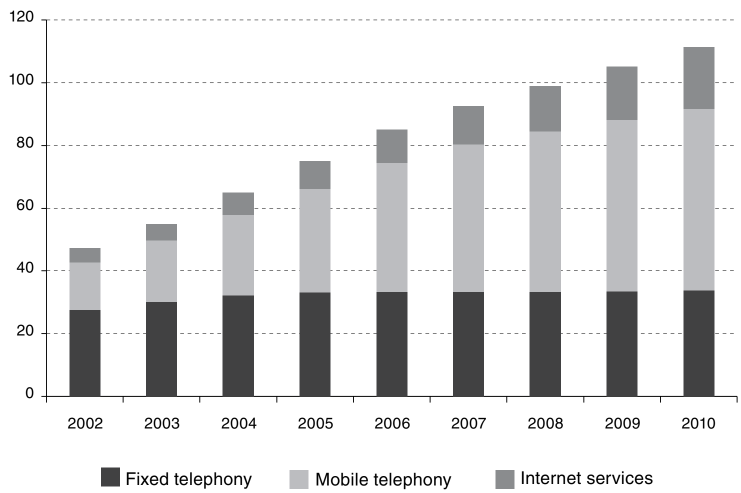
33 4G will be a system of systems, and a network of networks, based entirely on IP. This technology will become a reality after the convergence of fixed and wireless networks, computers, electrical devices and information technologies takes place. It could provide access speeds between 100 Mbps for mobile access and 1 Gbps for fixed access, maintaining highly secure end-to-end quality for all types of services at any place and time.

were privatized. The leading players in this process included some of the industry's major international providers. The reforms strongly affected infrastructure investment, technology transfer, prices (which dropped) and quality of service (which improved).

In the late 1990s, fixed telephony grew rapidly, becoming a very attractive business for providers. The firms met, and even exceeded, the requirements imposed by the privatization process, at the same time achieving a sharp increase in productivity. Cash flows made it possible to finance investments over a period of three years (Beca, 2007). In light of this performance, capital markets rendered a positive assessment of the providers, and financing became available to fund their expansion and diversification plans, particularly in the wireless segment. Against this backdrop, the fixed telephony client base increased from 25 million in 1990 to 72 million in 2000.

The crisis at the beginning of the new century had strong repercussions for operators, to the point that they practically stopped investing in fixed telephony. As in the developed countries, although less rapidly, the pressure of falling rates and competition for mobile services led to a significant flattening of growth in numbers of subscribers, as well as of revenues. Fixed telephony quickly lost ground, and between 2000 and 2006 its share of the sector's revenues fell from 60% to 40% (see figure V.4).

Figure V.4
LATIN AMERICA: TELECOMMUNICATIONS MARKET, REVENUES BY SEGMENT, 2002-2008
(In billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the *Institut de l'Audiovisuel et des Télécommunications en Europe* (IDATE).

Moreover, as in the rest of the world, mobile telephony grew explosively as mobile increasingly replaced fixed services. The expansion of mobile service was based to a large extent on the "calling party pays" scheme, on the prepayment modality that represents over 80% of the subscriber base, and on providers' strategy of subsidizing cell phones. However, the growth was accompanied by a substantial reduction in providers' average revenue per user (ARPU), as a result of the predominant type of client (prepaid) and the growing competition. Like its counterparts in the rest of the world, the Latin American mobile telephony industry was obliged to reduce costs and eliminate cross-subsidies (Beca, 2007).

Starting in the late 1990s, mobile telephony was the leading area of investment for the major regional providers, which aimed primarily to accelerate the shift from TDMA to GSM (both second generation technologies) and to expand and improve their networks. The importance of the European market for these providers contributed to the dominance of GSM technology, which is currently used by 72% of clients. Since that technology facilitates migration to new generations of mobile telephony, a number of providers have implemented 2.5G 3G services, despite the scarcity of frequencies and the cost of these latest generation services.[34]

Although LAC lags in broadband Internet access, this segment is growing in the region twice as fast as the world average. Providers initially lacked incentives to offer access through technologies such as ADSL, since this increased the risk that circuit switched telephone traffic would be replaced by VoIP. The absence of triple-pack offerings also contributed to the strength of the supply side of the access market. With the decline in their traditional revenues, however, and the emergence of alternative providers, the companies were forced to invest in modernizing their networks, and to include broadband access technologies. During the second half of the decade, ADSL connections constitute around 75% of the region's broadband access (Fundación Telefónica/IDATE/ENTER, 2007).[35]

2. Concentration of leadership

While these transformations were taking place in the Latin American market, an intense process of consolidation occurred among the principal providers. Some companies, especially United States firms,[36] abandoned the region because of the global competition, while others took

[34] The first operators that launched 3G networks included Telefónica (in Argentina, Brazil, Chile and Uruguay); América Móvil (in Argentina, Brazil, Paraguay and Uruguay); and Entel PCS (in Chile).

[35] However, the cable modem market should continue growing and become an alternative to the ADSL access controlled by the incumbents. Wireless solutions, such as WiMax, could foster the spread of broadband access in the near future.

[36] BellSouth, Verizon and AT&T sold their Latin American assets.

advantage of the situation to strengthen their position. This latter group included Spain's Telefónica and Mexico's Telmex/América Móvil, followed far behind by Telecom Italia[37] and Luxembourg's Millicom (see table V.2).[38]

Table V.2
AMÉRICA MÓVIL, TELEFÓNICA AND TELECOM ITALIA: LATIN AMERICAN OPERATIONS, 2007
(Thousands of clients)

	Telefónica de España				Telecom Italia		Telmex/ América Móvil	
	Fixed	Mobile	Broadband	Pay TV	Fixed	Mobile	Fixed	Mobile
Argentina	4 578	13 734	1 150	-	4 138	10 666	-	14 618 [a]
Brazil	11 960	33 484 [b]	3 289	231	-	31 268	2 674	30 228
Bolivia (Plurinational State of)	-	-	-	-	74	1 756	-	-
Chile	2 172	6 283	687	220	-	-	-	2 672
Colombia	2 329	8 372	200	73	-	-	-	22 335
Ecuador	-	2 582	-	-	-	-	-	6 936
Paraguay	-	-	-	-	-	1 626	-	...
Peru	2 782	8 129	623	640	-	-	-	5 455
Uruguay	-	1 148	-	-	-	-	-	...
Venezuela (Bolivarian Republic of)	-	10 430	-	-	-	-	-	-
South America	23 821	84 162	5 949	1 164	4 212	45 316	2 674	82 244
Mexico	-	12 538	-	-	-	-	17 800	50 011
Central America	125 [c]	5 278 [c]	22	-	-	-	2 197	8 157
The Caribbean	-	-	-	-	973 [d]	153 [d]	1 340 [e]	3 496 [e]
Total	23 946	101 978	5 971	1 164	5 185	45 469	24 011	143 908

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from Telefónica (http://www.telefonica.es); Telecom Italia (http://www.telecomitalia.it) and América Móvil (http://www.americamovil.com).

[a] Includes operations in Argentina, Paraguay and Uruguay.

[b] Joint operation with Portugal Telecom, of which Telefónica holds 50%.

[c] Telefónica operates in El Salvador and Guatemala in fixed and mobile telephony, and in Nicaragua and Panama in mobile telephony.

[d] Telecom Italia operates in Cuba.

[e] América Móvil operates in Puerto Rico and the Dominican Republic.

There are similarities between the two major firms active in the sector in Latin America. Both were the result of privatizations and were created as vertically integrated firms, the objective, in each case, having been to create a "national champion" that could compete with foreign providers

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[37] Telecom Italia centred itself in Brazil's mobile telephony segment, where it ranks second. Between 2004 and 2006, it sold its mobile telephony assets in Peru, Chile and the Bolivarian Republic of Venezuela. Furthermore, the Bolivian government announced the partial nationalization of ENTEL Bolivia in April of 2007. In Argentina, it owns part of Telecom Argentina.

[38] Millicom concentrated on mobile telephony in Central America (El Salvador, Guatemala and Honduras) and on small South American countries (Bolivia and Paraguay). It recently strengthened its position by acquiring Colombia Móvil for US$ 480 million, which gave it access to a market with a client base of 2.2 million clients.

(from Spain and Mexico) in the domestic market. They based their growth strategies on internationalizing their operations, which centred on Latin America. There are also differences between the two firms, however. Telefónica initially focused on fixed telephony assets in the Southern Cone countries. Later, it shifted its attention northward as it moved into the new segments (mobile telephony, Internet and, more recently, pay TV). Telmex/ América Móvil initially focused on the most dynamic segments (mobile telephony, corporate services and Internet, with the more recent addition of pay TV) and on the largest markets (Brazil and Mexico), expanding subsequently to cover nearly the entire region.

In the second half of the 1990s, when Spain's State telecommunications provider was being privatized, competition in the local market intensified. Looking ahead, and taking advantage of opportunities that had emerged from privatization in Latin America, it acquired assets in Argentina, Chile, Peru and the Bolivarian Republic of Venezuela. It also signed cooperation agreements with major European providers to strengthen its operational capacity and its chances of survival in an increasingly competitive market. In 1998, Telefónica took a fundamental step in its internationalization strategy when it participated successfully in the privatization of telecommunications in Brazil, acquiring, among other assets, control of the city of São Paulo's fixed telephony provider Telesp.

At the beginning of the present decade, Telefónica exchanged assets in the Brazilian market with Portugal Telecom (PT) and made public bids for the assets of Latin American subsidiaries that it did not yet control. In this process, dubbed "Operación Verónica", it spent approximately US$ 20 billion, nearly double what it had previously invested in the region.[39] It also entered the Mexican market after acquiring Motorola's operations in that country. Telefónica thus consolidated its position as the largest telecommunications provider in Latin America. At the same time, it implemented ambitious investment plans, particularly in the mobile telephony segment of the market, introducing new products and services.

Like Telefónica years earlier, TELMEX faced growing competition in its country of origin,[40] and decided that to survive it must position itself within the markets of its potential rivals. Thus, early on, it defined internationalization as a central element in its growth and consolidation

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39 This operation consisted of a public offering for the acquisition of Telefónica's Argentine assets, the Brazilian assets of Telesp and Tele Sudeste, and Telefónica del Perú, which led to a global process of linkage and reorganization of its assets based on businesses rather than countries.

40 While TELMEX had the fixed telephony monopoly, which lasted through the 1990s, some international providers began to undermine its position in other segments, particularly mobile telephony. This led the company to invest over US$ 13 billion in modernization, expansion and diversification of its telephone operations in Mexico.

strategy. At the end of the 1990s, after a frustrated attempt to enter the United States market, TELMEX acquired mobile telephony and Internet assets in Brazil, Ecuador and Guatemala. At the same time, it implemented new systems to capture new mobile telephony clients in the domestic market, where scale is highly important. TELMEX understood this early enough to incorporate low-income clients through the prepaid service modality.

Taking advantage of its solid leadership in the Mexican market, TELMEX extended its internationalization strategy, particularly in the area of wireless telephony. In September of 2000, it created América Móvil as a spin-off of some of its assets.[41] The new company developed its own strategy, attempting to take advantage of the low penetration of mobile telephony in Latin America to strengthen its international growth.

América Móvil entered the telecommunications business under particularly favourable circumstances. First, it had approximately US$ 2 billion in cash for new acquisitions. Second, it was a pioneer in developing new financing instruments in the Mexican market —the so-called stock certificates. This gave it the additional capital it needed for its international expansion. In its first stage, it attempted to establish partnerships with other international providers in order to obtain necessary experience and diversify the risk of operating outside of Mexico. In November 2000, along with Bell Canada Inc. and SBC Inc., it created Telecom Américas. Through contributions from partners and new acquisitions, it began to solidify a significant presence in a number of the region's countries, particularly Brazil. Nevertheless, its existence was brief, primarily because of the differing strategic visions of its shareholders.

Meanwhile, in view of its successful Latin American expansion, Telefónica was emboldened to enter the European market, participating in bidding for 3G licenses, with successes in Germany, Austria and Italy (ECLAC, 2001). It was forced to rethink the pace and depth of its international expansion, however, as a result of the deteriorating global and regional economic situation and the difficulties within the sector itself.

In the new circumstances, although the industry was in crisis, both Telefónica and Telmex/América Móvil began a new phase in their regional positioning. Their relatively positive financial positions allowed them to take advantage of opportunities not exploited by other providers. Brazil became their principal "battlefield", although the battle eventually extended to the entire region.

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41 TELCEL in Mexico, TELGUA in Guatemala, Consorcio Ecuatoriano de Telecomunicaciones S.A. (CONECEL) in Ecuador and Algar Telecom Leste (ATL) in Brazil.

- In 2002, América Móvil acquired its partners' shares and restructured Telecom Américas to focus exclusively on Brazil.[42] It subsequently acquired other firms and licenses, including BellSouth's Brazilian assets, which gave it national coverage in that country. In late 2003, it consolidated its regional providers under the "Claro" brand. It also acquired MCI's share in the Brazilian long distance firm EMBRATEL. At the same time, Telefónica joined with Telefónica Portugal to create a firm that allowed it to expand its geographical coverage in the Brazilian market by acquiring the principal cellular telephony company in the centre-west and northern sections of the country (Tele Centro Oeste, or TCO) and to launch the brand Vivo, which included all of the Brazilian mobile telephony operations of both firms. The new company thus became the largest mobile telephony provider in the southern hemisphere (ECLAC, 2007b).
- Between 2003 and 2006, América Móvil acquired Verizon's assets in Argentina, the Dominican Republic, Puerto Rico and the Bolivarian Republic of Venezuela, France Télécom's share of the Compañía de Telecomunicaciones de El Salvador (CTE), Telecom Italia's Peruvian subsidiary, and a firm created by Endesa España in Chile (Smartcom). It also acquired AT&T's assets in Latin America and other firms in Argentina, Chile and Ecuador, gaining an immediate presence in some of South America's largest fixed telephony, long distance and data transmission markets. Telefónica also acquired all of BellSouth's Latin American mobile telephony operations, which brought it 10.5 million clients and extended its coverage to Colombia, Ecuador, Uruguay and the Bolivarian Republic of Venezuela. At that point, the Spanish firm unified all of its operations (except for the Brazilian one) under the brand Movistar, which it had already established in Spain and in other countries such as Mexico. The acquisition of Colombia Telecomunicaciones (TELECOM) in 2006 gave it the means to strengthen its position in the fixed telephony segment.

These two firms thus achieved a wide-reaching and strong regional presence (see figure V.5), and turned their primary attention to rehabilitating and standardizing their infrastructure. The most important progress occurred in mobile telephony, with massive migrations to GSM technology. This enabled the firms to more easily incorporate new advances, and placed them in an advantageous position for negotiating

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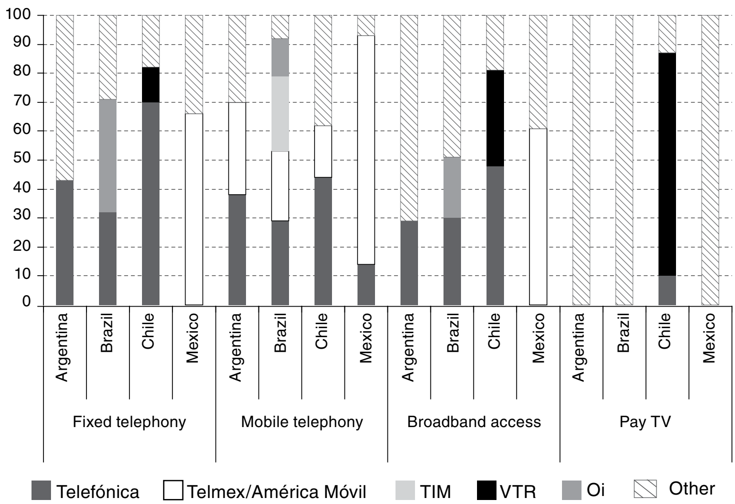
[42] América Móvil acquired the Colombian operations and other firms, which were finally merged under the COMCEL name in December of 2004.

with equipment and technology providers. In this field, América Móvil gained somewhat of an advantage over Telefónica, since the Mexican firm, from the beginning, defined a basic technological model for its activities in the hemisphere (GSM), while the Spanish firm faced an intensive migration from its old networks as well as from its recently acquired ones (such as the former BellSouth assets), where TDMA was the predominant technology.

In terms of physical infrastructure, particularly in the area of fixed telephony, Telefónica has a great advantage as the incumbent provider in a number of the region's largest markets (see table V.2 and figure V.5). Despite the pressure of competition from alternative providers such as cable television, Telefónica managed to commercialize broadband access through ADSL technology, and went directly into television, opting for the satellite alternative in order to offer different integrated services options, principally under the triple-pack model.

Figure V.5
LATIN AMERICA: MARKET SHARE OF THE PRINCIPAL PROVIDERS IN THE MAJOR REGIONAL MARKETS, BY SEGMENTS, 2007
(In percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from firms.

When Telmex/América Móvil reorganized its business areas, it ended up with large shares in some of the industry's most dynamic activities (mobile telephony, broadband access and the business segment), but experienced problems in integrating its operations. It is likely that the

Mexican company will continue on this course until it has completed its offering of services, including television, and can integrate its operations to offer new combined packages of services. Despite its huge power within the Mexican market, it failed to extend its presence into pay television, which is the only missing segment that it needs to gain triple-pack capacity.

In summary, Latin America has witnessed profound changes. During the 1990s, nearly all of its public telecommunications companies were privatized, and the resulting private firms, most of which were foreign-owned, became the countries' principal providers. After an initial period of enthusiasm, the lack of competition and the deteriorating economic conditions in various countries acted as a brake on the drive to invest, particularly in fixed lines. However, the growing demand for telecommunications services facilitated rapid development of the most dynamic segments, especially wireless telephony and, more recently, broadband Internet access.

In slightly over 15 years, due to an aggressive strategy of internationalization that initially centred on Latin America, Telefónica became one of the largest integrated providers in the world (see table V.1). And in less than a decade, América Móvil evolved into a larger and stronger company than was contemplated at the time of its creation. Thus occurred the consolidation of the two firms that have been the leaders in most of the region's markets. Both companies owe their success in part to their ability to take advantage of policies to encourage "national champions".

3. Convergent services: the role of the new competitors

Multi-pack solutions play an increasingly important role in the business dynamic. They first appeared in countries that led the reform process, and were developed by fixed telephony and cable television providers. The growing depth and consolidation of competition in certain markets made it possible for these offerings to emerge. In most of the countries, however, initial structural obstacles impeded the configuration of these types of packages (Beca, 2007).

In Latin America, cable television providers were the first to experiment with the triple-pack model, forcing the incumbent fixed telephony providers to accelerate implementation of ADSL technology in order to level the playing field and mitigate their loss of clients. Other providers have not yet had the necessary conditions to be able to implement this type of option. While the original mobile telephony service was based on prepaid subscribers, modernizing this model will present problems. Moreover, the fact that the financial performance of the fixed technology providers is better than that of the mobile providers gives them greater capacity and more resources to put together initiatives of this kind.[43]

The first experiment in this field took place in Chile in 2000, when the cable television company VTR launched a triple-pack scheme. It immediately evoked interest among users, and induced the fixed telephony providers, headed by the Telefónica subsidiary, to offer solutions that were at least comparable. For example, Telefónica accelerated its deployment of ADSL technology to offer broadband Internet access. However, all of the players in the field lacked at least two of the four elements needed for a full offering: mobile telephony and pay television. Given this situation, the Chilean authorities established clear rules for supplying these services,[44] and formulated requirements governing the use of cable modems and the intervention of virtual mobile telephony providers, in order to encourage competition.[45]

In some of the other countries of the region, these types of offerings lagged further behind, primarily due to resistance from incumbents and because of regulatory constraints. In Mexico —a case in point with respect to the former factor— the lack of capacity to challenge the incumbent (Telmex/América Móvil) held back the convergence process in comparison with other countries in the region, such as Brazil, Chile and Peru (*América Economía*, 2007). Given this scenario, it was foreseeable that the incumbent would make no major effort to put multi-pack offerings on the market, instead exploiting its position to observe and learn from the experience of others. Events did not play out as expected, however, and Telmex/América Móvil, along with Televisa, wagered on ratification of the Technological Convergence Agreement,[46] which was conceived as a way of lending viability to the configuration of these options. Thus, the way was paved for Telmex/

[43] In general terms, fixed telephony providers operate with EBITDA (earnings before interest, tax, depreciation and amortization) margins that are more than double the EBITDA in mobile telephony (Beca, 2007). EBITDA is a good indicator of the profitability of a business, since it is based on the profit and loss bottom line, and disregards financial and tax variables and accounting entries (depreciation and amortization).

[44] The Undersecretariat of Telecommunications and the Free Competition Tribunal established rules that gradually obligated providers of the four basic services to offer facilities to wholesalers to provide fixed telephony services, and to allow third parties to use the subscribers' loop.

[45] After VTR merged with the cable provider Metrópolis, it was obliged to offer wholesalers facilities for the provision of broadband Internet access via cable modem. As a result of merging its mobile assets with those of BellSouth, Telefónica was also authorized to facilitate mobile telephony services offered by virtual providers.

[46] The Technological Convergence Agreement of 2006 recognizes the interoperability of networks in situations where this is technically possible. It sets forth a series of operational standards that permit telecommunications (telephony, cable television and Internet) firms to offer all services. This was already contemplated in various national and international laws and agreements, and it includes the additional right to provide VoIP services —something that various local telephone providers around the world oppose (Beca, 2007). See also chapter VI, section C.3.

América Móvil to offer pay television services over telephone networks and complete its multi-pack configuration for the Mexican market.

In Brazil, structural constraints prevented incumbents from simultaneously offering mobile telephony services and pay television. However, the major firms are negotiating a change in this area that would permit them to become part of the international trend. Oi and Brazil Telecom merged in 2009 and produced a solid domestic firm capable of competing with the regional giants. In the initial phase, the two firms have moved towards converging their services, particularly in the fixed-mobile realm.

In short, the progress of the Latin American markets towards convergent solutions —still in its early stages— makes it unlikely that the debate will centre on the characteristics of networks, as is occurring in the developed countries. Attention is currently focused on the regulatory changes that make multi-pack offerings possible. Nevertheless, the growing demand for traffic inevitably evoked by these options will oblige providers to address the need to incorporate next generation fibre optic networks.

Chapter VI

Telecommunications regulation

A. Introduction

More competitive telecommunications markets —i.e. those in which there is strong competition between agents[1]— tend to have more and better services and a more efficient price structure, as well as greater ICT investment and higher rates of penetration. High telecommunications penetration rates contribute to social inclusion and economic growth. Telecommunications infrastructure has positive network externalities. To achieve these, a network must reach a certain critical mass —a point that is close to universal service (Röller and Waverman, 2001; Waverman, Meschi and Fuss, 2005). Thus, besides its social importance, the goal of universal access impacts economic growth. Developing a vibrant competitive market requires regulation, since the absence of a strong and effective regulatory agency can encourage practices that perpetuate oligopolistic or monopolistic structures, to the detriment of the sector's static, as well as dynamic, efficiency. Thus, regulation is essential for the sector's performance.

This chapter examines changing regulatory schemes and analyses their influence on the development of telecommunications in the region's countries. It emphasizes the most important milestone in this history,

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1 Broadly speaking, there are two main concepts of competition in economic thinking. One is the classic evolutionary view of competition as a *process* of rivalry between firms based on price, product differentiation, innovative initiative, etc. The other is the neoclassical view of competition as a *state* that leads to optimal results in terms of efficiency (Andrews, 1964). The present book employs the former, i.e., the dynamic view of competition.

namely, the widespread process of nationalization and privatization that occurred. It also describes the role of regulation and the agencies responsible for it, as well as the obstacles that they confront —in particular, those arising from the universalization of service in the wake of technological change and convergence brought on by the widespread availability of IP-enabled services.

B. Evolution of the sector in Latin America

The Latin American telecommunications sector has undergone three stages of development. The first extended from its creation until the Second World War. During this period, the sector was essentially private, and was in the hands of foreign companies. The second, stretching from the 1950s through the 1980s, featured nationalization and State telecommunications monopolies. The third began in the 1990s and is ongoing. It is marked by reform, re-privatization, and changes in the sector's traditional regulatory schemes.

1. State monopoly

The nationalization boom in the region's telecommunications sector occurred in the 1950s and 1960s, although this process began earlier in Mexico (1930s) and Argentina (1940s). By the early 1970s, nearly all of the region's telecommunications companies were State monopolies (Noll, 2000).

Although nationalization and the resulting monopolies were the result of various factors,[2] the most important was the fact that the sector was viewed —in terms of its social and economic nature— as a "natural monopoly", i.e., a market in which costs could be minimized only if there was a single operator. Telecommunications were considered a public service providing major social benefits, and thus an activity that should be handled by the State. One of the basic objectives of nationalization was, therefore, to expand service as a means of benefiting the rest of the economy. The concept of telecommunications as a natural monopoly was not limited to Latin America, but was also present in other developing countries (Wallsten, 2001) and in Europe (Gerardin and Kerf 2003), as well as, to a lesser extent, in the United States.[3]

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[2] The notion was prevalent in many developing countries that foreign telecommunications firms essentially served elites (particularly foreign elites) and the companies that did business with them. For a detailed analysis of this and other circumstances surrounding nationalization, see Noll (2000).

[3] In the United States, the concept of natural monopolies, although the subject of debate, has been widely recognized. Nevertheless, the government did not share this view. First, the monopoly in question was not a State monopoly, but rather a private one (AT&T), although it was regulated by the State. Regulation focused on three areas: (i) public service; (ii) prohibition of monopolistic behaviour; and (iii) ensuring investment in the

Nationalizations and the resulting State monopolies significantly impacted penetration. In 1981, the average telephone penetration rate in Latin America was 5.5 telephones per 100 inhabitants. This was greater than Africa's rate of 0.8 per 100, but far below the 83.7 reached in the United States, or even the 33.1 found in Europe, where, as in Latin America, the great majority of operators were State-owned (Saunders and others, 1993).[4] Despite these successes, State monopolies experienced a number of severe problems:

- Resource allocation was inefficient, since social objectives often led to cross-subsidies that distorted the market.[5] For example, uniform pricing meant that urban areas subsidized rural areas, where the cost of providing services was higher. To increase penetration, the price of access was generally set at a level below what it actually cost to provide service. This was balanced by higher per-call prices, which meant that larger consumers subsidized smaller consumers.[6]
- Services were not produced efficiently, due to the fact that lack of competitive pressure, combined with the pursuit of multiple objectives, often led to rates that had little relation to the cost of providing service, thus creating little incentive to reduce (or to not increase) rates.[7]
- Equipment costs were two or three times as high as in the developed countries. To stimulate local production of capital goods, components were manufactured under protectionist trade schemes that required high production volumes in order to reach a minimum scale of efficiency. Thus, prices and production costs were high for telecommunications operators.[8]
- Dynamic inefficiency was a problem. In general, decisions on the quality of service and on investment in new technologies were the result of public policy, rather than arising from demand

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sector. Regulation in the first of these areas was carried out by imposing obligations of a public nature, such as universal service, in the second by setting profit levels for AT&T, and in the third by guaranteeing the firm a predetermined return on its investments. This type of regulation is known as rate of return regulation. Cf. Economides (2004), and Oldale and Padilla (2004).

4 The European average was calculated on the basis of data from Noll (2000) for 16 countries.

5 Cross-subsidies are not inefficient per se. Some access subsidies can be efficient in the presence of network externalities (Oldale and Padilla, 2004).

6 These subsidies interfered with the role of prices —i.e., as a means of ensuring that consumers only purchase when the benefit that they receive is greater than the cost.

7 In some cases, governments used the sector's firms to create jobs, often for their political clients. In some developing countries, the number of employees per telephone line was much greater than in the developed countries or than in developing countries employing good practices (Noll, 2000).

8 Noll (2000) mentions this problem particularly in the cases of Brazil and Argentina.

or from innovative initiatives to encourage competitiveness. Moreover, money for investment was lacking, causing insufficient replacement of existing facilities and relatively little expansion.

- Quality of service was poor. In various countries, restoring service to a telephone line that was experiencing problems could take months, when only hours or days were required in the developed countries. The wait time for obtaining a telephone line could be long: 4.1 years in Argentina, 5.7 in Chile, 9.0 in Jamaica, 4.9 in Mexico and 2.5 in the Bolivarian Republic of Venezuela (Galal and Nauriyal, 1995). Furthermore, the probability of getting a dial tone upon picking up the telephone, or of completing a domestic call successfully after getting a dial tone, was under 80%, and the situation was worse for international calling (Noll, 2000).

In summary, although nationalizations brought increased investment and service improvements, these were short-lived. Deterioration and inefficiency characterized the sector during this period of nationalization, with the problems of State monopolies exceeding the benefits. The onslaught of the economic crises of the 1980s finally made reform of the sector a necessity.

2. Reform and privatization

Reform of the sector in the region was a response to three factors: (i) the economic crises that occurred in various countries in the 1980s, compounded by pressure from international institutions to implement reforms;[9] (ii) the sector's poor performance; and (iii) technological developments that made increasingly untenable the concept that telecommunications services were a natural monopoly (Wallsten, 2001).

Although the economic crises of the 1980s were primarily a phenomenon of the developing countries, there was general dissatisfaction with the sector's performance at the global level. The need for change was clear, but in order for this to occur, three things were necessary. First, serious scepticism concerning the notion of telecommunications as a natural monopoly had to be raised, and competition introduced. Second, the idea that State ownership was the most efficient means of providing service had to be challenged —a process that ultimately led to a wave of privatizations.[10] Third, new approaches needed to be taken to the economic aspects of regulation. This led to incentives-based regulation (Oldale

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[9] Li and others (2000) use data on 167 countries for the 1980-1998 period. They detect empirical evidence that the reform of the telecommunications sector arose from the sector's poor performance and from the loans that it received from the World Bank.

[10] The privatization that began in the 1980s in the United Kingdom, and that rapidly spread to the rest of the world, had effects beyond the telecommunications sector.

and Padilla, 2004). Although these issues were not initially articulated or resolved in Latin America, but rather in Europe and the United States, the thinking that developed as a result shaped the reform of the sector that eventually occurred in the region.

As technological progress reduced the cost of networks, the notion of competition between firms with different networks began to seem viable, at least in some markets.[11] The 1984 dismantling of the United States firm AT&T after a protracted legal process that compelled it to divest itself of its local providers was a catalytic event, and contributed to discrediting the concept of a natural telecommunications monopoly. The result was the creation of seven regional telephone companies known as the "Baby Bells", with certain segments of the original company continuing to act as regulated monopolies, while others, in areas where competition was considered a viable possibility —such as long-distance service, manufacturing, and research and development— were separated as distinct operations (Economides, 2004).

Europe experienced a similar trend. The 1983 *Littlechild Report* concluded that, in light of technological advances, national and international calling markets could no longer be considered natural monopolies, and should be opened to competition.[12] According to this report, competition was the most effective way of protecting consumers against monopolistic power, and regulatory measures were deemed capable of preventing abuses until such time as competition gained a solid foothold. As the concept of a natural monopoly became unsustainable, the importance of introducing competitors in the sector assumed high priority.

One of the objectives of privatization was to improve efficiency, by providing private firms in the sector greater incentives to maximize their profits, minimize their costs and accelerate investment, while making them less susceptible to pressures to divert their attention towards other objectives.[13] However, while privatization had the potential to increase efficiency, the shift from public monopoly to private monopoly left telecommunications service in the hands of a single firm with a powerful market position. As Vickers and Yarrow (1988) argue, change of ownership is only one of the factors that may affect a company's incentives structure

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11 Originally, the natural telecommunications monopoly was based on the economies of scale involved in switches and transmission links for domestic and international long distance calling. Application of the "natural monopolies" concept to the sector was not always sound, however, and technological advances ultimately made it untenable (Noll, 2000).

12 Littlechild (1983).

13 Research on the financial and operational performance of the firms before and after privatization shows that the improvement in their performance was not due to price increases after privatization, or to abuse of market position, but rather to increased efficiency as a result of better incentives schemes (see, for example, D'Souza and Megginson, 1999).

and influence the competitive framework in which it operates. Regulatory regimes also have major effects on incentives structures. Moreover, efficiency effects from changes in any one of the relevant factors (ownership, competition, regulation) depend on the status of the other two.

The message was clear: in the transition from a State monopoly to a competitive market structure, regulation and the promotion of competition were needed for a number of reasons, namely, to prevent abuses by those with market power, to create a favourable investment climate, and to ensure that improvements in efficiency translate into more and better products and lower prices for consumers.

The failures of the State monopolies, the consequent privatizations and the deficiencies of the traditional regulatory system gave new relevance to the question of how the sector should be regulated.[14] The response was to apply economic principles to regulation. Advances in microeconomic analysis, based on applying incomplete information theory and contract theory, ultimately produced a new regulatory approach known as incentives-based regulation.[15] Traditionally, it had been assumed that regulatory agencies had full information on firms' costs and on the effects of incentives. The new approach more realistically assumed that regulatory agencies worked under conditions of rationality and limited information. Rather than assuming that regulatory agencies would be able to supervise initiatives related to costs and cost dynamics, ways were sought to ensure that the regulatory scheme was based on rewards, and that it did, in fact, induce firms to adopt the desired behaviours (Oldale and Padilla, 2004).

3. Effects of reform

Changes in the sector in Europe and the United States were important in terms of the restructuring that they produced. Beyond this, however, they also played a fundamental role in influencing the substance and form of Latin American reforms. Privatization was the basic component of the process, followed or accompanied by government regulation designed to introduce competition and liberalize the sector in markets where this was practicable.

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14 There was also dissatisfaction in the United States with the classic system of rate of return regulation (Oldale and Padilla, 2004).

15 This regulation is based on the theory of principal and agent, as well as on establishing incentives to promote efficiency in cases of asymmetrical information. In this framework, the regulatory entity is the principal and the operating firm is the agent. From this perspective, the regulatory system can be classified as an incentives mechanism. For example, the firm has better information on costs than the regulator, but the regulator attempts to induce the firm to apply a scheme of prices, production and investment that is compatible with the public interest and with prevailing economic conditions. Asymmetrical information can lead to imperfect incentives, and hence to inefficiency in the system. In this regard, see Sappington and Weisman (1996), or Laffont and Tirole (1993).

Most privatization of telecommunications in the region began in the early 1990s, although there were some exceptions. Chile approved reforms in 1982 and privatized the sector in 1987. The process of privatization in the region varied from country to country, based on the particular strategies (and consequent results), and on the different sequences of privatization and regulation adopted (see table VI.1). While some countries (such as Bolivia, Peru and the Bolivarian Republic of Venezuela) created regulatory agencies in tandem with privatization of the State enterprise, others (such as Mexico and Argentina) did not establish their regulatory agencies until some years later. In Costa Rica and Uruguay, telecommunications remained a State enterprise, although a regulatory agency was also created.

Table VI.1
TELECOMMUNICATIONS REFORM: PRIVATIZATION AND CREATION OF AN INDEPENDENT REGULATORY AGENCY

Country	Creation of an independent regulatory agency	Privatization of the State-owned operator
Argentina	1996	1990
Bolivia (Plurinational State of)	1995	1995
Brazil	1997	1998
Chile	-	1987
Colombia	1994	-
Costa Rica	1996	-
Ecuador	1995	-
El Salvador	1996	1998
Guatemala	1996	1998
Honduras	1995	2003
Mexico	1996	1990
Nicaragua	1997 (TELCOR)	2001 2005 (SISEP)
Panama	1996	1997
Paraguay	1995	-
Peru	1994	1994
Dominican Republic	1998	1930
Uruguay	2001	-
Venezuela (Bolivarian Republic of)	1991	1991

Source: S. Wallsten, “An econometric analysis of telecom competition and regulation in Africa and Latin America”, *Journal of Industrial Economics*, No. 1, 2001; E. Rivera, “Modelos de privatización y desarrollo de la competencia en las telecomunicaciones en Centroamérica y México”, *Serie Estudios y perspectivas*, No. 66, Mexico City, ECLAC Subregional Headquarters in Mexico, 2007.

Another difference in the countries’ reform processes was that different periods of exclusivity were granted to those acquiring the privatized firms. In some countries (Argentina, Mexico, Nicaragua, Panama, Peru and the Bolivarian Republic of Venezuela), these periods were included as terms of the privatization, allowing the companies to gain a sound footing before the market was deregulated. Brazil, Chile, El Salvador and Guatemala, on the other hand, opted to privatize and deregulate the sector without any period of exclusivity.

Granting privatized firms exclusivity for a period of time had important effects on the sector's performance. Although it produced a significant increase in the sales price of the firm being privatized, it led to a decline in investment in the network, in public telephones, and in telephone penetration (Wallsten, 2004). Prolonged periods of exclusivity in Latin America produced increased prices for domestic and international service, and impeded the emergence of new services, even in those cases where markets were later opened up to competition (Wellenius and Townsend, 2005). In general, countries that provided periods of exclusivity had more difficulty creating competitive markets (Rivera, 2007).

The sector's quality of service and level of investment increased in the wake of privatization. Per capita connectivity figures also rose (see figure VI.1), but this cannot be attributed entirely to privatization, since similar growth occurred in Costa Rica and Uruguay, where the incumbents continued to be State-owned. Increased competition in the sector produced greater efficiency and reduced costs for local and international calling (Ross, 1999;[16] Wallsten, 2001;[17] Rossotto and others, 2004). For example, in 1995 a call to the United States from Argentina (where a private monopoly was in place) or from Brazil (where there was a public monopoly) cost between 4 and 7 times as much as from Chile (a competitive market), while a call from Argentina, Brazil or Mexico to Chile cost 2 or 3 times more than a call placed in the opposite direction (Wellenius and Townsend, 2005).

The initial objectives of the reform were to improve service and increase the penetration of fixed telephony. The next challenge was to exploit global advances in technology and increase the penetration of mobile telephony.[18] Today, the major objective is to increase Internet penetration and broadband use, which, of course, was not part of the original reform package.[19] It was only with the creation and spread of hypertext transfer

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[16] Employing a fixed effects model to analyse the effects of privatization and competition on the sector, this document presents evidence that increased competition is associated with improvements in efficiency as measured by number of employees per telephone line.

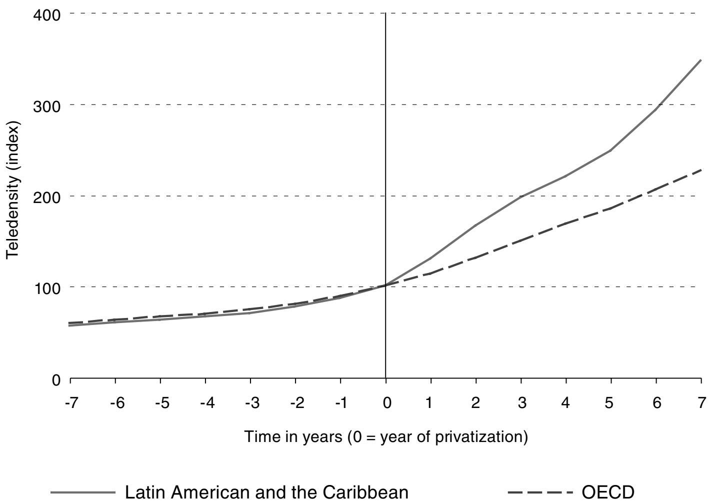
[17] This study examined the impact of privatization and competition by using fixed effects regression models to evaluate the performance of 30 African and Latin American countries between 1984 and 1997.

[18] As explained in chapter II, the sharp increase in telephone penetration starting in the late 1990s was due to the rapid growth of mobile telephony. Beginning in 2001, the number of mobile lines per 100 inhabitants in the region exceeded the number of landlines, and the difference has grown over time.

[19] In the late 1990s, the majority of the major international donors of financial assistance, as well as the technical assistance institutions, such as the World Bank, ITU and WTO, tended to consider Internet access a secondary capacity and a luxury, rather than a fundamental segment of the telecommunications infrastructure.

protocol (http) and the world wide web, starting in 1994, that industry analysts began to recognize the revolution brought about by the development of the Internet. As indicated in chapter II, Internet penetration rose quickly in the region, but levels of access, especially via broadband, remain very low in comparison with the developed countries. One of the main reasons for this is cost, both for providers and consumers. The commitments that firms assumed with privatization did not take account of the cost of expanding the network and increasing capacity. Moreover, uncertainty regarding the short-term profitability of such investment created scepticism among entrepreneurs, leading to low levels of investment. The cost of connecting to the global Internet backbone —and the associated hardware and software costs— further complicated the problem.[20]

Figure VI.1
TELEPHONE LINES AND PRIVATIZATION
(Per capita index)



Source: OECD Development Centre, based on data from the International Telecommunications Union (ITU), "What rules for universal service in an IP-enabled NGN environment?", 2006.

Note: Year 0 is the year in which the incumbent operator was privatized. The scale of telephone density is normalized to 100 for the time at which the privatization occurred. Average data were used for the countries in which privatization occurred at least 7 years earlier and for which there were data for the period following privatization (Argentina, Belize, the Plurinational Sate of Bolivia, Brazil, Chile, El Salvador, Guatemala, Guyana, Mexico, Panama, Peru and the Bolivarian Republic of Venezuela).

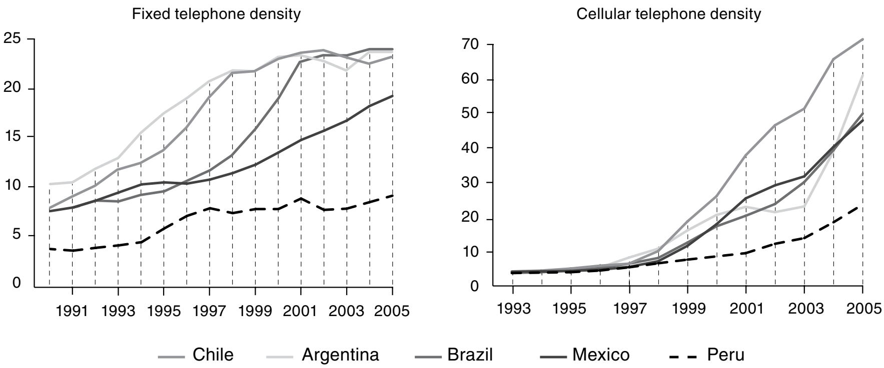
[20] For an analysis of the evolution of the Internet and some factors limiting its expansion in the developing countries, see Wellenius and Townsend (2005).

4. Concentration in the sector

As detailed in chapter V, during the last decade the telecommunications market in most of the region's countries has remained heavily concentrated, particularly in the telephony segments. Although this does not in itself imply abuse of market power, it has the potential to facilitate such abuse, and this has been a cause of concern for the regulatory agencies and authorities advocating competition.

High levels of concentration can lead to a supply of services that is far from optimal, limit penetration and lead to rising rates. Figure VI.2 shows changes in fixed and mobile telephony in five of the region's countries between 1990 and 2005. The lowest fixed telephony penetration rates were in Mexico and Peru, where markets were much more concentrated than in Argentina, Brazil or Chile.[21] Notably, the increase in the density of fixed telephony in Mexico accelerated one year after the market was opened up to competition (1998).[22]

Figure VI.2
DENSITY OF FIXED AND MOBILE TELEPHONY, 1993-2008
(Lines per 100 inhabitants)



Source: Author, based on International Telecommunications Union, *World Telecommunications Database*, 2009.

In mobile telephony, Peru has the lowest penetration rates of the countries considered, while Mexico, despite its high concentration, has levels comparable to those of Argentina and Brazil. As indicated in

21 While Mexico and Peru had levels of concentration near 9,000 (according to the Herfindahl-Hirschman Index, which has a maximum of 10,000), the level in the other three countries ranged from 3,000 to 5,000 (OECD, 2007b).

22 Comparing Mexico's situation with that in OECD member countries shows Mexico as having one of the most expensive baskets of telecommunications services, exceeded only by Hungary, Portugal and Turkey (Rivera, 2007).

chapters II and III, although the principal determinant of ICT penetration is a country's per capita income level, data on concentration can also help to explain the dynamic. Table VI.2 compares countries with fairly comparable per capita GDP, showing that in Mexico the average revenue per user (ARPU) is higher than in Argentina and Chile, where, on average, consumers make more use of service. This suggests that greater competition is needed to reduce prices in that market.

Table VI.2
CONCENTRATION, USE AND ARPU FOR CELLULAR TELEPHONY IN SELECTED COUNTRIES, 2005

Country	Concentration (HHI)	Use (minutes per user per month)	ARPU (dollars per user per month)
Argentina	3 270	125	13
Brazil	2 394	79	13
Chile	3 794	112	15
Mexico	6 154	109	19

Source: Author, based on information of Fundación Telefónica, IDATE and ENTER, *DigiWorld América Latina 2007*, Editorial Ariel, 2007.

Though an exhaustive analysis (by geographical area and product) would be needed to determine the state of competition in each of the sector's markets, evidence indicates that there is ample margin for increased competition, and consequently for greater penetration, better services and lower prices.

C. Regulatory agendas

1. Regulation and technological convergence

The last few years have seen radical innovations in the telecommunications sector. A decade ago, mobile telephony, broadband, digital television and Wi-Fi technology were niche products, or were simply non-existent. Today, they are mass products. Technological innovation and digital convergence transformed a relatively stable sector with high entry barriers and a monopolistic structure into a very open and rapidly changing market with increased competition.

New trends in services and technologies, along with regulatory changes, have stimulated competition, not only within single platforms, but also between different platforms. This creates a significant challenge, both for the sector's business models and for regulatory agencies, which must adapt their operations to the new realities. Thus, it is important for regulatory agendas to combine efforts to encourage competition with support for technological convergence.

Recent, highly proactive approaches in the developed countries reflect an attempt to use public regulatory agendas to encourage competition in the area of technological convergence. This may take the form of intense State coordination, as in Europe and Japan, or of a more market-based approach, as in the United States. The posture of the Latin American countries, in contrast, has been reactive, particularly in the five countries explored in detail in this chapter (Mexico, Peru, Chile, Argentina and Brazil). In analysing the experience in these countries, a distinction can be made between the first three, which have defined agendas, and the other two, where agendas have only recently begun to be developed.

Leadership is required in order to incorporate technological convergence in programmes that have been established. This can come either from the agency responsible for protecting competition (Chile) or through executive branch policy (Mexico and Peru). In both cases, not only were programmes developed, but efforts were also made to reduce legal impediments to participation in third-party markets by firms that had previously been unable to gain access to them.[23]

2. An agenda led by the agency responsible for protecting competition

In Chile, it was the ruling issued by the Free Competition Tribunal (Tribunal de la Defensa de la Competencia, or TDLC) in Voissnet's suit against Compañía de Teléfonos de Chile (CTC) that led to establishing standards to encourage convergence.[24] The suit accused CTC of engaging in unfair competition by preventing its users from making free use of the different applications, services and possibilities offered on the Internet —particularly IP telephony. The ruling set criteria for the convergence process. These covered areas such as the interconnection of networks that use different technologies, classification of IP telephony as a public telecommunications service, and the assignment of IP telephone numbers. It created an important precedent for eliminating artificial barriers to competition, such as contractual limitations imposed by operators. The ruling attempted to provide network economies to users by integrating two different types of networks, and provided for number portability. The

[23] In addition to the usual types of decisions of the regulatory agencies, programmes to promote convergence involve institutional decisions to reduce access barriers in specific markets. One example of this would be suspending the provision that excludes certain providers (generally telecommunications operators) from the cable TV market, which is outside the area of their concession (original license). In general, telecommunications operators could not enter the cable TV market, because of market allocations that favoured operators in that segment.

[24] Ruling no. 45/2006 of 26 October 2006.

basic objectives of regulation were also emphasized, i.e., regulation should have the effect of ensuring the greatest possible freedom of access to the market, and should prevent the creation of artificial barriers.

This ruling had major repercussions on the regulatory regime, inasmuch as it led to an analysis of proposed rules on issues that are fundamental to convergence, such as the treatment of IP telephony. It also defined new functions and tasks for the regulatory agency. Moreover, in mandating that regulation be kept to a minimum, it promoted a shift from traditional ex ante regulation to ex post regulation designed to correct failures of the market.

Numerous public forums to discuss these issues were also held, focusing particularly on the creation of a telecommunications superintendency to monitor service, regulate public VoIP service, and develop legislation to change the concessions system. The benefits of some of the proposals arising from these public discussions included the potential to eliminate artificial barriers to access, by reducing delays and requirements in bureaucratic procedures (i.e., a new concessions regime), while reducing costs for telephone service providers, which are currently compelled to operate their local and long-distance services separately (i.e., savings through horizontal integration).

These public forums reflect an effort to bring regulation into line with the new environment, and to identify elements of the regulatory system that could impede convergence. The concerted attempt to include all stakeholders in the process was aimed at enhancing the legitimacy of any measures adopted, reducing the discretionality of the executive branch and enhancing its credibility.

3. Agendas dictated by public policy

(a) Mexico

In Mexico, the agenda for encouraging convergence emerged from an executive branch initiative —the Technological Convergence Agreement of 3 October 2006, which was designed to promote convergence between local fixed telephone services and limited television and/or audio services over wired and wireless (including satellite) networks.[25] Under the agreement, local fixed telephony companies that voluntarily adopted the agreement's provisions would be allowed to offer limited television and audio services, and vice versa.

[25] Also important was the promulgation of the amendment to the Federal Telecommunications Act (April 2006), one of whose principal provisions gives the Federal Telecommunications Commission (COFETEL) authority over broadcasting, an area previously under the authority of the Secretariat of Communications and Transportation (Article 9-A).

This arrangement sought to facilitate the convergence of telecommunications networks and services, while at the same time promoting competition between concessionaires using public networks to offer limited television or audio services, and providers of local landline telephone service. The definitions set forth in the agreement have important implications in terms of convergence-related regulation, elimination of artificial (legal) barriers to access in certain markets, the ability of providers to offer previously restricted services, promotion of interconnection and interoperability between networks with different services and technologies, and implementation of number portability.

While Mexico took important first steps towards convergence, the process required that new definitions be established, and that an analysis be undertaken to determine the conditions needed in order for the process to have positive market effects.

(b) Peru

In Peru, it was the passage of the Single Concession Act (Ley de Concesión Única) in 2006 that led to creating a regulatory agenda to encourage convergence. This legislation reduced barriers to access for IP service providers.[26] The "single concession" gives the sector's incumbent firm the right to provide all of the public telecommunications services (local carrier, domestic long distance, international long distance, connection to the trunk line, PCS, mobile and satellite telephony, fixed telephony, wireless telephony, cable television). Under this scheme, all that is required, in addition to the single license, to offer value added services, is automatic registry with the Ministry of Transportation and Communications.

Another executive branch initiative established guidelines to develop and consolidate competition and expand telecommunications services (Supreme Decree 003-2007-MTC of 1 February 2007). This decree sets goals for 2011 for the telecommunications sector, authorizes convergent products that expand the commercial supply of public telecommunications services, and mandates number portability for mobile services as of 2010.

These changes reduce the regulatory barriers to market access, and make it easier for new providers to enter the market. The very fact of eliminating barriers generates greater competition, since, regardless of whether new competitors actually enter the market, markets become more

[26] This law is innovative in establishing that "the State promotes the convergence of networks and services, facilitating interoperability between different network platforms, as well as the provision of different services and applications over the same technological platform, recognizing convergence as a fundamental element for the development of the information society and the integration of the country's different regions" (Article 1, Law no. 28737 of 18 May 2006).

contestable, limiting the actions of incumbent operators. With regard to convergence, the new rules make it possible for providers to reduce costs by providing packages, thus encouraging the bundling of multiple services.

In addition to creating conditions more favourable to competition —through measures to prevent non-discrimination and to reduce user costs for changing mobile service providers— these changes, by setting specific objectives and timelines, highlight the importance of convergence as part of the public policy agenda. However, implementation measures have yet to be established, and further attention needs to be given to the fact that regulations, under the Single Concession Act, still do not eliminate economic barriers to market access, particularly as regards interconnection with the incumbent operator's network. Nevertheless, the changes in the regulatory framework improve the regulatory environment with regard to convergence (Barrantes, 2007).

4. Ongoing development of agendas

(a) Argentina

The country's economic recovery following the crisis of 2001 and 2002, accompanied by the normalization of contractual relations between the government and the large providers, created a stable institutional policy framework, thus paving the way for formulation of a plan to promote convergence. Political and institutional stability has positive effects on the telecommunications sector. One example is the universal service regulations that were approved in the first half of 2007, which require operators to contribute 1% of their revenues to a Universalization Fund. Such a measure would not have been viable during the crisis, given that the drop in demand for telecommunications services, along with the freeze in rates, severely impacted the profitability of operators.

Specialized publications cite the fact that potential changes in the telecommunications law offer new possibilities for private operators. The potential providers maintain that the major impediment to convergence in the current regulatory framework is the rule that prevents operators of fixed and mobile telephony from offering television services to their subscribers and, thus, from developing strategies based on providing multiple packages over IP networks. Their criticism of this rule is based on its asymmetry: while they themselves are limited in what they can provide, cable television providers are not barred from providing telephone service.

(b) Brazil

Both in private sector forums and in the technical committees of Brazil's National Congress, there has been considerable discussion on what basic objectives and specific features should be incorporated in a regulatory framework to encourage convergence in the country.

In 2006, partial acquisition of cable television assets by incumbent telecommunications operators (TVA by Telefónica and Way Brazil by Telemar) intensified the debate, particularly with regard to regulatory asymmetries. To avoid the restriction that prevents a concessionaire in a given region from also owning cable television networks in the same area, some of these acquisitions occurred in regions where the providers do not have concessions, and where they are not authorized to provide telecommunications services. These acquisitions of companies in different segments, as a means of circumventing the restriction on offering multi-packs, once again brought institutional and regulatory issues to the forefront.

One specific type of discrepancy (i.e., regulatory asymmetry) at issue concerns the different rules that apply to the different media used to provide television service to subscribers: cable, direct-to-home (DTH) satellite connections, and terrestrial microwaves distribution systems (Multichannel Multipoint Distribution Service, or MMDS). One of the major differences between regulations governing these different services is the role of foreign capital: while there are no foreign-capital restrictions for DTH or MMDS, foreign capital is limited to 49% in cable TV enterprises.

Plans for number portability are already in place in Brazil. The process began in August 2006, with public discussion of the proposal for general regulations on the issue, involving a combined provision by which users may keep their numbers when changing service providers, regardless of whether the change is within a single type of mobile or landline service, within a local fixed landline telephone service area, or within a personal mobile service zone. In addition to providing the basic conditions for competition, lowering prices and improving the quality of service, the goal is for users to have only two numbers —one for mobile and one for landline.

Finally, the Brazilian convergence agenda stresses the importance of terrestrial digital television. In 2006, Brazil's terrestrial digital television system (known by its acronym SBTVD-T) was created, and guidelines were established for the transition from analogue to digital service (Decree 5.820). The new system consists of a set of technological standards for the terrestrial transmission, reception and broadcasting of digital signals and images. It will allow for digital transmission of both high-definition television (HDTV) and standard-definition television (SDTV), simultaneous digital transmission for terrestrial, mobile and portable reception, and interactivity. Each channel provided to concessionaires, and for authorized services, will have a corresponding radio frequency channel with 6 MHz of bandwidth, thus allowing the transition to digital technology to occur without interrupting analogue transmission. The channels used for analogue transmission will be reintegrated into the system following the transition —a process slated to take 10 years. From that point forward (1 July 2013), the Ministry of Communications will grant licenses only for digital broadcasting of signals and images.

D. Strengthening regulatory agencies

1. Regulatory agency objectives

Regulation is generally applied in markets whose structure is unlikely to effectively encourage competition. In the past, the function of regulatory agencies in these markets, which are characterized by high fixed costs and a bias towards natural monopolies, consisted of ensuring that industry performance was as equivalent as possible to what performance would be under competitive conditions. This function changed as technological advances made it possible for more than one firm to successfully enter telecommunications markets. The current regulatory objective is to create the environment and conditions needed to promote effective competition, thus making regulation increasingly unnecessary.

The World Bank has set forth a detailed set of objectives that should guide telecommunications regulators, namely: (i) to promote opening markets to competition, in order to improve the services provided (quality, modernity, price efficiency); (ii) to prevent abuses by firms with market power (price fixing, anticompetitive practices); (iii) to create an investment climate that favours the expansion of telecommunications networks; (iv) to encourage the confidence of the markets through transparent regulatory procedures and licensing; (v) to develop greater connectivity through efficient interconnection agreements; and (vi) to optimize the use of scarce resources, such as the radioelectric spectrum, telephone numbers, and rights-of-way (World Bank, 2000).

2. Characteristics of regulatory agencies

This section analyses two features of regulatory agencies that are important for their effective functioning: independence and technical capacity.[27]

[27] This is not to deny the importance of other features of regulatory agencies. For an analysis of regulators of telecommunications and other services subject to rate setting, see González (2007).

(a) Independence

As long as the State was managing telecommunications services, there was no perceived need to establish independent regulatory agencies. Policy decision-making, enforcement of regulatory standards and provision of telephone service were overseen by civil servants. The privatization of State-owned enterprises and market deregulation created a need for regulatory agencies independent of those operating and managing the networks, in order to prevent abuses by incumbent firms with powerful positions in the market, and to promote development of the sector and the gradual entry of competitors.

Although regulatory agencies are structured on various models, the fundamental component of the most widely accepted institutional principle is independence.[28] An independent regulatory agency is in a better position to enforce rules objectively and impartially, and its independence increases the probability that it will, in fact, protect competition, and not merely individual competitors, with clear positive consequences for the development of the sector. A study of telecommunications regulatory agencies in Latin America and the Caribbean by Montoya and Trillas (2007) found quantitative evidence of the positive effects of independence on the rates of penetration of fixed telephony.[29]

At the same time, economic agents' trust in the impartiality of regulatory decision-making increases with the independence of the regulatory agencies, and can stimulate investment by both incumbents and new competitors. OECD (2007b) presents an analysis of 21 countries, showing that those with independent regulatory agencies received more foreign direct investment per capita, on average, during the period studied, achieved greater increases in telephone density over the last 15 years, and attained greater equality of access to telephone services than did those that lacked such agencies.

The independence of regulatory agencies varies according to the national structures —legal, political and institutional— involved. Although, in practice, few regulatory agencies are totally independent of their governments —making it difficult to draw conclusions from databases regarding their regulatory or legal independence— table VI.3 indicates that independence has positive effects on the sector's performance.

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28 This aspect of regulatory agencies does not imply independence from national legislation and rules. Legislation must define the precise scope and limits of the independent regulatory agency's mandate, and the agency remains accountable to the legislative branch and other public entities.

29 The indicators employed measure the formal or standard-setting independence of regulatory agencies, not their actual degree of independence.

In general, operators and investors have greater confidence in the sector when an independent agency regulates the market in an objective and transparent fashion. Their confidence is a function of the regulatory agency's credibility as a professional and impartial entity capable of averting problems of dynamic inconsistency.[30]

Table VI.3
INDEPENDENCE OF REGULATORY AGENCIES AND THEIR PERFORMANCE IN THE TELECOMMUNICATIONS SECTOR

	Number of countries	Telephone density (2005) (percentages)	Change in telephone density (1990-2005) (percentages)	Index of telephone concentration	Cumulative foreign direct investment in the sector (dollars per capita)
With autonomous regulatory agency	16	55.6	50.4	0.29	151
Without autonomous regulatory agency	5	49.6	43.0	0.35	58

Source: OECD, *Economic Perspectives for Latin America, 2007.*

Regulatory agencies' decisions often generate controversy among potentially affected parties, and give rise to attempts to exert pressure on the institutions.[31] Independence helps the agency act neutrally and autonomously in the face of political pressure or pressure from operators (risk of capture). This is extremely important in cases where decisions on promoting competition may have negative effects on certain private interests. The risk that firms will co-opt the agencies that regulate them is a perennial threat to the proper development of the sector.

Interconnection and the identification of anti-competitive practices are complex issues requiring intervention from a regulator that is "strong" not only in terms of independence, but also in technical capacity.

[30] Problems of dynamic inconsistency emerge when there are incentives for governments not to fulfil their commitments. This can discourage investment (Noll, 2000; Noll and Shirley, 2002; Newberry, 2000). For example, it is essential, for investment purposes, that there be confidence that a government will not carry out expropriations. For a study of this factor, see González (2007).

[31] One issue that is a continual subject of debate is decisions on interconnection, which are a fundamental aspect of introducing competition. In general, the network's owner (the incumbent) has no incentive whatsoever to give its competitors access to the network, and therefore does whatever it can to postpone reaching an agreement or to avoid facilitating interconnection, thus delaying the entry of new providers and distorting the development of competition by creating barriers to entry.

(b) Technical capacity

The functions of a regulatory agency involve specialized analysis of complex and constantly changing realities. This means that technical capacity, as well as independence, is required. Such capacity is an important element in creating confidence in the agency's decisions among economic agents (users, businesses and the government itself) —confidence that in turn affects investment decisions.

Technical capacity is essential in determining what type and degree of regulation should be applied to a sector, and involves ongoing evaluation of a variety of factors: changes in markets, technological advances, and changes in providers' structures and strategies. Determining the degree of regulation needed in the sector is one of the basic functions of regulatory agencies. Although excessive regulation can be counterproductive and can impede development, premature liberalization (or deregulation) can generate anti-competitive practices, particularly in environments where some operators dominate the market or have significant market power.

Thus, regulatory agencies must constantly evaluate and review the most important telecommunications markets and analyse their structures. Their choice of ex ante regulatory measures or ex post competitive policies will depend on the degree of concentration in the market, but must also be accompanied by comprehensive analysis of the market environment and competitive conditions. The rapidity with which changes occur in the sector highlights the importance of having a regulatory agency with strong technical capacity, capable of adapting regulations to current conditions in the industry.

3. Regulatory agencies and convergence

The convergence of networks and services in telecommunications markets, which was examined in chapter I, has given rise to dramatic changes in the sector. Though the regulatory objectives remain the same —namely, to introduce and protect competition in the sector— convergence requires changes in the means and methods of regulating.

Convergence poses new challenges to the traditional regulatory scheme, primarily because it does not fit into existing models. Technological progress in telecommunications has made it possible to reduce the cost of services, while at the same time eliminating, or at least significantly reducing, the traditional differences and boundaries between different networks and services. Today, a variety of services can be provided through the same network, and the same services through different networks.

The pace of technological change has had significant repercussions in terms of reducing barriers to market access. It has created increasing pressure, on the part of both new and traditional providers, for entry to new markets —or to markets in which the providers have not previously been active. The need to adapt quickly to the new environment has posed major challenges for the regulatory apparatus. Given the outdated regulatory systems, regulators find it difficult to confront new situations effectively. In particular, the appearance of new providers of convergent services has caused problems for regulators unsure of how to treat these entities. In the United States, for example, no regulations whatsoever have been established for IP telephony, due to a justifiable fear that regulating a new technology will impede its development.

In developed countries that have technologically sophisticated markets with massive purchasing power, there is a trend towards greater competition. In Latin America, both of these factors are absent, thus making investment in the sector less attractive. In such an environment, instruments have to be created to foster competition and create a culture of innovation that stimulates providers to offer services that will be attractive to consumers. For this reason, the governments of some countries, such as Chile and El Salvador, have opted for more ambitious liberalization policies.

Another important challenge facing regulators is whether to promote competition based on networks or based on services. In the first case, each provider must provide its own network. While this would help expand the provider's network, it would have negative effects on market entry, as well as on competition between services, in the short term. In the second case, in which new competitors are allowed access to existing networks, the system could stimulate competition for services, but would have the disadvantage of working against the expansion of networks. The choice of which form of competition to promote —i.e., networks- or services-based— will depend on the particular characteristics of the individual market.

In a convergent environment, it is important to coordinate with, and take account of, already existing relationships with other public entities involved in the sector. This entails solving the following four problems (García-Murillo, 2009):

(a) Duplicative and overlapping regulations. Convergence forces cooperation among agencies responsible for the telecommunications, broadcast and science and technology sectors. As indicated in chapter V, some operators offer packages of multiple services (telephony, television, data), and electric energy companies may also move into one or all of these sectors in the future. In the past, there was a well-defined separation between the activities of these different industries, and the actions of the corresponding regulatory agencies had no effect on sectors outside their industry. However, once a cable TV company, a broadcaster or a content or data provider begins to offer services outside its traditional area, the responsibility of regulating the new services falls on multiple regulators, leading to a possible duplication of activities. For example, when a telephony provider and a television production company collaborate to offer television to subscribers, it is probably appropriate for the service to be regulated by two agencies: the telecommunications regulator and the broadcast regulator.

(b) Conflicts between legislation and regulation. In a number of countries, legislation affecting different communications sectors is enacted in isolation, without considering issues of impending convergences.[32] If there is no initiative to align the legislation governing all of these industries, contradictions may ultimately arise between the legislation, on the one hand and, on the other, the provisions adopted by the different governmental entities overseeing the areas concerned.

(c) Integrating decision-making and the development of rules. In the short term, it is difficult, and perhaps not even desirable, to integrate all of the entities overseeing the sector, since their respective mandates are not necessarily limited to specific sectors. It is essential, however, for them to consult with each other when making decisions that affect the functions of their sister agencies. This requires effective channels of communication and calls for establishing relevant provisions and procedures when proposing rules or adopting measures that have repercussions on the converging sector.

(d) Integrating conflict resolution. The convergence of technologies, industries and services translates into activities that are closely related. This can create controversy around issues such as access to content or networks. Here, too, regulatory agencies, in attempting to resolve conflicts as simply as possible, must establish procedures to avoid uncertainty and prevent subjective or arbitrary decision-making by other relevant entities.

In the international context, the situation is even more complex, since individual governments have their own terminologies, procedures, laws and regulations. In Latin America, initiatives to harmonize different bodies of legislation are still in their infancy. Notable for its accomplishments in this regard are Central America's efforts to coordinate its telecommunications legislation and regulations.

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[32] As a result of this process, some countries introduced radical changes in their legislation. For example, one of the pioneering countries in creating a "convergent regulatory agency" was the United Kingdom, which in 2003 established the Office of Communications (OFCOM). This brought together five regulatory agencies, including the Office of Telecommunications (OFTEL) and the Independent Television Commission (ITC).

In conclusion, regulatory agencies are central players in the convergence process, since they interpret and enforce rules, issue regulations and interact with the private sector. Their credibility and stability, as well as the efficiency, transparency and independence of their procedures, are instrumental in attracting investment to the sector and in reducing transaction costs. An additional element in a convergent environment is the need for all entities associated with the sector to coordinate their activities, decisions and regulations, in order to maintain a positive climate for investment. This means implementing procedures that facilitate coordination, including the creation of an online presence for these agencies.

4. From ex ante regulation to policy that promotes and protects competition

Prior to technological convergence, telecommunications services used separate networks. "Fixed-voice" communication used landline telephony; "mobile voice" services were provided via cellular networks; data were transmitted over dedicated networks; and sounds and images were sent over their own specific networks (broadcast, free, cable or satellite TV). Convergence blurs the boundaries between products and markets, and leads to direct competition between firms that previously occupied different markets —e.g., telephone providers and cable television companies. Thus, convergence has gradually reduced the old barriers to access, requiring a redefinition of the various markets, particularly with regard to the range of services covered by each.[33]

Complex challenges face regulators as they attempt to promote competition in telecommunications markets. One of the most complex of these is the challenge of establishing rules for coexistence and competition between networks of different sizes, when one of them (generally an incumbent operator's terrestrial network) has greater capillarity and was previously governed by a different regulatory regime. In such cases, mechanisms for access and interconnection must be provided to ensure that new competitors and networks are given access and have the opportunity to develop. At the same time, new regulations must be formulated to govern the activity of incumbent operators in areas in which their position is different from that of other providers, e.g. interconnection.

Common to all regulatory frameworks for telecommunications markets is a mandate for network interconnection, intended to ensure that users have a single network at their disposal. Nevertheless, in practice,

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[33] The advance of digital technology changes the structure of markets, even with regard to the two last "scarce resources" in telecommunications, namely, the radio frequency spectrum and the availability of numbers.

there continue to be asymmetries, at least from a regulatory perspective. This occurs because networks that were part of State monopolies (land-based copper-pair networks) remain in place even when the monopolies themselves are eliminated. In such cases, costs and regulations are different from those that are beginning to appear in deregulated markets such as mobile telephony networks. In practice, there is no real interconnection between —or coexistence among— similar networks, thus requiring that there be ex ante regulation and rules governing competition.

Regulation to promote and protect competition, unlike traditional regulation, combines mechanisms and instruments designed specifically to achieve these ends through sectoral regulatory mechanisms. There are various schemes for dividing up the regulatory functions among different enforcement agencies. Sectoral regulation is generally designed in the context of non-competitive markets in which dominant firms operate, and is not used for markets involving true competition. Regulation to protect competition is designed to promote economic efficiency, and is capable of functioning in any market environment. Technological convergence accelerates the convergence between sectoral regulation and pro-competitive policies.

The convergence of services has increased the complexity of the regulatory challenge. It forces regulators to modify their definitions of markets.[34] At the same time, while the growing number of providers in the market can intensify competition, thus reducing the need for regulatory action, regulatory institutions also face an expansion in the scope of their coverage. This means that they must constantly increase their technical capacity and their ability to coordinate with other public entities that have supervisory responsibilities in the sector.

E. The universalization of services

Guaranteeing access, or providing universal service, is a particularly important social objective for regulatory agencies. In a context of technological convergence, the task of determining what package of services is to be made universally available requires that a series of questions be answered: What telecommunications should citizens have access to? Does such access require some form of public intervention to establish that the selected package of services furthers the goal of universalization? Which activities should be relegated to the market and which should come under the purview of public policy?

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34 For example, with convergence, the market that is the object of the competitive analysis must be considered under a broader criterion, especially when being subjected to the hypothetical monopoly test (Delorme Prado and others, 2007).

Technological convergence entails change, personalized services, and packages adapted to consumers' individual needs, leading to an increased diversity of offerings. Policy designed to universalize only "basic services" —e.g., voice telephony— would lead to greater disparity in access to ICT, as explained in chapter II. Such a situation would not only reflect existing inequalities of income and welfare between citizens, but would exacerbate them.

The developed countries have slowly begun to redefine the concept of universal service, going beyond voice services to include services based on convergent platforms in which Internet access is a focus of attention.[35] The expectation that convergence will increase competition in telecommunications markets raises the question of whether programmes to promote universal service will remain necessary to achieve universal coverage for telecommunications services. This question is suggested by the hypothesis that the very dynamic of competition and the appearance of new providers supplying higher quality at lower cost will displace traditional voice services, offering in their stead reasonably priced integrated or convergent services with universal coverage. This hypothesis is based on the assumption that the costs of installing convergent wireless networks will decline.

Questioning the need for programmes to promote universal access may be valid insofar as the barriers to universalization are due primarily to a limited supply of services. As pointed out in chapter II, however, demand itself is a constraint in the Latin American and Caribbean countries, due to low and unequal income. Thus, in a convergent context universalization becomes a major challenge, and must be considered from a dual perspective. It requires designing instruments to affect both supply (universal presence of convergent networks) and demand, i.e., reasonable prices or direct subsidies for use. This in turn means treating universal service as an integral aspect of public policy —one that reaches beyond the field of telecommunications.

In order to universalize service, two gaps must be closed. One of these is the "market gap", or the difference between what the market actually does and what it could potentially do if new providers had reasonable access to it. The other is the "development gap". This is the tension between what market forces are capable of remedying and what Government views as necessary to achieve economic growth that takes account of priorities such as equity and cultural integration (Regulatel/ECLAC/World Bank,

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35 The European Union uses the concept of "functional Internet access" (FIA), which is still limited to dial-up access. In Australia, the concept employed is that of "digital data service obligation" (DDSO), which refers to a level of service in accessing data via an integrated services digital network (ISDN) (ITU, 2006a).

2006). This second type of gap lies beyond the scope of what the market is capable of addressing (Wellenius and Townsend, 2005).

These two gaps are a reflection of the two types of access problems faced by Latin America's countries. One consists of supply problems resulting from the fact that the cost of providing services increases with distance and also is higher in markets with lower density. The other consists of demand-side problems due to the countries' low and unequal income levels. Under such constraints, a significant portion of the population will remain untouched by the expansion of convergent services unless universal access programmes are in place. Therefore, specific policies must be implemented to provide packages of convergent services to be delivered universally. It is equally important that regulations be flexible, and that the execution and management phases of programmes for universal access not only take advantage of technological advances, but also remain consistent with the primary goal of universality.

Technology makes invisible to users the distinction between communication services and information services. Accordingly, the two should be regulated jointly, and might better be termed "convergent information and communication services", or "ICT-based services". This new terminology would contribute to the change of perspective needed to avoid confusion between the concept of "universal access" in its modern sense and mere public telephony.

In order to obtain the resources needed to expand access, a number of the region's countries have used various forms of financing[36] to create funds that further the goal of universal access. In many cases (El Salvador, Guatemala, Mexico, Panama and Plurinational State of Bolivia,) this involves only telephone service. In 2006, such funds totalled US$ 2.7 billion, of which only 11% had actually been used. This suggests a need to review legal restrictions and macroeconomic constraints that impede the use of these funds and hinder their functionality and effectiveness, so as to optimize their impact, while expanding their scope to include the more advanced ICT (OSILAC, 2007a).

Given the varying needs for universalization from region to region, including differences at the local level, convergence can provide a wide range of opportunities for narrowing the digital divide. Declining costs and the variety of new wireless technologies hold the prospect of providing personalized and less costly solutions. In seeking to achieve convergence and progress towards the information society, the traditional approach to universalization must be reshaped. The Latin American Forum of

[36] For example, a percentage of revenues from telecommunications operators, issuance of licenses and fees for use of the electromagnetic spectrum, fines and sanctions, energy and telecommunications concessions, or State funds.

Telecommunications Regulators (Regulatel/ECLAC/World Bank, 2006) has listed elements required for appropriate new-generation universal access programmes (see diagram VI.1).

Diagram VI.1

EVOLUTION OF UNIVERSAL ACCESS PROGRAMMES

First generation programmes		New generation of programmes
Universal access Public coin telephone (voice) service in rural and urban areas.		Universal access Everyone has reasonable, low-cost access to telephone and Internet service.
		Universal coverage X% of the population has access to private ICT services based on ability-to-pay market prices. (Determining the percentage is a public policy decision.)
Universal service Not applicable in Latin America, owing to low penetration and income levels.	Market and technological innovation	Universal service Applicable once initial universal coverage goals have been met. The conditions for universal service are considered to have been met when both individuals and households are in a position to pay for connection to, and use of, basic ICT infrastructure and services.
Characteristics		Characteristics
A single ministry, with little coordination.		Strong leadership and horizontal ministerial coordination.
Vertical decision-making.		Broad autonomy for managers of the fund.
Emphasis on telephone service.		Decision-making characterized by both leadership and autonomy.
Supply-centred.		Convergence centred on IP.
Infrastructure approach.		Comprehensive approach: supply and demand, infrastructure and strengthening of capacities.
Resources allocated through bidding, with minimal subsidy.		Resources allocated through various mechanisms, including loans and venture capital funds.
Slow disbursement of funds		Rapid disbursement of funds.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Regulatel, *Programas de acceso universal de telecomunicaciones en América Latina. Resumen ejecutivo,* Regulatel, ECLAC and World Bank, October 2006.

In short, regulatory agencies have two functions to fulfil in connection with providing universal services. One is to reduce the "market gap" through regulation that facilitates a supply of more efficient solutions, in order to reduce the pressures and burden on universal service programmes. The other is to coordinate with public entities responsible for formulating policy on access and universal service, so as to ensure complementarity. It is not the role of regulators to establish strategies or public policies for equal access, but within the constraints of their defined functions and authorities they must support other governmental entities responsible for these areas.

Regulatory agencies must consider the general policy framework governing universal service, and their actions must be designed to support it. This issue is particularly relevant as regulatory agencies change their regulatory instruments to focus on convergence. The challenge is complex, since measures must simultaneously be taken to ensure that efforts to promote universalization do not adversely affect competitive markets, while at the same time ensuring that obligations imposed on particular providers do not handicap them vis-à-vis other providers operating under similar circumstances (non-discrimination).

F. Conclusions

Telecommunications reform in Latin America has been beneficial to the sector in terms of investment, product variety and quality, penetration of services and pricing. Some countries have not benefited fully, however, owing to a lack of competition. Three conclusions emerge from the analysis presented here. The first relates to the nature of regulation in a competitive market, the second to the effects of technological convergence, and the third to creating universal access.

Evidence indicates that greater competition or rivalry between service providers produces downward pressure on costs, increasing efficiency and generating benefits that can be passed along to consumers. As technology makes it possible for more than one provider to compete in the market, regulatory agencies' role as promoters and facilitators of competition in the different telecommunications markets assumes greater importance.

The countries' regulatory frameworks should permit the relevant agencies to adopt measures that lead to self-sustaining competition, thus reducing the need for ex ante regulation, and leading eventually to ex post measures designed to protect competition. In this connection, it is important to strengthen technical capacities and the independence of the agencies, so that their decisions promote the development of the entire sector, not just that of particular groups.

The nature of the transformations generated by convergence requires not only changes in business strategy, but also a fundamental change in how the sector is regulated. Firms that are not responsive to the changes brought about by convergence will disappear. The big question is whether the same will happen to regulatory agencies. There is undoubtedly a risk that obsolete regulatory criteria will create difficulties for the sector's development or will slow its progress. Therefore, strengthening regulatory agencies in ways that make them more able to adapt to constant technological change is a basic prerequisite for ongoing development of the telecommunications sector.

Digital convergence is transforming the sector dramatically, as boundaries between different products and markets disappear. Digital convergence requires that markets be defined differently, and this, in turn, calls for new analysis on the part of regulatory entities. Convergence has the ability to promote the transition from a regulated sector to a sector shaped by competition between firms.

The universalization of some services is an important element in achieving social inclusion and in ensuring that telecommunications have the network effects needed to foster economic development. In this sense, appropriate regulation and competition that closes access gaps are essential. It is in this respect that regulatory agencies' role in ensuring universal service is vital. However, the actions of regulators and the functioning of the market have their limits, and are not, in themselves, sufficient to close the "development gap". The creative use of universalization funds and other public policy mechanisms are essential to reduce gaps that the market alone cannot solve.

Combining regulation to promote market efficiency with interventions, incentives and subsidies for social inclusion can create contradictions. The very nature of regulatory agencies, and the analytical tools used in policymaking, makes it impossible to deal with the two objectives simultaneously. Doing so would impede transparent and efficient decision-making, and could lead to an unworkable dual agenda. One possible solution is to create an institutional separation between the authorities regulating the sector's efficiency and those focusing on universal access. Although the two functions are complementary, they require clear and independent, although coordinated, objectives and processes.

Digital convergence lends even greater complexity to the challenge of determining which products should be universalized. A solution to funding the universalization of communications services has yet to be found, for as competition increases and companies' average revenue per user (ARPU) declines, it becomes more difficult to apply cross-subsidies.

Chapter VII

The debate on intellectual property rights with regard to ICT

A. Introduction

To date, consumers' access to ICT (computers and Internet) in the region has been on a pay basis, though they have not necessarily had to pay for software, content and related services. Where software is concerned, microenterprises and medium-low income consumers have taken advantage of free access to illegal copies. Text and videos protected by intellectual property rights laws and agreements have, in practice, also been available to consumers, both through digital piracy, i.e. illegal commercial reproduction and distribution of copies, and through non-profit social sharing of copies among Internet users.

This situation is changing, as restrictions are increasingly being placed on free access to information and knowledge via the Internet. New generations of devices and software known as technical or technological protection measures (TPMs) have emerged. These are increasingly effective in controlling and preventing access to patented software, content protected by intellectual property rights and Internet services whose producers charge a fee. The developed countries have also launched an offensive to strengthen intellectual property rights in the area of digital media, and to increase the efficiency and effectiveness of enforcement, i.e. administrative measures, legal action and policing to suppress digital piracy and illegal sharing of software and content.[1] However, the trend is not strictly unidirectional: there are substantial disputes and considerable debate on the nature of intellectual property rights law. Ultimately, how these questions are resolved will determine the direction of public policy, and it is therefore of urgent importance that the region's countries define the parameters of such policy.

B. Intellectual property rights in the digital environment

The generation of information and knowledge takes place in a context of contradictions. Innovators and creators must cover their costs and assume risks, despite the fact that they only partially receive the benefits of their efforts. At the same time, wide dissemination of information and knowledge is important as a source of technological innovation and creative cultural activity.

Two mechanisms are available to foster the ability of creators and innovators to appropriate the benefits of their efforts. One of these mechanisms consists of TPMs that control access to information and knowledge, either by maintaining confidentiality or by restricting access.[2] The other involves regulation and enforcement of intellectual property rights provisions that establish exclusive economic rights over inventions and creations for a given period of time. Patents and copyright are the principal mechanisms used for this purpose.[3] The aim of intellectual property rights provisions is not only to guarantee the right of private parties to benefit from the products of their innovation and creation, but

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1 This does not mean that free content and services are not already available on the Internet. Indeed, these will, for various reasons, continue to expand, and will include: a growing volume of information and knowledge on the websites of executive and legislative branches of government, NGOs, and community services such as Wikipedia; the presence of firms and creators developing new business models to provide access to free copies of music and text files; search services such as Google and Yahoo; free telephone service between computers via Skype and Net2Phone; and, even, word processors and spreadsheets.

2 Technological protection measures (TPMs) are tools that restrict unauthorized access to material protected by copyright, related rights or both, although they can also be used to limit access to content not protected by copyright. There are two types of TPMs: (i) those that control access to content available on the Internet or other digital networks, or that limit which operations can be carried out by users of physical or digital media that contain content (e.g. region coding, and files that expire after a given time period); and (ii) those that protect the exercise of rights by limiting copying, digital distribution, communication to the public and broadcasting (e.g. encryption, digital signatures and electronic seals).

3 Intellectual property rights regulations also function as means of supporting TPMs in relation to works subject to intellectual property rights protection. These regulations are of four types: (i) those whose purpose is to prevent activities such as reproduction or distribution of works over the Internet; (ii) systems of conditional access; (iii) tools that mark and identify works; and (iv) digital rights management (DRM).

also to create incentives that encourage these activities, and to ensure dissemination of the content and the benefits generated. Intellectual property rights are not absolute or unlimited in duration, but rather are subject to limitations and constraints, including a finite period of time. In this way they attempt to balance private control with social access (Lessig, 2006), i.e. to balance the rights of inventors and creators with the public (or "social") availability of new knowledge and information.

Achieving this balance requires institutions and legal standards, and creating these is a complex process fraught with conflict. The situation regarding intellectual property rights was relatively stable throughout most of the twentieth century, but has undergone rapid change with the technological developments that began in the late 1980s. Intense innovation and global dissemination triggered a digital revolution that has vastly reduced the cost of reproducing and distributing information. An institutional response to these changes, in the form of major regulatory change advanced most conspicuously by the United States, led not only to the 1994 Trade-Related Aspects of Intellectual Property Rights (TRIPS), but also to the World Intellectual Property Organization (WIPO) agreements of 1996, the Federal Telecommunications Act of that same year and, in particular, the Digital Millennium Copyright Act (DMCA) of 1998, which was followed by similar legislation in Europe and Japan. There have been systematic initiatives since then to universalize the provisions involved, as reflected in the free trade agreements that the United States signed with 10 Latin America and Caribbean countries.

Approaches to constructing the new regulatory framework are the subject of ongoing discussion and debate. The issues can be understood in terms of a three-layer model that includes hardware, software and content (Benkler, 2006). Specific appropriation mechanisms —some technological, others legal— have particular relevance to each of these layers (see table VII.1).

As described in chapter VI, the debate concerning regulation of telecommunications infrastructure centres on degrees of market openness and competition. There is a tendency to emphasize controls on telephone and cable TV operators rather than emphasizing the access side of telecommunications and Internet services. This makes it difficult for competitors to enter the market for voice services, and limits access to the data and audiovisual content available on the Internet. There is also a tendency to intensify competition and open up telecommunications networks, while requiring unbundling of services and creating greater availability of IP-based services. In terms of hardware, the debate focuses on whether or not to introduce systems such as those attempted in the

United States to prevent the use of methods for circumventing intellectual property rights.

Table VII.1
MECHANISMS FOR THE APPROPRIATION OF CONTENT, SOFTWARE, HARDWARE AND NETWORKS

Layers	Intellectual property rights	Technological protection mechanisms
Content	Expanded creator rights Fewer limitations on copyright Protection of databases Brands Domain names Legal protection via effective TPMs	TPMs Responsibility of Internet service providers (ISPs)
Software	Patents for software algorithms Patents for business methods Confidentiality of source code Legal protections plus TPMs	TPMs Integration of various programmes in a single software package
Hardware and telecommunications networks	Patents on electronic and communications technologies Protection of industrial circuit designs	Regulatory requirements for establishing trusted systems No unbundling of networks, in order to increase providers' market power Treatment of broadband as an information service

Source: Author, based on Yochai Benkler, *The Wealth of Networks,* Yale University Press, New Haven and London, 2006.

There are two important debates regarding the software layer. One concerns legalizing patents on software and business methods, a move promoted by the United State but rejected by the European Parliament. The other involves improving TPMs and their regulation as a means of countering their potential adverse effects on competition, innovation and consumers' rights.

The content layer is also a subject of debate. First, some criticize the trend towards extending the period of time during which copyright is to remain in effect and reducing the limitations and exceptions established in international treaties such as the 1883 Berne Convention. Second, there are disagreements about the issue of regulating TPMs, which, as in the case of software, are increasingly important in business strategies based on Digital Rights Management (DRM).

C. Software

Where software is concerned, a broad range of protections is available to ensure private appropriation of the associated profits (see table VII.2).[4] Until the late 1980s, the only form of protection available to ensure exclusivity in this area was total or partial secrecy of source code ("patented software", as opposed to "open source" software for which the code is publicly available). The confidentiality of source code is legally protected as the basis of a competitive advantage, provided that reasonable efforts have been taken to maintain secrecy. However, there are constraints associated with the secrecy. One is that technological knowledge is not eligible for patent protection and cannot be assigned a value as intangible capital. Another is that there is no protection against reverse engineering, which is an increasingly important process, as the ability of compiler programmes to reveal source code grows. At the same time, users are increasingly insisting on open source code to increase the security of their systems and to achieve interoperability with other applications.

Table VII.2
MECHANISMS TO PROTECT SOFTWARE AS INTELLECTUAL PROPERTY

Type	Definition	Protection
Trade secret	Computer programs(software) require a set of files, compilers, assemblers or interpreters to convert human-readable programming language to computer-executable form. When source code is kept partially or totally secret, the public has access only to the compiled form of the software, which is called "object code". This is termed "closed-source" code.	No registration required. Indefinite duration.
Patents on inventions	The European and Latin American countries grant patents for inventions that incorporate software, but, in contrast to the United States, not for software as such.	Patent must be requested and, once approved, is granted for a specific number of years from the time of the application. It is non-renewable.
Technology protection measures	Devices or software that identify, and impose conditions for access to, computer programs, preventing their reproduction and distribution, and identifying the user.	No registration required. Indefinite duration.
Copyright	Exclusive right to fix and reproduce, to grant authorization to make available to the public, to communicate to the public, to distribute and to rent computer programs. Compilations of data or other types of material may be included, but the protection does not apply to the data or materials themselves.	No registration required. TRIPS establishes a minimum period of 50 years from the date of the author's death. The period is longer in the United States and Europe, as well as in some Latin American or Caribbean countries.
Private contract	Software licences based on commercial law. They may contain provisions prohibiting reproduction for any purpose, rental and resale, and reverse engineering.	No registration required. Indefinite duration. The use of the software involves acceptance of the contractual clauses.

Source: World Trade Organization (WTO) and World Intellectual Property Organization (WIPO).

[4] The analysis excludes brands and domain names, which protect neither inventions nor creative works. Brands and domain names reduce the cost to the consumer of searching for information, and generate incentives for firms to invest in quality, since these words and signs increase the value of the firms' intangible capital.

In 1964, the United States Copyright Office announced a provision to partially protect published software, and this was increasingly used by firms such as IBM and Borroughs. In 1980, the United States Congress passed legislation granting computer programs total protection under copyright law. Ten years later, the European Union incorporated software among the types of work protected by copyright. In 1994, the TRIPS agreement extended this worldwide, including the Latin American and Caribbean countries.

Copyright protection, however, is not all-encompassing. First, it protects only the form or expression of an idea, not the idea itself, which must be protected by patent or by secrecy. Second, copyright law includes a number of exceptions that permit copying for personal or educational use and for research and development. Third, even when copyright is combined with closed source code, reverse engineering is possible, and it is legal to copy features of a program that are not text, and that therefore do not constitute "expression". Finally, the marginal costs of reproducing and distributing software are practically nil, and administrative mechanisms, customs, policing and legal action are not efficient ways of providing protection.

In the United States, the insufficiency of legal copyright protection and the inadequacy of source code secrecy led to the development of software patenting. Although patents for software incorporated in hardware have been granted since the 1970s, court rulings in the 1980s invalidated the doctrine that "pure" software, or software "as such", is a mathematical method and thus is not eligible for patent protection. In 1996, the United States Patent Office (USPTO) established rules for patents on "pure" software and computing algorithms designed for commercial use, but the European Union rejected this approach.

While intellectual property rights legislation was evolving, new private contractual arrangements were developed to provide legal protection. These contracts make software licences contingent on the user's agreement not to reproduce or distribute copies, and prohibit reverse engineering. Some also include a waiver of the "fair use" right, which normally allows for making copies for personal use. Such clauses go beyond what is provided for in multilateral conventions and national copyright legislation. However, they are based on commercial law, and are an effective form of legal protection. Such mechanisms are effective when applied to a limited number of licences, but they do not prevent the illegal copying of software that is used on a mass scale. In such cases, enforcement is practically impossible.

Firms also increasingly use TPMs to protect their software and digital content. In the United States and Europe, these measures are legal and effective ways of protecting material covered by copyright. They can entail major social costs, however, since they disturb the balance established by intellectual property rights conventions and legislation (Lessig, 2001). While they can circumvent copyright limitations and exceptions, as well as preventing partial copying for educational purposes, they can also lead to abuses of monopoly power and prevent access to works and information not protected by copyright that are in the public domain.

1. Software patents

Patents for "pure" software began to be granted in the United States in 1996 as an exclusive right, with a twenty-year protection period. Approval of applications for such protection by industrial property rights offices in countries that grant this type of patent (Australia, Japan and United States, among others)[5] can take years. If the patent is granted, the holder of the patent must divulge sufficient technical information to allow an expert to reproduce the invention. In the United States, over 131,000 software patents were granted between 1996 and 2005. This represents 37% of ICT (hardware and software) patents, and 8% of all patents for that period.

Patents are essential in industries with high research and development (R&D) costs, and where the marginal reproduction cost of the new products is extremely low. It is therefore no coincidence that incumbent software firms collect patents (Mansfield, 1986), even though they use them not as an intellectual property right, but rather as a way of excluding third parties (Lemley and Shapiro, 2005). Moreover, since tangible assets play only a small role in this industry, where the most important assets are intangible, intellectual property rights are important for companies, enabling them to place a value on their assets and helping them to attract investment.

Nevertheless, the growth of software patents in the United States does not seem to explain the industry's increased R&D spending, or the growing process and product innovation in ICT markets.[6] Innovation by software firms would appear to be at least partially attributable to appropriation strategies that employ some of the available instruments cited above. At the same time, the presence of major innovations that use open source software

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5 Both Europe and the United States grant patents for software incorporated in hardware or associated with a physical device. The United States, however, also grants patents for "pure" software, or software "as such", while Europe rejects this option, arguing that such software does not solve technical problems or problems related to physical processes. Europe has adopted the doctrine of "computer implemented inventions" (CII). Thus, it grants patents for computer programs provided that they use "technical means" to achieve "technical ends".

6 Bessen and Hunt (2006) suggest that, from the perspective of firms, the protection provided by patents is not commensurate with the intensity of their software research and development.

(Internet, P2P, Firefox, Linux, etc.) proves that other incentives also play a role —incentives that will be examined later in the book.

For emerging software companies in the United States, patents do not, in the early stages, seem to have much importance, since these firms must first concern themselves with other elements of survival (Samuelson, 2007), and can make use of other forms of protection, such as copyright, closed source code, TPMs and private licensing contracts with end users. In addition, it is extremely difficult to patent complete computer programs. Some contain hundreds of algorithms, many of which are already patented or in the public domain, and the attempt to patent them increases the risk of litigation —a situation that start-up firms seek to avoid at all costs. Once such firms are on a sound footing, however, and have a new, innovative product, patent protection can enrich their competitive strategy by lending value to their intangible capital, attracting venture capital, facilitating negotiations to create joint ventures and permitting the use of cross licensing as a means of using patents to protect products that they have developed (Gallini, 2002). All of this suggests that at least one motivation for patenting is defensive in nature. The large ICT firms (Microsoft, Google, Yahoo, etc.) have portfolios of patents, including some not applicable to the technologies they are developing. These they hold either to support strategies involving cross licensing with other software companies[7] or to prevent opportunistic litigation by so-called "patent trolls" or "patent squatters", who have acquired them from bankrupt firms with a view to subsequently suing third parties that are using the patented technology.

There is intense debate in the United States on the usefulness of software patents. Institutions such as the National Science Foundation, the National Research Council and the USPTO itself are active in this debate, which turns on the following arguments:

- The software industry is an extreme case of cumulative innovation, in which a new invention depends essentially on a number of previous inventions. In this context, the transaction costs associated with obtaining licences may, for many patents, exceed the profits generated by them, thus discouraging innovation.
- There is a perception that the USPTO standards defining innovation are too low, leading to the issuance of trivial patents and creating a legal quagmire that encourages opportunistic

[7] According to Hall (2006), most software patents in the last 20 years have been granted not to firms specializing in software, but rather to hardware firms that are vertically integrated with software producing firms that need patent portfolios to protect their inventions. Similarly, Bessen and Hunt (2006) indicate that, as of early 2000, 95% of software patents were owned by large hardware firms, whereas firms dedicated exclusively to software held only 5% of the total.

litigation. Indeed, before USPTO decided to grant software patents on a large scale, there had already been four decades of development, and many computer programs and algorithms had been developed in the public domain. The Patent Office had few skilled staff, and lacked information on the technological knowledge incorporated in the unpatented software. Thus, it was practically impossible to adequately assess patent requests, and many of the patents that were granted did not meet the requirements for innovativeness (Barton, 2003).

- In principle, patents should contribute to disseminating the knowledge incorporated in the invention, since inventors must divulge sufficient detailed technical information for someone reasonably versed in the field to reproduce the invention. However, the way in which this disclosure requirement is enforced has been criticized. The requirement is considered to suffer from the same general defects that apply to patents, which may contain excessively vague or incomplete descriptions (Cohen and others, 2003). In addition, a firm obtaining a patent is not required to divulge its source code and can keep it secret. This causes software companies to seek technical information from sources other than in patent information.[8]
- Patents can represent an ex ante incentive for innovation and thus generate social benefits, but they can also lead to monopolies and impose social costs, discouraging innovation and making technological progress difficult (Nordhaus, 1969; Scherer, 1972). This is particularly germane in the case of the open source software community, which has been extremely critical of these patents, based on the fact that, in practice, they prevent the coexistence of open source software and patented software. It is difficult for a new product developed by an open source software company, and protected only by copyright, to use copyleft or GPL (general public licence) unless the firm can be certain that it will not be threatened with litigation by parties with similar, already patented algorithms. Thus, software patents impede the development of the open source software industry, unless a system of low-cost mandatory licensing is in place.

These criticisms have given rise to a number of proposals to eliminate the granting of software licences, at least for software "as such", while other proposals have aimed at reforming the overall system,

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8 Mann (2004) indicates that the United States Appeals Court specializing in intellectual property rights has ruled that the requirement to disclose patent information cannot be interpreted as requiring firms to reveal information that is directly useful to their competitors.

with consequent repercussions for software patents. One proposal calls for stricter application of innovation criteria, with a system to facilitate assessment, so that any dispute over innovativeness can be resolved without costly litigation.

2. Open source software

Open source software (OSS) is a privately produced public good.[9] Some believe that its rapid spread casts doubt on the conventional economic theory that questions the sustainability of voluntary and cooperative contributions. Others, however, invoke precisely this theory to explain the phenomenon. To understand this debate, one must distinguish between two forms of OSS: community and commercial. In the beginning, the most common form of OSS was community OSS, and the main players were the software developers. Their intensive participation in OSS development, as Lerner and Tirole (2005) explain, entails costs, but generates profits in both the short and long term. In the short term, developers receive personal gratification, avoid routine programming tasks, improve their work performance, and increase their ability to find specific solutions for the firm at which they are employed. In the long term, they expand their work options.

However, this does not explain why a growing number of companies employ people whose normal work hours are devoted to open source software projects. Rielhe (2007) suggests that software companies involved with systems integration —consisting of packages of hardware and software services— have much to gain by OSS, since it allows them to reduce costs and avoid paying for licences, increases their ability to segment markets by price, and permits them to sell a greater volume of related services. Software producers can enjoy all of the advantages of closed source software and add elements that increase their appropriation of the software —for example, creating a set of patented programs centring around an open source software program. One example of such programming is middleware for interconnection and data exchange between different components or applications.

Nevertheless, open source software has not been successful in all types of markets and private initiatives. Experience suggests that its greatest potential lies in the areas of operating systems and middleware (e.g. web servers, databases, Java applications and graphic user interfaces), rather than as software applications for direct sale to consumers. In other words, OSS is more likely to serve as an input for firms using software than as an end product for large consumer markets. Perens (2005), in this

9 Although it may not be technically rigorous, this chapter makes no distinction between "open source software" (OSS) and "free and open source software" (FOSS).

connection, suggests that open source software seems to be more useful in cost centres or for user firms' generic activities, than in operations that permit consumers to differentiate the firm from its competition. In the former case, which requires a higher proportion of developed software, the use of OSS makes sense; in the second case it does not.

A number of factors come into play regarding the advantages and disadvantages of open source software. First, OSS functions well when there is a need to diversify software production and distribution costs and risks, given strong externalities that make appropriation difficult. For example, web servers and the first browser (Netscape) were invented by universities and programming communities, not by commercial firms. However, when the objective is to sell software applications to end users, proprietary software —protected by patent, copyright and TPMs— is needed, making this type of diversification of costs and risks impossible.

3. Issues under debate

Although no Latin American country has an explicit doctrine on the subject of computer programs, the general criterion prevailing in legislation on industrial property rights in the region provides for patenting inventions that meet criteria for innovativeness and industrial applicability. Since the concept of "industrial applicability" refers to goods-producing sectors, not services, the tendency has been not to accept patents for "pure" software, or software "as such". Although there is no statistical evidence on which to make a judgement, this has not prevented patents or devices/hardware with incorporated software from being granted patents, at least in Brazil and Chile.

Inevitably, however, pressure will increase to expand the types of software for which patents can be granted, since local software companies are emerging and are increasing their production of software. This could generate more demand for software patents, especially on the part of foreign firms. Each year, approximately 37,000 foreign patent applications are received, and this will increase as the number of countries that are party to the Patent Cooperation Treaty (PCT) expands, creating stronger pressure for corresponding changes in national bodies of legislation.

Since there is no established doctrine regarding the granting of these patents, it is likely that the debate in Latin America will follow the lines of the European debate. In practice, this means expanding the permissible scope of software patents. It remains to be clarified whether "business software patents" will be accepted. Given the background, the following policy alternatives deserve examination.

Preserving the exclusions permitted by TRIPS

Most of Latin America's software companies are in the start-up stage. Start-ups need to have as much access as possible to the growing accumulation of technical knowledge, and need to focus their creative capacities on developing high-quality software that can satisfy the demands of the market and of the public sector. Thus, from the perspective of enabling these start-ups, permitting the patenting of "pure" software is not good public policy. Moreover, based on experience in Europe and the United States, applications for patents on products with incorporated software need to be more rigorously regulated.

Nevertheless, incorporated software inventions with industrial applications could be patented if the software is indispensable to the proper functioning of the device or machine being patented. In such cases, a number of precautions should be taken. First, material that merely describes a product's functioning —including structured databases or descriptive material as such— should not be granted patents unless it is essential for the processes that the product is designed to perform. Second, inventions that incorporate hardware with non-functional descriptive material —e.g. music or text— should not be patentable, since these are covered by copyright law. Third, criteria for innovation should be more stringent, and there should be streamlined and transparent mechanisms to revoke patents that have been granted erroneously (such as incorporated software that already was in the public domain). The procedure in such cases should allow for third parties to submit evidence challenging the inventiveness, innovativeness or industrial applicability of the patent requested. This would facilitate the work of patent offices.

Such an approach would not deprive firms of effective mechanisms to protect their intellectual property, since copyright law can be used to protect software from illegal copying. Firms would be able to use closed source code to strengthen their ownership rights, as well as making use of increasingly sophisticated TPMs.

Since TRIPS and the free trade agreements of the region's countries do not mandate software patents, the countries could continue to consider "software as such" a "mathematical method" without direct industrial application. This would facilitate reverse engineering and sequential innovation, leaving the leeway necessary for the development of open source software.

Promoting the development of open source software

While open source software has the described benefits and represents an opportunity for the region's software industry, OSS business models must be improved. The main driving force for the development of open source software comes from the public sector, which needs increasingly sophisticated capacities to integrate operating systems, middleware and various applications that often lack interoperability.

Sustainable development of architectures composed of hardware, software and telecommunications technology in the public sector requires open source software. This process is already occurring in some of the region's countries, where Apache servers using the Linux operating system have proliferated.[10] This trend should be encouraged, but there is also a need to establish policy to overcome the disorder rampant in public sector computer systems. This policy area is explored in the chapter on e-government.

A second initiative that must be considered is one to promote projects involving platforms that use open source software. Networks of universities, educational institutions and municipal entities are the ideal environment for this, although it is also possible to promote projects to develop public goods, or "club goods", for conglomerates or productive chains of firms.

D. Content

Copyright and related rights protect books, music, visual expressions (painting, videos, film), software, multimedia content and databases.[11] In these "creative industries", there are chains of actors involved in creating, reproducing and distributing works. This gives rise to high sunk costs in the production of new works (such as films), combined with uncertainty about demand —factors that lead to a tendency towards short-term, often informal, contracts. In this context, international treaties such as the Berne Convention and the WIPO Treaty serve not only to identify individuals (authors, interpretive artists, performers, phonogram producers and broadcasters), but also to define a range of protected rights, such as reproduction and public communication or dissemination (see table VII.3).

The digital revolution is challenging traditional forms of private management and public regulation of intellectual property rights, as the advent of new technologies has changed the paper-based world. In the new environment —independent of the cost of the initial investment needed to produce a work— a work can be reproduced and distributed at virtually no marginal cost. This change in the area of content provoked

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[10] Apache is the most popular type of http server on the world wide web. As of mid-2007, it was used by 50% of websites. It is an OSS developed and maintained by an open community, and is compatible with various operating systems, including MS Windows, Netware, Unix, Linux and Mac OSX.

[11] Copyright encompasses "every production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression" (Berne Convention, Art. 2).

an institutional response similar to the one examined above with respect to the software industry. In this case, as in that one, the new rules have changed the balance between private control and social access (Lessig, 2006), between protections granted to inventors and authors, and public and social rights to access knowledge and information.

Table VII.3
COPYRIGHT AND RELATED RIGHTS[a]

Types of rights	Categories of rights	Definitions of rights
Copyright	Ownership rights. May be ceded or transferred by licence, and include the right to authorize or prohibit use.	Ownership rights over the work's reproduction,[b] public representation or interpretation,c broadcast (radio, television, cable, satellite) or other form of communication to the public, translation, adaptation, as well as opposition to, and claims for, any deformation, mutilation or other alteration affecting the integrity of the work or causing harm to the author's reputation.
	Moral rights.	These cannot be transferred, and are granted only to natural persons.
Related rights	Interpretive artists or performers.	Authorization/refusal of requests to fix, broadcast or communicate to the public representations of the work.
		Right to remuneration for broadcast and communication to the public.
		Moral rights (some countries).
	Producers of phonograms.	Authorization/refusal to reproduce, import and distribute their phonograms and copies thereof.
		Right to remuneration for broadcast and communication to the public of their phonograms.
	Broadcasting entities.	Authorization/refusal to broadcast, fix, or reproduce their broadcasts.
		Right to rent phonograms and audiovisual works.
		Specific rights covering cable transmissions.

Source: Authors.
[a] Copyright and related rights are always protected once the work is put into some medium or physical form.
[b] Reproduction rights include the right to distribute copies of the work to the public by means of sale, rental of copies of the work and control over the importation of copies.
[c] "Public interpretation" includes listening to compact discs through amplifying systems in places such as discotheques, air planes and shopping centres.

One of the effects of these transformations has been the extension of the period of protection from 50 to 70 years.[12] At the same time, initiatives emerged to significantly restrict copyright limitations and exceptions by using TPMs. The United States is currently promoting a global initiative to strengthen copyright enforcement through two mechanisms: the United States Trade Representative's Special 301 Report, which includes a

[12] Akerlof and others (2002) conclude that extending the duration of copyright protection does not create significant incentives for creation, although it does increase the profits of copyright holders.

unilateral annual assessment of the situation in each country and therefore acts as an ongoing form of pressure (Roffe, 2004), and free trade treaties, which include important chapters on the enforcement of intellectual property rights.

1. Technological protection measures (TPMs)

One essential element of intellectual property rights law is that users and consumers may use the works protected under it without prior consent from, or payment to, the authors. Specifically, the Berne Convention (endorsed by the TRIPS agreement) defines three types of limitations on copyright protection: *limitations* for specific types of works that must always be available to citizens, such as official and legal governmental and legislative texts, news, and speech in the legal and legislative context; *exceptions* for special cases that represent no threat to the copyright holder's normal commercial exploitation of the work, and that do not do undue harm to the copyright holder's legitimate interests (e.g. adaptation of material for the visually handicapped); and *mandatory licences* that permit use of a work without prior consent under certain conditions, but require payment to the copyright holder. Table VII.4 summarizes the different types of limitations and exceptions established in the Berne Convention, which remain valid in the context of the digital economy. However, with passage of the Digital Millennium Copyright Act (DMCA), the United States undertook a strategy to reduce such limitations and exceptions. The most important initiatives in this strategic framework attempt to establish the principle that temporary copies may violate the reproduction rights of authors and holders of related rights, and to strengthen the legal backing provided by TPMs.

The argument is that ICT make it possible to produce copies and to distribute them on a mass scale through the Internet, and that this makes it difficult to limit the practices and exceptions that allow consumers and educational entities to copy and share material. This enforcement problem makes it necessary, on one hand, to limit individuals' right to obtain single digital copies of works for private non-commercial purposes, and, on the other, to restrict the non-commercial reproduction of protected works in educational establishments and libraries, since this creates a risk that illicit copies will be made.

Because of the complexity of modifying the multilateral Berne, TRIPS and WIPO treaties, initiatives to reduce the limitations and exceptions primarily rely on TPMs. In principle, these measures benefit not only copyright holders, but also support the exceptions set forth in international treaties and national legislation. However, a threefold risk is involved: that copyright limitations and exceptions will be restricted, that research and development rights will be restricted, and that freedom of artistic expression and access to the public domain will be stifled. TPMs could prevent users from exercising their right to use works without authorization in situations not expressly covered by the law.[13]

Table VII.4
COPYRIGHT LIMITATIONS AND EXCEPTIONS

Material	Type
News and press information (literary works)	Limitation
Government texts (literary works)	Limitation
Political and legal speech (literary works)	Limitation
Control of monopolistic abuses (all works)	Limitation
Cinematic works (limited to co-authors)	Exception
Talks, etc. (literary works)	Exception
Translations	Exception
Reporting on current events (all works)	Exception
Newspapers, articles, works for broadcast (literary works)	Exception
Ephemeral recordings (music and words)	Exception and/or mandatory licence
Quotations (all works)	Exception and/or mandatory licence
Illustrations for educational purposes (all works)	Exception and/or mandatory licence
General (all works)	Exception and/or mandatory licence
Recordings of music and words	Mandatory licence
Broadcast (all works)	Mandatory licence

Source: Author, based on Sam Ricketson, *Study on Limitations and Exceptions of Copyright and Related Rights in the Digital Environment* (SCCR/9/7), World Intellectual Property Rights Organization (WIPO), Geneva, 2003.

Limiting the copyright exceptions would entail the following problematic effects: (i) restrictions of the right to quote, which is guaranteed under the Berne Convention;[14] (ii) restrictions on educational use, which is specifically protected under the Convention;[15] (iii) limitations on libraries that need back-up copies to perform their multiple tasks; and

[13] Two types of limitations or exceptions apply to the first of these risks: (i) use permitted under the law without previous authorization from, or payment to, the copyright holder, with the principles of "fair use" and "fair dealing" applying to private copies for personal use; and (ii) use permitted under the law, subject to proper payment to the copyright holder (voluntary and mandatory licences). The Berne Convention established the "right to quote" as the only mandatory exception, but optional exceptions applying to all works are also provided for.

[14] Under Article 10.1 of the Berne Convention, it is "permissible to make quotations from a work which has already been lawfully made available to the public, provided that their making is compatible with fair practice, and their extent does not exceed that justified by the purpose, including quotations from newspaper articles and periodicals in the form of press summaries". This makes it possible to use passages from any type of work, such as images, musical passages or parts of a literary text, in any form, whether reproduction, communication or other, without authorization or payment.

[15] These rights are essential for access to culture and education. TPMs can, in fact, limit the use of works to prepare teaching material and to carry out educational activity in person or remotely, with adverse effects on the quality of education.

(iv) restrictions on access for disabled persons, such as those affecting the blind in the case of electronic books that are designed to be read on a screen, and have no listening or Braille option.

Technological protections designed to give rights holders the ability to prevent unauthorized activity, if effective, could also give them the ability to prevent legitimate research and development activity, such as reverse engineering of films/games legitimately acquired in one country and used in another country outside the area designated by the rights holder.

In short, while TPMs have the benefit of hindering piracy, they also can generate costs by restricting competition, complicating imitative and incremental innovation and increasing the cost for consumers to access information and knowledge that is in the public domain.

The European Union and the United States differ on legal treatment of TPMs. The relevant European Union Directive prohibits any action to circumvent TPMs that are designed to control access and ensure the exercise of copyright and other related rights (i.e. those that protect against copying). The Directive provides for taking appropriate measures against tools or services designed to allow such circumvention. The DMCA, in the United States, also prohibits circumventing access controls (TPMs and others), but it does not set forth sanctions for circumventing copy protections. The European Union Directive is more flexible than the DMCA in terms of TRM-related exceptions, which it specifically enumerates.

2. Copyright enforcement

The traditional means of enforcing intellectual property rights were developed in the context of a world of paper-based information, and have become obsolete. In the digital world, the cost of reproduction and distribution is far lower, and the Internet makes it difficult to detect and prevent violations.

Therefore, one of the main concerns of the developed countries, especially the United States, is to strengthen the legislation and institutions responsible for criminal, civil, administrative and customs procedures designed to prevent illegal copying and piracy, which is defined as the reproduction and distribution of illegal copies for profit.

There are currently efforts to harmonize enforcement at the international level. In addition to the TRIPS and WIPO agreements, trade agreements between the United States and various countries have played an important role in promoting the harmonization of standards and provisions to strengthen controls on cross-border smuggling, and in making civil action for violation of intellectual property rights more efficient by expediting criminal procedures. Moreover, consideration is being given to provisions that would establish a legal basis for TPMs such as encryption, along with legal mechanisms that would sanction Internet service providers (ISPs) for violations, in attempts to minimize their participation in distributing illegal copies via the web (safe harbour measures).

What will be the consequences of stronger enforcement in the content industries? Theoretically, a firm that is protected would become a monopoly and would capture all of the profits from the sale of authorized copies to firms and consumers with sufficient purchasing power. Meanwhile, low-income sectors and less productive firms without the resources to acquire legal copies would no longer be allowed access. However, if the protected firm segments its markets, establishing different prices to maximize its profits, lower-income consumers would have some access —albeit to versions of inferior quality and more limited functionality.

This theory, however, is open to debate. It assumes that enforcement will be totally effective, and that TPMs will prevent illegal copying entirely. In reality, large niches are likely to remain for unauthorized copies, in the form of either non-profit social exchange or commercial piracy. Experience in Latin America suggests that there is a large gap between the letter of the law and the ability to enforce it.[16] In addition, effective technologies for circumventing TPMs are likely to continue to be devised. This does not mean that nothing will change. The use of unauthorized copies can be expected to diminish, especially in wealthier segments of the population, in the public sector and among large and medium-sized firms.

For software producers, specifically, two additional considerations must be taken into account. First, even if the effectiveness of enforcement and of TPMs increases, high prices could bring open source software developers into the market. This would be a significant threat to firms operating with patented software, and could even lead them to adopt more flexible competitive strategies —a situation that is already occurring.[17] Given that software is a product that provides an “experience”, distributors could permit distribution of free copies to generate network economies, and then sell original copies of higher quality and greater functionality (Varian, 2005).[18] They could also set a price low enough to discourage the

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16 The presence of a large informal sector that combines legal and illegal activities suggests that there will continue to be individuals for whom the benefit of obtaining a copy outweighs the risk of being detected and sanctioned.

17 It is no coincidence that a number of patented software firms have established a symbiotic relationship of partnership and competition with open source software firms and projects (Lerner and Tirole, 2005).

18 Network effects or economies occur when the usefulness of a piece of software for a user depends on the number of users using it (Liebowitz and Margolis, 1994).

purchase of unauthorized copies, or offer supplementary services that only owners of legitimate copies could access.

The market for illegal copies is unlikely to disappear entirely, at least in the medium term. The combination of greater enforcement and more complex TPMs could reduce, though not entirely eliminate, illegal social exchange and trading in unauthorized copies. Thus, content providers will have to live with the illegal reproduction and distribution of unauthorized copies, as they do today. This situation does not necessarily work against the competitive strategies of firms producing patented software, whose main objective, rather than being the complete elimination of the supply of illegal copies, will become one of preventing their dissemination among segments of the market where significant purchasing power exists. The possession of illegal copies by low-income families and small firms would continue to be a problem, but it would also generate network effects and help expand the market for the product.

3. Issues under debate

There are two fundamental copyright issues that must be considered by countries that have free trade agreements with the United States. The first is treatment of copyright limitations and exceptions in the digital world.[19] The second is the balance between TPMs and consumers' rights on one hand, and the conditions needed for innovation and creation on the other. The region's countries must use the flexibility that they have under the agreements to take appropriate advantage of the limitations and exceptions set forth in the Berne Convention and endorsed by TRIPS.

National intellectual property rights (IPR) legislation on digital media and content should reflect the limitations and exceptions established in the Berne Convention and incorporated in TRIPS, and should: guarantee the right to make copies for personal use, the right to reproduce material for educational purposes, and the right of the press and of websites to reproduce articles on political, religious and scientific issues; maintain the exceptions for ephemeral recordings; preserve and strengthen the role of libraries; ensure access to information for the disabled; and permit the copying of software designed to facilitate interoperability.

In order for this to be viable, it is essential that decisions be made regarding legal treatment of TPMs, which, although necessary in the digital

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19 The States that signed the 1996 WIPO agreements ratified Articles 1 through 21 of the Berne Convention, and declared that: "The reproduction right, as set out in Article 9 of the Berne Convention, and the exceptions permitted thereunder, fully apply in the digital environment, in particular to the use of works in digital form. It is understood that the storage of a protected work in digital form in an electronic medium constitutes a reproduction within the meaning of Article 9 of the Berne Convention."

age to protect intellectual property rights, can jeopardize the copyright limitations and exceptions by transferring to the private sphere the authority to exclude public access to protected works (Okediji and Prosser, 2006). Thus, it is important to maintain the balance between enforcement of effective TPMs on one hand, and consumers' rights on the other, while ensuring that innovators and creators will have the conditions needed to develop their creations and inventions.

To prevent abuses of TPMs and to serve their original purpose, which is to prevent monopolistic abuses and protect consumers' rights, consideration should be given to initiatives that: establish an obligation to divulge the use of TPMs; make it mandatory to provide interested parties a way to legally bypass TPMs; prohibit use of TPMs that is detrimental to certain categories of users, such as educational institutions, libraries and persons with physical disabilities; and ensure that policy to promote competition takes account of the risk of monopoly abuse of TPMs.

E. Conclusions

The countries of Latin America and the Caribbean are only recently beginning to face what will be the highly contentious process of formulating a new framework to balance the right to appropriation with the need for universal access in the information age. Changing intellectual property rights regimes presents major challenges for public policy, requiring a systematic approach. A new framework is required, reflecting the fact that new technologies vastly increase the potential for access to information, knowledge and culture. Three types of action are needed. First, intellectual property rights legislation, in addition to adhering to agreements made in multilateral and bilateral treaties, must be as flexible as possible, create an appropriate balance between intellectual property rights and incentives for innovation and creation, and facilitate the dissemination of knowledge and information at reasonable cost.

Second, a set of public policies and complementary laws must be put in place to address the issues of innovation, education, competition and consumers' rights. This is a necessary adjunct to expanding the intellectual property rights system. Furthermore, intellectual property rights must be made an integral aspect of sectoral policy.

Third, a legal and institutional framework must be created, that represents the interests of intellectual property rights holders, as well as the interests of consumers or users of the protected property. This requires implementation of a transparent and legally guaranteed system of checks and balances to maintain balance among all of the parties involved.

It will be necessary to strengthen enforcement of existing laws, and countries will need to take measures to reduce piracy (the illegal production of copies for commercial purposes). Piracy, however, should not be confused with making digital copies for personal use, and measures to prevent piracy must not interfere with the functions of public libraries or with scientific and technological research. Implementation of comprehensive intellectual property rights protections must be accompanied by expansion of the public library system, creation of national informational networks, and public provision of digital information to all citizens. In regard to computer programs, the countries should examine and encourage the use of open source software, while ensuring a proper balance between the intellectual property rights system and the protection of competition. Protecting the right to exclusive commercial exploitation of a product for a given period of time does not mean permitting monopolistic abuse.

Finally, with regard to economic growth, there is consensus that the region's countries must move towards an economy increasingly based on knowledge and innovation. Strengthening intellectual property rights will inevitably entail increased costs in those segments of the economy where competitiveness is based solely on copying and imitation. In such areas, even the most effective protection of intellectual property rights will not be sufficient to provide all of the incentives necessary for investment, since new knowledge, which is a non-exclusive public good, will always generate externalities. Thus, it will be necessary to design and improve policies to further national research and development, technology transfer to small and medium-sized enterprises, training of highly skilled professionals and development of high-calibre educational systems. Intellectual property rights issues go beyond legislation and the institutions directly involved and have repercussions on development policies in almost all areas of social inclusion and economic growth.

In summary, the intellectual property rights regime for the twenty-first century must be based on a new framework that includes new legal provisions and balanced participation by the different stakeholders involved. Incentives for creators and innovators should be balanced by legal provisions that ensure the greatest possible dissemination of knowledge, information, content and culture. This is a key challenge in the effort to create an environment conducive to economic and social progress.

Part three

ICT for development: applications and content

This section of the book analyses progress in incorporating ICT in the economic and social organization of Latin America and the Caribbean, in areas such as education, public administration, business, healthcare, and disaster prevention and management (chapters VIII to XI). These chapters analyse the sectoral ICT infrastructure, the use and sector specific applications and assess the supporting complementarities needed to incorporate ICT in the process of modernizing the "way things are done" of the region's emerging information societies. These chapters do not analyse the development of ICT as an end in itself, but as a means to the end for development of the chosen sectors. While ECLAC sees education, government, business, health and disaster management as key sectors for the development of any society, this list is not exhaustive and could easily by expanded to include other areas of ICT application.

Chapter VIII

Education

A. General context

ICT access and usage for education is highly unequal in the region. While some countries have made major progress in providing connectivity for public schools, most have not yet reached even a third of the schools, and this figure is even smaller in rural areas. There are similar disparities between private and public schools within the countries. While 53% of Argentina's private schools had Internet access in 2005, this was true for only 13% of public schools. The corresponding percentages in Peru were 13% and 2% (see figure VIII.1). The social disparities underlying these percentages are even greater, since private school students have greater access to computers at home. Thus, far from compensating for unequal income, the existence of these two types of schools accentuates the disparities.

This chapter examines policies designed to support ICT in education in the diverse settings found within the region. After presenting a view of the effects that these technologies may be expected to have on education internationally, it analyses changes in ICT policy in the region. Finally, it looks at the extent to which there has been progress in this policy area, in terms of the overall conceptual framework and the evolving effort to close the digital divide.[1]

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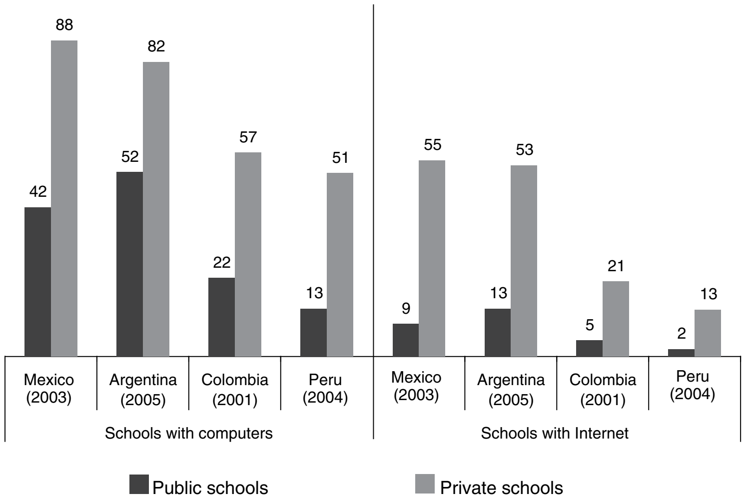
[1] This chapter is based on partial evidence, since there is currently no inventory of educational ICT policies in the countries of the region.

Figure VIII.1
CONNECTIVITY IN PUBLIC AND PRIVATE SCHOOLS IN SELECTED COUNTRIES
(In percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), partially based on Observatory for the Information Society in Latin America and the Caribbean (OSILAC), *Monitoring of eLAC2007: advances and current state of the development of Information Societies in Latin America and the Caribbean*, Santiago, Chile, 2007.

Many developed countries have started to treat ICT usage as a "basic skill requirement" (on a par with reading, writing and mathematics). It is considered to prepare students for their employment, which contributes to economic growth. ICT are also used to improve school management and further the teaching/learning process (OECD, 2001).[2]

Literature on the topic identifies several reasons for and benefits of the adoption of ICT by the education sector (Kozma, 2005; OECD, 2003a). There is general agreement that these technologies improve students' performance.

Use of ICT in the developed countries has shown that individuals to acquire capacities and skills that help them perform successfully in the society. In the developing countries, however, where people do not necessarily have the basic skills needed to exploit the potentials of ICT, this argument should be regarded more sceptically. It does not seem reasonable to suppose that merely learning how to use ICT will automatically enable individuals to contribute significantly to the growth of their economies,

2 For a more detailed analysis, see Jara (2007).

especially considering the poor performance of the region's countries in international educational tests such as CIVED,[3] TIMSS[4] and PISA.[5]

A complementary line of reasoning about ICT and education shows a growing amount of evidence that the use of ICT as a tool for educational management[6] can improve the teaching and learning process (BECTA, 2006; Carnoy, 2002; Kugemann, 2002). While hard evidence on this issue is still scarce, the argument seems intuitively convincing since the administrative needs of a school are quite information intense. Many private universities in the U.S. have already demonstrated the benefits of systematically digitizing their bureaucracies. Finally, the argument that ICT are an effective tool for improving teaching and learning is still being debated (Balanskat, Blamire and Kefala, 2006; Cuban, 2001). In brief, the arguments are as follows:

(i) The use of ICT in teaching and learning can improve students' performance. This argument is used both explicitly, in documents on designing ICT policy for education (McMillan Culp, Honey and Mandinach, 2003), and implicitly, in reports on progress in implementing policy (BECTA, 2006). A number of studies have attempted to show a positive correlation between available ICT infrastructure and improved student performance, but it has not yet been possible to accurately test this relationship (Balanskat, Blamire and Kefala, 2006). Moreover, some qualitative studies have examined how students' learning is affected by different ways of using ICT (Kozma, 2003; Venezky, 2002). Neither type of

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3 Civic Education Study carried out by the International Association for the Evaluation of Educational Achievement (IEA) from 1994 to 2002. The evaluation included 14-year-olds from 31 countries (including, from LAC, Chile and Colombia). It assessed their knowledge, attitudes and civic commitment (see: www.iea.nl/cived.html).

4 Trends in International Mathematics and Science Study (TIMSS), a study carried out by the International Association for the Evaluation of Educational Achievement (IEA) in 1995, 1999, 2003 and 2007. The assessment covered students ages 9-10 and 14. In 2003, it included 50 countries (from LAC, Argentina and Chile). TIMSS attempts to determine the proportion of mathematics and science curricula that teachers actually develop, and then uses information from students to ascertain the extent to which the curricula are effective (www.iea.nl/timss2003.html).

5 Programme for International Student Assessment, coordinated by the Organization for Economic Cooperation and Development (OECD) and executed in 2000, 2003 and 2006. The evaluation covered 15-year-old students, and included 57 countries in 2006 (including, from LAC, Argentina, Brazil, Chile, Colombia, Mexico and Uruguay). The programme evaluates students' ability to use their knowledge and skills in reading, mathematics and science to solve problems that are relevant to their future lives, rather than measuring memorization of information. The evaluation is not limited to areas covered in curricula, but rather focuses on skills that facilitate life-long learning (www.oecd.org).

6 Generally, the concept of "school management" relates to economic and human resources (teachers, board members, administrative personnel, etc.), students (matriculation, grades, reports), parents/guardians (backgrounds, communications), subjects (schedule planning) and teaching (curriculum planning, monitoring of curriculum development, lesson plans).

study has been able to establish widely applicable correlations, since they report only partial results obtained under specific conditions. Nevertheless, the high demand for such studies, as well as the amount of research carried out, demonstrates the continuing interest in, and need for, evaluating the impact of ICT on students' learning.

(ii) ICT are only one component of a coordinated strategy to improve curriculum, pedagogy, evaluation, professional development for teachers, and other aspects of school culture. This argument downplays expectations of finding a causal relationship between the use of ICT and improved student performance, suggesting that ICT do little more than help provide the basic conditions for improving performance (OECD, 2001; Roschelle and others, 2000).

(iii) ICT create a new environment for teaching and learning. Based on the opportunities that ICT offer, those making this argument advocate radical change in students' ways of learning and in the methods used by teachers, promoting constructivist, student-centred pedagogy[7] that promotes active commitment, dialogue and interaction (Voogt and Pelgrum, 2005; Yelland, 2006). What is interesting about this argument is that it centres on developing the potential of ICT to create new areas and forms of representation that foster a wider and more effective pedagogical repertoire (Dede, 2000).

(iv) The proliferation of ICT calls for the formulation and implementation of new curricula. This argument is based on the idea that an information society requires new capacities and skills, such as knowledge creation (Scardamalia and Bereiter, 2006),[8] a capacity for change and innovation (Roschelle and others, 2000), and life-long learning abilities (Voogt and Pelgrum, 2005).

(v) ICT are a tool for learning and teaching. This argument considers these technologies a tool for improving learning and teaching processes, without maintaining that they have any intrinsic transformational capacity. Even if the curriculum is not revised, plain access to the Internet for a teacher enables access

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7 The teaching process, in this view, should centre on promoting and encouraging the student's development of strategies and methods that improve learning. It stresses comprehension over plain memorization.

8 This means that students must develop the ability to create and share knowledge, participating in various communities through networks. One example of such activity is the development of Wikipedia.

to the latest and most adequate content to present in classes, multiplying the available textbook ad homework examples, allowing them to break their dependence on the scarce and outdated teaching resources often found in the libraries and inventories of local schools in developing countries.

(vi) Management of schools is information intensive. The inevitable bureaucracy can be modernized by bringing the required procedure online, digitizing the interaction of students, parents, managers, authorities and among educational entities. The coexistence and periodic emergence of new perspectives on ICT and their possible roles in education have led to an ongoing debate that has not yet produced definitive conclusions (Dillon, 2004). The reason for this is that, given the rapid evolution of ICT, it is difficult to establish and maintain strategic or political objectives (Rycroft, 2006), and frequently ICT are used merely as a "battle cry" by governments. Thus, educational goals get redefined as political circumstances change.

To examine the current situation and the ICT dynamic in education, it is useful to have an analytical framework that incorporates an "ideal" model for the integration of technologies. This chapter employs the model proposed by Selwyn (2004), which analyses different conceptual stages of the digital divide (see table VIII.1).

Table VIII.1
CONCEPTUAL STAGES OF THE DIGITAL DIVIDE

Formal or potential access to ICT and content	Formal availability of ICT in households, communities, schools and workplaces, potentiality to be used by all of their members.
Actual access to ICT and content	Availability of ICT in households, communities, schools and workplaces, to be used by those who consider themselves able to do so.
Use of ICT	Any type of contact with ICT. May or may not be significant, and may or may not have medium or long-range consequences.
Appropriation of ICT	Significant use of ICT, with a degree of control and choice over technology and content. Their use can be considered useful, beneficial and valuable, and is important to the user.
Concrete and noticeable results	Immediate or short-range consequences from ICT use.
Concrete and perceived consequences	Medium- or long-range consequences from ICT use in the form of participation in the information society. These can be evaluated based on the types of activities involved: productive, political and social, consumption, savings.

Source: Neil Selwyn, "Reconsidering political and popular understandings of the digital divide", *New Media & Society*, Vol. 6, No 3, 2004, p. 352.

1. Access

In terms of formal or "potential" access to ICT and content (i.e. availability of equipment), the region's digital divide has narrowed in recent years. However, with regard to the technical quality of access (the ability to transmit, compute and store information), the divide continues to widen, with no discernible prospect of a change in this trend (see chapter II.A). This has direct repercussions on the second layer of the model, namely, actual access to ICT and content, since poor technical quality has the effect of making users feel deprived of "true" access.

ICT policies in the field of education have been instrumental in providing access to disadvantaged sectors. In Chile, for example, it is generally recognized that the "Enlaces" programme has contributed to reducing the digital divide (OECD, 2004a). More generally, access to ICT in the region's schools has the potential to significantly compensate for the enormous inequalities in home access (Sunkel, 2006).

In order to provide infrastructure in schools, a number of countries have implemented educational information technology policies in the last few years to provide computers and Internet access (Jara, 2007). Although there has been progress, the situation in the region continues to be uneven, by far still lagging behind developed countries (see figure VIII.2). In 2005, the ratio was one computer per 30 students in Chile, as compared to 98 students per computer in El Salvador —a striking contrast with the OECD countries, where the average number of students is 9. The difference is even greater if one considers how the equipment is used. Generally, access to —and educational use of— ICT in schools occurs in computer labs rather than in classrooms. This may be due, in part, to the need for sharing equipment. However, a considerable number of school computers are used exclusively by administrative staff and are unavailable to students.

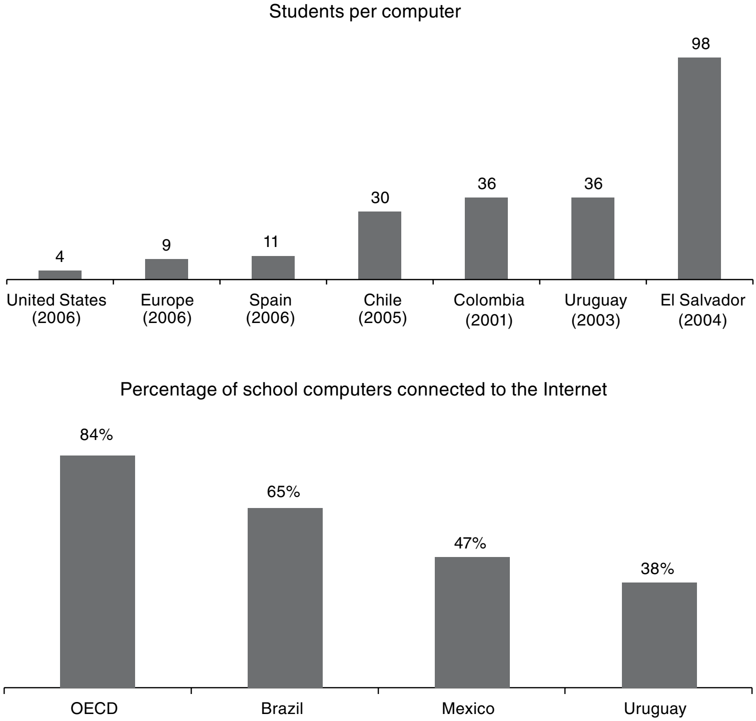
In the process of developing ICT infrastructure, some countries are replacing obsolete computers with recycled ones,[9] while others use Linux-based client-server solutions, in which one new computer operates as a server, while others function as clients, with updated software.[10] The latter is an inexpensive solution that maximizes the sharing of the computational power of one central machine. This can be attractive for countries that receive donations of second-hand computers, which can still be used as clients. Finally, in addition to requiring infrastructure, ICT use requires properly functioning hardware and software. While this seems

9 Cf. Colombia's computer recycling programme, "Computadores para Educar" (www.computadoresparaeducar.gov.co), which has been used as a model by other countries, e.g. Chile, in its Chile@nter programme (www.chilenter.cl).

10 One example of this type of solution is Chile's EduLinux initiative (www.edulinux.cl), which has been successfully used in over 2,000 schools.

obvious, many teachers do not use the resources available, due to technical problems in the hardware or software configuration.

Figure VIII.2
STUDENTS PER COMPUTER, AND PERCENTAGE OF SCHOOL COMPUTERS CONNECTED TO THE INTERNET



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Observatory for the Information Society in Latin America and the Caribbean (OSILAC), *Monitoring of eLAC2007: advances and current state of the development of Information Societies in Latin America and the Caribbean*, Santiago, Chile, 2007.

2. Use of ICT

A common strategy of educational ICT policy in the region is to provide the community at large with access to ICT infrastructure at local schools, thus making the schools public venues for Internet access. This promotes the economic sustainability of computer labs by imposing a minimal charge on outside users, while at the same time often makes part of a national strategy to bridge the digital divide by providing access for disadvantaged segments of the population. Community "digital literacy" strategies, which have also been considered, have been implemented more in Latin America than in the Caribbean.[11]

Most educational ICT policies in the region include strategies to provide teachers and students with training, as well as access to content.[12] Most training initiatives include teacher training programmes,[13] and some also include training for students. In the former case, the purpose of the policies is to develop the skills and capacities necessary to use ICT in teaching, but time is also dedicated to elements related more to "digital literacy" than to specific pedagogical uses. In most cases, the pedagogical models are defined on the basis of existing curricula, or are devised to conform to current educational reforms, and do not take ICT use into account. Educational reform initiatives often fail to include the pedagogical dimension of ICT. While alternative pedagogical models, involving ICT use in the classroom, are sometimes proposed, they tend to have more to do with ministerial rhetoric than with tangible applications of the technologies.

Nevertheless, these strategies ultimately do play a role in efforts to provide students with the ability to use ICT effectively. This is especially true when teachers support the process and make sophisticated use of technologies in their teaching (Becker, 2000).

Most initiatives to train students in use of ICT are oriented towards functional skills (use of word processors, spreadsheets, presentation programs and e-mail, and ability to access the Internet). Only in some cases do the skills correspond to internationally defined standards,[14] such as the International Computer Driver's Licence (ICDL),[15] or Internet and Computing Core Certification (IC3).[16] Countries have implemented few if any initiatives to develop capacities and skills that go beyond the use of concrete applications and would encourage creative uses of ICT (Voogt and Pelgrum, 2005). Strategies to prepare students for the broader challenges of living in an information society continue to be missing from the countries' ICT policymaking process.

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[11] Cf., for example, the Chilean project "Enlaces abierto a la comunidad" (www.enlaces.cl).

[12] Additional initiatives appear in developed countries, e.g. the distribution of comprehensive ICT-use models and the provision of open-access educational resources (OECD, 2007c).

[13] Cf. Brazil's training initiatives through ProInfo, which uses virtual environments to promote teachers' professional development.

[14] In Jamaica, for example, the secondary school curriculum includes computer classes designed to provide students with international certification in computer use. Chile's Enlaces initiative developed an elective course for secondary students to learn to use computers, but official certification is not included.

[15] See: www.ecdl.com.

[16] See: www.certiport.com.

In terms of content, the most important initiative is the Latin American Network of Educational Portals (also known by its Spanish acronym RELPE). Its purpose is to promote the use of ICT to improve quality and equity in teaching, through the free exchange and use of digital resources located on members' websites (Sunkel, 2006).[17] RELPE can be thought of as a regional system for the storage and circulation of educational content that is constantly being expanded and updated. Its nodes are the national educational portals designed by each country as part of the network. RELPE creates a community for educational sharing and collaboration, involving both the countries' educational policymakers and individuals who oversee the websites (including their technical teams).[18]

Initiatives to foster the availability of educational content, like RELPE, are in dire need. Figure VIII.3 shows the elements present on the official educational websites of Latin American countries. Only 76% of the sites include educational content. Many provide only ministerial and sectoral information, and only 64% of the educational content is organized by grade level. Software for classroom teaching is the least common type of content to be found, despite the wide range of free software available on the Internet. Moreover, data indicate that only a very small proportion of students and teachers make use of the ICT infrastructure available at schools, thus limiting the overall effort to expand use of these technologies. (Sunkel, 2006).

Use of ICT for educational management purposes (Education Management Information Systems, or EMIS) remains very limited.[19] In general, initiatives have placed priority on developing computer systems to improve local school administration and to manage statistical information provided to students.[20]

In short, policies are moving in the right direction, in terms of training strategies. It is vital that school teachers and administrators have the proper training if they are to gain the skills and mindset needed to use ICT effectively. Teachers' lack of appropriate skills remains the most common barrier to incorporating ICT in the teaching and learning process (Carnoy, 2002; Pelgrum, 2001). In order to use computers effectively, teachers must not only use technology in the classroom, but must also be familiar, with its potential uses. Thus, the use of ICT in teaching will

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17 In 2009, RELPE has eight full members (Argentina, Chile, Colombia, the Dominican Republic, Mexico, Nicaragua, Peru and Uruguay), 11 adherent members and Spain as a member of honour.

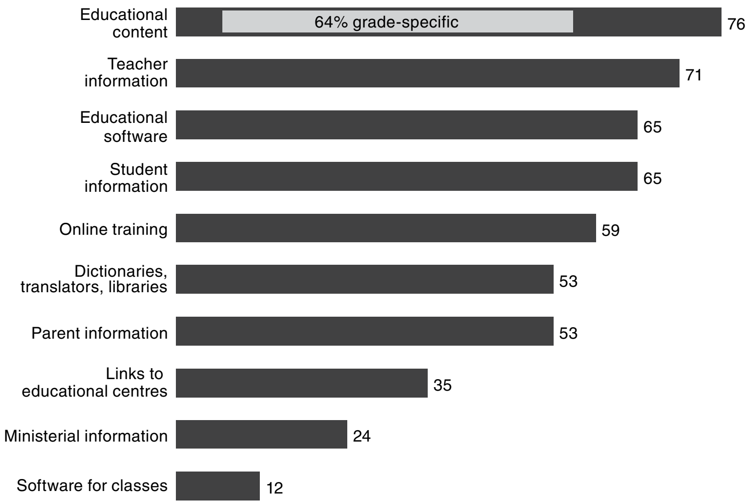
18 See: www.2.relpe.org.

19 For example, the ministries of education of the Bahamas and Jamaica developed projects to implement computer systems for educational management overseen by the ministries.

20 Jamaica, for example, developed a school administration system (SAS) that was implemented in the late 1990s.

depend on the skills of teachers. The region's countries are also working to acquire content for teaching and learning, and although little progress has been made in this respect, the presence of RELPE, and its future expansion, provides a starting point for addressing this issue. Progress in using ICT for educational management purposes has unfortunately lagged behind the other areas.

Figure VIII.3
CONTENT OF 17 LATIN AMERICAN COUNTRIES' OFFICIAL EDUCATION WEBSITES, 2007
(In percentage of sites)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on information from the education websites of members of the Latin American Network of Educational Portals (RELPE) provided by the countries' education ministries.

Note: Classroom software: applications that help teachers prepare and teach classes.

In light of the above-mentioned initiatives and the increasing availability of infrastructure, it is clear that countries in the region are generally making progress in creating the conditions for ICT use in education. However, strategies remain to be developed and implemented to facilitate their effective use and to exploit their full potential.

3. Appropriation

One means of encouraging different stakeholders to use ICT is to incorporate ICT-related objectives and content in the curricula. In fact, one of the most basic prerequisites to effective classroom use of ICT bears no relation whatsoever to the quality or quantity of the new technologies available, but, rather, is a matter of coherent, sustainable teaching strategies within ministries, educational establishments and classrooms. These serve as the backdrop for all ICT activity. Like other resources, computers must be integrated harmoniously with teachers' instructional methods. This means that there needs to be good planning and effective management of time and resources. The integration of ICT in the educational system will be effective only insofar as it is part of a coherent system in which the other elements (curriculum, educational resources and assessment) are aligned and oriented to a common objective (Kinelev, Kommers and Kotsik, 2004).

Some Latin American and Caribbean countries have incorporated ICT skills as an independent subject, which is usually defined in terms of functional skills that can be tested and officially certified.[21] Other countries incorporate ICT in the form of horizontal objectives within different subject areas. This, however, presupposes that teachers will know how and when to use ICT in teaching their particular subjects. Another issue, which few countries have addressed, is that of developing secondary-level technical/professional training programmes in ICT deployment.[22]

In short, many policies in the region fail to include strategies to facilitate the integration of ICT in teaching. From the perspective of innovation and educational change, the view proposed by Huberman (1992) is that innovation is a process of "grafting" the new onto the old. The "old" here is a local context, with its own history and patterns. Olson (2000) defines change as a process in which new, well conceived practices challenge existing practices, rather than simply replacing them. Both of these definitions treat the process of change as a gradual, rather than a radical, one and assume that "the new" must somehow be based on "the old".

B. Progress

Over a period of three decades, the governments of a number of countries have explored ways of using ICT in education. They have considered (in chronological order) technologies such as radio, television, computers, Internet and mobile devices such as cell phones, handheld computers and personal digital assistants (PDAs). The initial purpose of these initiatives was to increase educational coverage via radio. The focus then shifted to "packaging" educational content for television. For example,

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21 This is the case in the Caribbean countries, which developed a common ICT certification for secondary students as part of the Caribbean Secondary Education Certification (CSEC) system. Defining and administering these examinations are the responsibility of the Caribbean Examinations Council (CXC) (www.cxc.org).

22 Cf. Jamaica's HEART/NTA initiative (www.heart-nta.org).

Telesecundaria de México began broadcasting in 1968 to increase the coverage of secondary education in rural areas, and now reaches over 900,000 seventh to ninth grade students annually (de Moura Castro, Wolff and Garcia, 1999).

During the 1980s and mid-1990s, these initiatives took an exploratory form, generally attempting to use ICT to influence outcomes in the teaching and learning process or to improve administrative procedures in schools. Costa Rica, for example, began its National Educational Information Technology Programme in 1988. Its objective was to improve educational quality by creating learning environments that incorporate technology and stimulate creativity, logical thinking, problem solving and fluency in using technology (REDAL, 2005). In 1992, Chile implemented its Enlaces initiative, which is designed to enhance educational quality and increase equity through the use of multimedia software and computer networks (Hepp and others, 1994).

Finally, the mid-1990s saw the beginning of initiatives to incorporate ICT in education with an emphasis on student access, particularly targeted to the most vulnerable segments of the population. The conclusions of the third Spanish-language CERI/OECD seminar confirmed and accentuated this, stating that "although progress has been made in ICT access for the most disadvantaged groups, there is still great inequality in this area in most countries, and there is a risk that it will increase. Therefore, it is urgent to define more aggressive policies to promote equal access to and effective use of ICT, especially in education" (MINEDUC, 2006).

Unlike other areas of research on the digital divide, few international studies track the results and effects of progress on ICT policy in the educational realm. Some, however, monitor progress in students' perception of their own ICT capacities (Sunkel, 2006).[23] It should be borne in mind that these studies reflect only the perceptions of those surveyed, not an objective assessment of their progress. There has been little participation by the region's countries in international initiatives to evaluate ICT use in education. Chile was the sole participant from the region in a series of studies known as the Second Information Technology in Education Study (SITES) —sponsored by the International Association for Evaluation of Educational Achievement (IEA)— a study linked to the SITES M2 (1999-2002) and SITES 2006 (2006-2008) studies.[24] In the OECD-

[23] This result is based on the response of students, teachers and principals to questionnaires, which are part of the educational performance tests (PISA, TIMSS, etc.) and are conceptually and methodologically designed to evaluate educational achievement.

[24] The SITES studies have three components: (i) SITES-M1: a study performed in 1998 and 1999, designed to identify availability of, access to, and teachers' use of ICT infrastructure in schools, along with management and planning activities related to ICT use. The study included 25 countries, none in Latin America or the Caribbean; (ii) SITES-M2: a

coordinated study of ICT use and organizational change in schools, Mexico was the only country from the region that participated. Efforts must be made to bring the countries of the region into the culture of international evaluation and comparison.

Education-related ICT policies in Latin America and the Caribbean have addressed the issue of ICT access and use by providing computers, basic Internet access and training, and by selecting content. While these elements are certainly necessary, they are not in themselves sufficient for effective ICT use. In general, the countries have not implemented national strategies to promote effective ICT use and to ensure that both students and teachers incorporate them in the teaching/learning process. This is a necessary step if these technologies are to yield the hoped-for results and effects.

In developing countries, one of the explicit or implicit reasons for incorporating ICT in education is to give students the capacities needed to overcome the digital divide and thus "indirectly" contribute to economic and social development by becoming a member of an emerging information society. In developed countries, the approach is more direct and tailor-made. ICT policy focuses on increasing students' digital competitiveness and on improving the teaching and learning process. This difference in approach is presumably due to the enormous disparity between computer and Internet penetration in the households of the developed countries and penetration levels in the developing countries (see chapter II).

From the perspective of strategies for ICT policy, analysis of initiatives launched in the last few decades to incorporate ICT in education reveals different trends. In the early 1980s, it was thought that computers were a "Trojan horse", and would bring the seeds of change and innovation into the world of teaching and learning (Olson, 1988 and 2000). In the 1990s, ICT were considered a catalyst capable, under certain circumstances, of accelerating the process of educational change and innovation (McDonald and Ingvarson, 1997). Currently, they are considered a form of "leverage", i.e. a tool that can be used deliberately to generate change (Venezky, 2002). This view no longer assumes that change will occur by itself; rather, it assumes that a strategy for change is necessary, and that ICT can be useful tools for reaching defined goals.

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qualitative study of innovative teaching practices employing ICT, carried out in 1999 and 2002, covering 28 countries, including Chile. The study analysed 174 cases of ICT use, and sought to identify patterns in the teaching and learning process, as well as contextual factors influencing the practices involved; and (iii) SITES 2006: a study that began in 2006, designed to identify teaching practices employing ICT in schools, availability of, access to, and teachers' use of ICT infrastructure, along with management and planning activities related to ICT use. Chile and 20 other countries participated in the study.

National strategies to incorporate ICT in education are frequently associated with innovation and change, especially in political rhetoric (for example, in connection with educational reform), though the strategies, once approved, do not necessarily lead to concrete action. Thus, there are many instances in which the primary motive for investing in these technologies is to project the image of being modern, up-to-date and efficient, rather than actually making processes and activities more efficient. This tends to lead to actions centred more on providing means (infrastructure and access) than on changing processes (innovation).

C. Conclusions

A number of elements emerging from the foregoing analysis merit consideration in designing policy for the incorporation and use of ICT in education:

(i) Strategies must seek to continually expand the coverage and quality of ICT access for everyone in the educational system, with more computers and improved Internet access.

(ii) It is also important to broaden and deepen training strategies so that teachers can gradually and continuously acquire the capacities and skills needed to use ICT in their professional lives. In addition, strategies must be formulated and implemented to promote teachers' use of these technologies, e.g. through comprehensive models of ICT use.

(iii) Strategies for integrating ICT use in curricula must be designed and implemented in ways that ensure that their use in the classroom is compatible and harmonious with each country's pedagogical strategies. Moreover, learning assessments must include an evaluation of students' progress in using ICT.

(iv) In order to assess the outcomes and repercussions of ICT in education, quantitative indicators must be developed to measure their incorporation and use in education, thus making it possible to carry out comparative assessments of the success of policies in this area.

Chapter IX

Government

A. General context

The concept of electronic government (e-government) relates to the functions and objectives of the executive branch in a State (as a complement to the judicial and legislative branches) and, therefore, to the use of ICT in public administration. This chapter is based on an analytical framework that considers semantic, organizational, technical and governance aspects of e-government policies, so as to assess their level of development in Latin America and the Caribbean. Some significant results are also highlighted, such as increased government transparency and efficiency through the use of electronic public procurement systems. The evidence presented indicates that the use of ICT in public administration produces major benefits for society at large, be it indirectly or directly.

In a number of Latin American countries, e-government services have led the way to increased use of digital applications in other sectors. Unlike the evolution of these technologies in developed countries, where e-business applications paved the way for more general use, Latin American websites for government procurement or online tax statements introduced many citizens and firms to the digital world for the first time (ECLAC, 2005a). This role of e-government as a catalyser is not insignificant. However, the main benefit of e-government consists in increased efficiency provided by electronic government applications —which leads to important savings for the State and for society, and to increased accountability, provided by digital transparency.

Efforts to optimize public administration occur in the context of constraints that are part of the very nature of a democratic State that is based on the rule of law. The objective of e-government is not to minimize costs or maximize revenues —as is the case with the use of electronic tools in the private sector— but rather to make public administration efficient, transparent and beneficial to citizens, while respecting the limits imposed by a country's constitution and laws, which in a democratic State reflect the will of the people.

Strong disagreement exists on how to define e-government and on how to evaluate its impact.[1] Despite these differences, there are at least two global annual assessments that classify countries according to the development of their e-government systems (i.e. UNPAN e-Government Readiness Ranking (United Nations, 2005c, 2008) and the Brown University classification (West, 2005)). However, the variability in countries' efforts to carry out these measurements is reflected in the wide variation in assigned values.

One of the most commonly used criteria for evaluating the development of e-government, employed by the OECD and the European Union (OECD, 2005a and CAPGEMINI, 2005), considers e-government to be an evolutionary process of improving or modernizing government, which occurs in four stages. The process begins with the simple provision of information on government websites, and culminates with the complete integration of the processes and information present in government entities. In the first (or "informational") stage, governments use the Internet to publish information on the activities of governmental entities and services, and on other matters relating to the State. Citizens have continuous access to these materials, from any location with an Internet connection. In the second (or "interactive") stage, governments not only provide information, but also allow citizens to use the Internet to obtain and print forms, which they can then complete prior to appearing at the relevant government office where the particular procedure must be carried out in person. This reduces the travel required. In the third (or "transactional") stage, governmental entities allow citizens to carry out certain procedures —such as submitting completed forms, requesting balances due, obtaining certifications needed for other procedures, and paying for certain permits— online. In the fourth and final (or "integration") stage, the government implements a system that provides for the fluid and secure flow of information between organizations (interoperability) and includes automatic verification and certification for citizens requesting services or permits, regardless of the citizen's physical location at the time. The interoperability of e-government systems obviates the need for travel between different agencies to obtain

1 Practically all authors begin their books and articles with some definition of electronic government. Moreno (2007) provides a compilation of 37 different definitions. E-government websites also often include their own definitions.

certifications or make payments, and constitutes a quantum leap in the quality of service provided by government. The major reductions in time and cost entailed by eliminating the need to transact these formalities in person represent a significant benefit to citizens.

In considering the development of e-government in this four-stage framework, one might gain the impression that the phenomenon is purely a technical one, and that the progression from one stage to the next is simply the result of utilizing digital solutions provided by the e-government system. However, this is hardly the case. In order to understand the phenomenon, one must take account of the political and organizational, as well as the technical, dimensions that shape the development of e-government.

This analytical model is the most useful method of identifying and evaluating the specific ICT solutions provided by e-government (whether tax payments, public procurement, health services or education). However, such an analysis does not, in itself, determine what criteria should be used to monitor a country's e-government, or to measure its effects on the society. One limitation of this model is the fact that the four stages it describes are all linked to use of the Internet. Other channels of communication, such as call centres, can also provide e-government services without resorting to the Internet. Thus, a broader analytical framework is required, one that addresses the full range of factors that affect the development of e-government.[2]

1. E-government: levels of development

Before proposing an alternative analytical framework, it is necessary to identify the stages through which public administration moves in developing ICT use. Each stage corresponds to a particular use of the institutional and technical means that government has at is disposal to achieve its objectives. This process of change must be described starting from the stage that precedes ICT use, to the stage in which ICT are fully functional. This description must include not only the features of the ICT solutions involved, but also the roles and needs of citizens and public employees (see diagram IX.1). Citizens are the focal point of public administration. They are the ones who require the government's goods and services, and to whom government is accountable. It is the responsibility of public servants to ensure that e-government achieves its policy objectives.

The first stage, "bureaucracy prior to the advent of ICT", is symbolized by the image of a public servant at a government office, surrounded by files and papers that are difficult to keep organized, with citizens lined up behind a window waiting to be assisted. The individuals in line have the documentation required for the procedures they wish to

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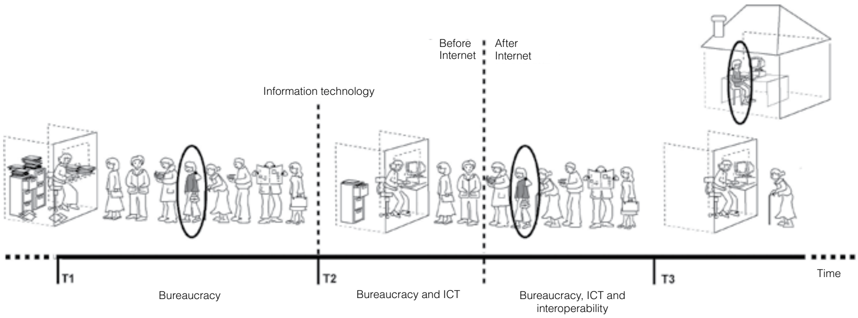
[2] See Moreno (2007) for the development of the framework used in this chapter.

carry out —documentation provided by other government agencies, based on information in their records.

Diagram IX.1
STAGES OF EVOLUTION OF PUBLIC ADMINISTRATION IN RELATION TO ICT USE



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Hernán Moreno Escobar, *El fin del gobierno electrónico*, 2007.

The second stage, "bureaucracy and ICT", is reached when public administration employs digitally stored information to process formalities. This stage is represented graphically by a public servant using a computer, at an office that appears more orderly than did the pre-ICT office. Better service is being provided to the citizens who stand at the window. Note that the line here is just as long as in the previous setting. Despite the incorporation of information technology, people still have to the documentation needed to complete the required procedures. Thus, they are required to wait in line at other offices in order to obtain information stored in the public records of the particular office involved.

The third stage, "bureaucracy, ICT and interoperability", involves the full use of ICT in public administration. It can be represented graphically by citizens carrying out all bureaucratic formalities via computer from home or office, without having to travel from one office to another collecting documents. In this stage, the interoperability of e-government systems makes it unnecessary for citizens to present documentation, since the government entities themselves can verify the information. The few citizens in line are those who, for special reasons, have to carry out procedures in person. However, they are all served by a single entity, which possesses the information necessary to assist them. Physical files and paperwork are no longer present in the office.

This evolution does not occur at the same pace for all governmental entities. The adoption of ICT —and the administrative changes that this produces— occurs at different times and with differing results. In a given country, each agency —and even different offices within a given agency— may be at a different stage. The stage of e-government development reached by any given country is a function of the number of entities at each of the stages.

2. Semantic, organizational, technical and governance considerations

The information and knowledge available to public entities are the result of a semantic process. The crux of this process is the interconnection of all informational units that the government requires to comply with the law. Institutional processes require that each agency establish rules for its own functioning in order to achieve its objectives. The rules are reflected in hierarchies, organizational charts, procedural manuals, training of staff and monitoring mechanisms. Technical processes make it possible to manage, record, calculate, search for and file information, carry out procedures, and provide an accounting to citizens' organizations and oversight bodies. The interoperability of technological solutions ensure fluid and secure exchange of information through a single platform. Governance processes provide the means for entities to coordinate their personnel, and for different agencies to coordinate their activities, while ensuring that legal standards are met and that responsibilities are correctly assigned among the different organizations. These processes also establish oversight mechanisms to monitor achievement of objectives and to potentially take timely corrective measures to ensure efficient, effective and democratic functioning.

The challenges of the three steps outlined above have been described by the European Interoperability Framework for Pan-European e-Government (IDABC, 2004), which serves as the foundation for the European Commission's study on local and regional interoperability (European Commission, 2006). Four types of challenges are identified: semantic, organizational, technical and governance (see table IX.1).

In the first stage (bureaucracy), the semantic process is supported by paper forms, which are stored in files following the completion of the relevant formalities. Agencies are responsible for their own semantic processes, and for managing their information. The formalities that they process require information that must be provided and certified by other agencies. The documentation is authenticated by means of seals and signatures.

Table IX.1
CATEGORIES FOR ANALYSING THE STAGES OF DEVELOPMENT OF E-GOVERNMENT

Challenge \ Stage of evolution	Bureaucracy	Bureaucracy + IT	Bureaucracy + ICT + Interoperability
Semantic	Paper forms	Paper forms Digital forms	Digital forms
Organizational	Agencies manage information autonomously	Agencies manage information autonomously	Agencies manage their own information autonomously They use information from other agencies
Technical	Typewriters, calculators, paper files Certifications, seals	Typewriters, calculators, paper files Computers, printers Digital files Certifications, seals	Computers, printers Digital files Interoperability, digital certification, electronic signature and payment
Governance	Legal framework, internal regulations governing the agency	Legal framework, internal regulations governing the agency	Legal framework, internal regulations governing the agency Privacy regulation Interoperability, standards, coordination with other agencies

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Hernán Moreno Escobar, *El fin del gobierno electrónico*, 2007.

In the second stage of e-government development (bureaucracy and ICT), certain paper forms are replaced through the ability to create digital records. Thus, paper files and digital files coexist. The benefits provided by ICT at this stage affect only the agencies' internal operations. Procedures previously carried out manually are now processed on computers, and information filing and searching are streamlined. The semantic, organizational, technical and governance processes here are similar to those of the bureaucracy stage, and are present side by side with new ICT procedures. In this stage, improvements brought on by the digital processing of information do not actually impact the quality of service received by citizens.

In the third stage (bureaucracy, ICT and interoperability), ICT are in full use in public administration. This is the maximum stage of development of e-government. All information is managed digitally, and most manual transportation and manipulation of paper files disappear. ICT is used in an interoperable environment, and citizens no longer need to request and submit documentation, since the information required for the formalities can be verified electronically. Each entity records only the information within its area of authority, but the information can be accessed by other agencies, or directly by citizens. A very important and delicate point at this stage is the safeguarding of citizens' privacy. Technologically, it is possible to provide every civil servant with all kinds of information about a single citizen, giving incomplete insight into its civil status, criminal record, health condition, income sources and educational challenges, among others. However, not everything that is technologically possible is also desirable. The creation of a completely transparent citizen inevitably reminds one of maybe the oldest vision of an information society: the Orwellian Big Brother State (Orwell, 1948). Having this in mind, countries around the world currently face the challenge of developing strict privacy rules, regulating who is allowed to interconnect with information with what. These regulations also need adequate technological implementation and continuous oversight to prevent abuses.

(a) Semantics

The semantics of e-government are the result of a process in which a system of interconnected informational units enables the public administration to unambiguously identify any relevant item. The semantics are integrated with definitions and descriptions of information generated through dialogue among public agencies, in the environment created by the e-government governance system. The basic elements of e-government semantics require shared definitions and representations of the informational units relevant to e-government. This is key to assure the smooth processing of operations and exchange of information among agencies. Each agency needs to have a common understanding of "what is meant by what". Labels should be unambiguous and with exhaustive categories to prevent the possibility of any unlabelled object to fall between the cracks. This is not a "once and for all" regulation, but an ongoing and evolving system, which leads to several institutional requirements of the system:

- Processes to establish a formal definition of common elements. To effectively institutionalize common definitions, procedures must be accepted and observed by all agencies. New elements emerge as regulations and authorities change. The system needs to be stable, yet dynamic, and allow for the smooth evolution of definitions to prevent the creation of archaic and outdated procedures.
- Formal documentation of definitions. Documentation supporting common definitions must be officially determined. There can be no room for ambiguity. Changes in definitions over time must be recorded, with a rigorous system for managing the different versions of the documentation. At the same time, these systems must be user friendly. The challenge of this point can be seen when visiting the historical records of Wikipedia entries, which can quickly become very complex. Notwithstanding, they are important in order to understand the creation and sense of established consensus.

- Promotion and dissemination of definitions. Unless definitions are disseminated, they are of no use. It is important that they be available to all agencies. In addition to means of mass communication (Internet), it has proven to be effective to hold workshops, seminars and courses to ensure that the definitions become part of the individual entity's standard repertoire.
- Stability and reliability of definitions. Although definitions may change over time, it should be impossible to arbitrarily change them. Interoperability definitions are not Wikipedia entries. The most recent version of a definition should be consistent with the previous one. An organization that has not yet adopted the new version should not have to interrupt its usual exchange of information with agencies that have already made the change. Backward compatibility creates trust in the institutions that adopt the definitions.

(b) Organizational level

The organizational dimension of e-government involves the formal establishment of modus operandi (hierarchies, organizational charts, procedural manuals, staff training, administrative oversight mechanisms). In this process, objectives and business models are defined to facilitate collaboration and interaction between organizations that exchange information. The institutional unfolding of e-government processes must take account of the differing structures and internal processes of different agencies. Ultimately, there will be a redefinition of the available services in order to meet citizens' needs. The basic institutional components involved in this process are:

- The principle of legality. Governments are subject to a legal framework that determines what they do and how they do it. At times, this may prevent a country from employing technological solutions or practices used by other countries. Thus, the modernization of administrative procedures and public services cannot necessarily be expected to keep pace with the speed of technological innovation.[3]
- Horizontal services and applications. Integrating the information provided by different governmental areas and systems through integrated interaction, centring on the interests of citizens and firms. This is especially important for processes that involve different

[3] One example of this is the process of annual income tax declarations in use since 1995 by natural persons and firms in Brazil, where tax documents can be transmitted via the Internet without need for electronic signatures or digital certificates —a procedure not permitted by other countries' laws.

governmental entities (for example when a citizen is moving) and for processes that involve different levels of government (local, regional, national and international).Intermediation among processes. Process flows can differ in multiple ways between one organization and another. However, the creation of common intermediation mechanisms (middleware) and the introduction of minimal adjustments can facilitate the exchange of information without a need for organizations to reformulate their procedures. These mechanisms take on the role of a translator between the heterogeneous administrative landscapes.

- Multi-channel services (provided in person, online, via landline or cellular telephony, or by fax). The ongoing technological convergence (see chapter I.B) forces government entities to offer multiple channels. In practice, this often leads to the need for gateways that provide for conversion between different channels of communication, such as call centres, help centres and special applications developed for the Internet.
- Services for the disabled. The requirement for social inclusion must be taken into consideration. This requires that the relevant mechanisms be established to facilitate such services.

(c) Technical level

The technical process is the starting point for interoperability among public entities, i.e. the source of fluid and secure information exchange over a single platform. This involves the technical elements needed to interconnect computer systems and services that allow for streamlined exchange of information, and includes basic components such as open interfaces, interconnection services, integration of data and middleware, services to ensure accessibility and security, and definition of standards and best practices. However, it is important to identify other functions that must also be adopted and implemented, such as the elements involved in administering and managing the interoperability platform, the way in which services provided by each organization are inputted, and the scheme for authorizing their use. The basic components of the e-government technical level are:

- Interoperability, security of information and protection of citizens' rights. Interoperability among public administration entities does not mean that their databases must provide unrestricted access. Privacy rights must be taken into account in any process of optimizing public administration through the use of ICT. In processing digital information, public entities must guarantee that in filing, manipulating, managing or disclosing information, they protect the basic rights of citizens. This implies a dichotomy between privacy and information access. The necessary balance and harmony must be addressed when developing e-government processes. What is required is a coherent set of standards that take account of the need to modernize public administration, while at the same time addressing the need to respect citizens' rights.

The issues of privacy and information access are fundamental, since the development of e-government must facilitate a relationship between citizens and government in which government and its organizations possess and manage information on citizens, so as to improve the services for which they are responsible and ensure interoperability at the municipal, national and international levels, while safeguarding citizens' rights.[4]

- Definition and adoption of technical standards. In using technologies designed to handle the structure and semantics of information and services, existing national and international standards must be taken into account.
- Diversity of platforms and open source code. Some of the region's countries have already established policies for the gradual adoption of open source code systems. This is important for two reasons, which might be different from the application of open source in private sector entities. First, technological platforms are based on different operating systems, databases and service-oriented architectures. The design of open source code systems permits easy and flexible interoperability among entities as needed, producing economies of scale and streamlining solutions. Second, open source code is the ultimate requirement for transparency. Citizens and watchdog groups have a right to inspect what is happening to "public" information. Only open source code can provide the kind of transparency that is required to assure that existing laws and

[4] The countries of the region have already expressed their positions regarding the elements that should be taken into account in developing the technical features of their electronic government systems. Goal 25 of the eLAC2007 plan refers to the development of policies for harmonizing regulations, "paying special attention to legislation on the protection of privacy and personal data… as a framework for the development of the information society". Likewise, the Declaration of Santo Domingo on "Good Governance and Development in the Knowledge-based Society", adopted at the Thirty-Sixth Regular Session of the General Assembly of the Organization of American States, emphasizes the use of ICT in accessing information as a basis for democratic governance. While the goals and objectives of eLAC2007 are clearly defined, is seems necessary to formulate policy guidelines on electronic government in order to address the problems of interoperability and the need to protect citizens' right to the confidentiality of their data.

regulations are rightfully implemented in digital systems. This is important even if governments maintain specialized internal oversight agencies (*quis custodiet ipso custodes?*: "who watches the watchmen?").

(d) Governance

Interoperability governance requires that there be methods for reaching agreement between public entities and private institutions involved in efforts to achieve interoperability. Governance mechanisms allow for the definition of policies, standards and financial provisions to ensure monitoring of e-government objectives. The governance process also helps to identify and establish appropriate forums for dialogue, in order to achieve consensus on the institutional, semantic and technical aspects of interoperability. The basic requirements for such governance are:

- Public goods. Interoperability solutions involve significant investment of resources and time. The technical specifications for developing the architecture and interoperability platform, data, metadata and XML schemes, e-documents, standards and methodologies, digital applications and other intermediate products constitute a patrimony of knowledge, and represent a valuable economic asset. As a result, creating an interoperable environment can be quite expensive, but efficiency calls for permitting their unrestricted use without charge, also by public entities. From a dynamic perspective, however, it is also necessary to provide an environment conducive to the development of new solutions. Funding mechanisms need to be in place that allow for continuous dialogue to create and flexibly maintain the interoperability framework.[5]
- International cooperation and economies of scale. Cooperation among countries and reuse of solutions developed elsewhere make it possible to create economies of scale on an international level. This, in turn, supports the process of automation and interoperability for the applications of all participating countries. Eventually, the interoperability solutions of all countries will have to be interconnected, especially in fields like international trade, security and other issues of global importance, such as environmental norms.

[5] Open technical standards are an example of a public good, since they can be used freely without paying authors. Another example is experience with open source code systems, which are governed by intellectual property rights and patent registries different from the traditional copyright system. Cf. chapter VII of this book.

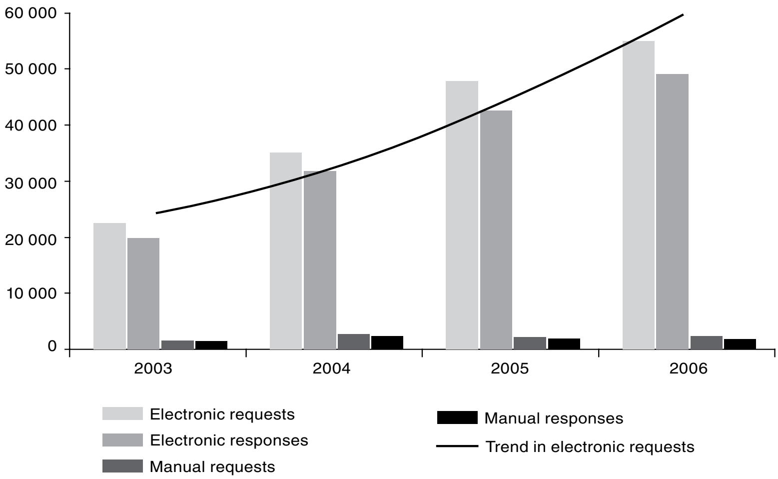
- National e-government interoperability strategies, programmes and measurement. As the analysis of best international experiences and practices shows, successful implementation of interoperability processes within or between countries requires carrying out specific projects that translate into concrete, measurable results.
- Expanding the use of electronic signatures, and of digital certificates and electronic identities. The dissemination and increasing use of information on interoperability do not depend exclusively on technical factors. The adoption of these technologies must be promoted by public employees, citizens and firms, until a critical mass makes use of the services a viable option. All too often, the bottleneck is not the lack of technological solutions, nor missing legislation, but human inertia.
- Leadership, promotional activity and clear management of interoperability. Defining the roles of each responsible party —and supervising the execution of the activities— promotes the collective effort. One attribute of governance is that each organization exercises these functions based on its own style, and in accordance with the dynamics of its institutional mission.

3. Evaluating quality of service

The essential differences between the three stages of development of e-government relate to the ability of agencies to provide services capable of meeting citizens' needs, while at the same time incorporating timely accountability (see figure IX.1). Quality of service will be the result of the semantic, organizational, technical and governance processes employed by government agencies to meet citizens' needs. The dimensions that make it possible to monitor and evaluate the quality of e-government services are:

- Effectiveness: government's compliance with its obligation to provide the goods and services that citizens need, in a timely fashion.
- Efficiency: optimization of the use of governmental resources for legally mandated objectives.
- Democracy: enforcement of citizens' rights, transparency and accountability, and supply of uniform-quality services by all public agencies, as well as efforts to encourage citizens' participation in decision-making and in the oversight of public administration (Codagnone, Boccardelli and Leone, 2006).

Figure IX.1
ACTIVITY OF MEXICO'S FEDERAL INSTITUTE FOR PUBLIC INFORMATION ACCESS (IFAI), 2003-2005
(In number of information requests and responses)



Source: Author based on information from http://www.ifai.org.mx/textos/stats.xls.

4. Interoperability governance and architecture

Since policy and governance structures differ from one organization to another, based on their respective trajectories and objectives, it is neither possible nor appropriate to impose a uniform operational pattern. However, it is possible to design an e-government architecture or strategy that can serve as a framework for developing organizational, semantic and technical standards to promote coordination and interoperability among different entities.[6]

Interoperability allows information systems and business processes to exchange data and information. When an e-government and interoperability architecture is defined, common processes (e.g. the management of rights to access information) and ways of structuring exchange of data (data and information syntax) are standardized. The programmes that manage these standardized forms of information

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6 Although it is generally recognized that e-government must be based on solid architecture, there is no precise definition for such architecture, and highly varied concepts are invoked in describing it: e-government architecture, governance and architecture, interoperability frameworks and business architecture (ITEMS International and Moreno, 2007). The workable definition offered by ANSI/IEEE (2000) is: "The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution."

exchange operate on platforms to which all government agencies have access, under security and privacy policies that ensure that information is available only to authorized parties.

Interoperability architecture for e-government includes a series of procedures, standards and guidelines that describe how public agencies establish —or can establish— mechanisms for mutual interaction (IDABC, 2004). This type of architecture takes into account three aspects of interoperability: typology, governance and operating platform (Moreno, Sin and Silveira-Netto, 2007).

B. Progress

Like all public policy, the development of e-government is the result of processes of design, execution and monitoring by one or more public entities. E-government governance in Latin America and the Caribbean is the result of centralized, shared or participatory decision-making and includes the way in which objectives and coordination mechanisms are defined, resources allocated and responsibilities designated. Governance of e-government development is centralized when it is the responsibility of a single public entity; it is shared when the responsibility is distributed among a number of agencies; it is participatory when persons or entities outside of government also take part.

1. Coordination of e-government

The organizational aspects of e-government start with the designation of the entity responsible for executing e-government policy and depend on the hierarchical and thematic location of this entity. It may be an entity reporting directly to the President of the Republic, with the allocation of responsibilities and resources for e-government occurring by presidential authority, and thus be political in nature. It may also be an entity of a more technical nature, whose purpose is to reform or modernize government functioning; in this case, it will be part of an administrative or institutional body —e.g. a ministry of science and technology, industry and commerce or telecommunications. Each alternative has advantages and limitations, related to the decision-making power and legitimation of the entity and its knowledge and insight into procedural and technological aspects.

Moreno, Sin and Silveira-Netto (2007) use the nine combinations of governance and e-government organization categories to describe the interoperability architecture of the Latin American and Caribbean countries. Their presentation is based on information from the websites of organizations responsible for e-government in 24 countries (see table IX.2).

A vertical axis locates the e-government executing agencies based on their orientation, namely: (i) a predominantly political orientation (reporting to the president or to a presidential executive office); (ii) an administrative orientation (part of a ministry or similar government entity); or (iii) a clearly technical orientation (under a sectoral ministry promoting ICT development). The horizontal axis categorizes the countries according to whether the body responsible for e-government decision-making is: (i) a single executive branch entity; (ii) a collegial group formed by a number of executive branch entities, such as ministries; or (iii) a combination of the executive branch with other branches of government or sectors of society, in the form of a commission or other such forum. The category "(0) no information" was added to cover four cases in which the websites of the entities responsible for e-government provided no governance information.[7]

Table IX.2
E-GOVERNMENT IN LATIN AMERICA AND THE CARIBBEAN ACCORDING TO TYPE OF ROLE IN POLICYMAKING AND EXECUTION

Type of organization of e-government				
Technical 3	Antigua and Barbuda	Cuba	Brazil Colombia Ecuador	Venezuela (Bolivarian Republic of)
Administrative 2	Bahamas Barbados	Jamaica Trinidad and Tobago	Argentina Costa Rica Mexico	Nicaragua
Political 1	Paraguay	Guatemala Dom. Republic Uruguay	Chile El Salvador Panama Peru	Bolivia (Plurinational State of) Honduras
	No information 0	Sole institution 1	Ministerial commission 2	Executive branch, legislature, society 3
	Type of governance involved in defining e-government			

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on Hernán Moreno Escobar, *El fin del gobierno electrónico*, 2007.

In most of the region's countries, e-government policymaking (the horizontal axis) is the exclusive domain of the executive branch of the State, and only four (Bolivarian Republic of Venezuela, Honduras, Nicaragua and the Plurinational State of Bolivia) include non-governmental entities. Six of the 24 countries (Cuba, Jamaica, Trinidad and Tobago, Guatemala, the Dominican Republic and Uruguay) have a single e-government policymaking entity, while ten (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Mexico, Panama and Peru) have interministerial arrangements.

[7] For detailed information, see Moreno (2007).

In 10 countries those entities report directly to the president (type 1) (Chile, Dominican Republic, El Salvador, Guatemala, Honduras, Panama, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay,). In eight they are administrative in nature (type 2) (Argentina, Bahamas, Barbados, Costa Rica, Jamaica, Mexico, Nicaragua and Trinidad and Tobago). Their nature is rather technical in six countries (Antigua and Barbuda, the Bolivarian Republic of Venezuela, Brazil, Cuba, Colombia and Ecuador).

Leaving aside the four countries whose websites do not publish governance information, table IX.2 shows clearly that there is a great deal of diversity in ways of formulating and executing e-government policy (9 groups).

According to the "web measurement index" of the *Global e-Government Readiness Report 2005* (UNPAN, 2005c), which assesses the sophistication of specific e-government websites, five countries of the region were ranked among the most advanced 31 countries worldwide. These were Chile (ranked 6), Mexico (12), Brazil (17), Argentina (27) and Colombia (31). In these five countries, e-government issues are overseen by a ministerial group, and there is a shared system of governance. An analysis of the institutional aspect of e-government execution indicates that Chile's entity reports to the President, Mexico's and Argentina's are administrative and Brazil's and Colombia's are technical in nature. Thus, shared governance can produce positive e-government results in the region regardless of what type of entity is responsible for executing it. In the 2008 version of the same United Nations report (UNPAN, 2008), the most advanced countries of the region included Mexico (14), Brazil (30), El Salvador (32), Peru (34), Chile (35), Argentina (36) and Colombia (38). It is characteristic that all of those countries can be found in the ministerial commission group. This seems to reconfirm the intuitively plausible logic that a stable and all-embracing e-government structure needs to be based on a shared governance structure that considers the needs and contributions of all agencies inside the executive branch. It is also interesting to note the abrupt drop of Chile's ranking (from world rank 6 to 35), which can partially be explained by the political nature of its e-government strategy (see table IX.2). This indicates the benefits and threats of this governance option: in times with much political support, the e-government agenda is able to make outstanding progress, while a period of lacking political support can quickly turn attention to other areas of interest.[8]

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[8] During 2006 to 2008, the Chilean government was struggling with a major change in its public transportation system, which captured most of the attention of policy makers that would otherwise have continued to concentrate the State modernization process.

2. Some specific e-government applications

This section presents examples of improvements that have been achieved in transparency, observance of privacy for personal information, use of electronic signatures and cost reduction in public administration.

Reducing costs in the public sector improves efficiency, with positive effects on costs in the private sector, where less time is then needed for bureaucratic procedures. Reducing information asymmetry leads to greater transparency and better controls. There is less room for conflicts of interest and corruption in government agencies, while wise investment of public resources is encouraged.

Public administration operates under a system of oversight that requires public entities to account periodically for their actions. Nevertheless, some public employees may have incentives for not properly informing the public —which ultimately is responsible for overseeing their activity.[9] The following sections present five examples of how e-government increases transparency and efficiency in Latin America (Suárez and Laguado, 2007):

(a) Citizen oversight of public administration in Mexico

Mexico's federal law to promote transparency and access to information in government entered into effect in June of 2002, at the same time that the Federal Institute for Public Information Access (Instituto Federal de Acceso a la Información Pública, or IFAI) was established. The new legislation required over 250 government offices and agencies to publicly provide information on their budgets, targets, performance and pay, and created a mechanism for reviewing the activities of offices and institutions that fail to do so.[10] The programme has effectively protected public interests and has enhanced the efficiency with which information is provided: 89% of the 169,364 requests for information received between

[9] Corruption is reflected in the excessive costs built into government contracts in various developing countries. For example, Paraguayan government contracts bear the burden of an additional 21.8%, Colombia's an additional 15.9%. Peru's 15.8%, Ecuador's 14.4%, Ghana's 8.3% and Sierra Leone's 8.5% (OECD, 2004c and OECD 2005a). Ultimately, no oversight mechanism will be effective if citizens do not view themselves as being in a position to oversee the functioning of government.

[10] "There shall be available access to information which, under Article 7 of the Transparency law, is required to be published by all agencies and departments of the federal executive branch, as well as by the legislative and judicial branches and autonomous entities. This provision falls under the rubric of 'transparency obligations', which apply to the organizational structure of covered entities, and to the authority, goals, objectives and services of their administrative units, the management and monthly remuneration of their public servants, the addresses and telephone numbers of their liaison units, information on their allocated budgetary resources, results of audits conducted, reports mandated by law, etc." (http://www.ifai.org.mx/test/new_portal/acceder.htm).

January 2003 and December 2006 were responded to appropriately. Figure IX.1 shows the increase in information requests by citizens, and the effectiveness of the response system.[11]

(b) Protection of personal information

In most of the world's countries, constitutional law and regulations govern the protection of personal information. Despite significant differences, the right to privacy and confidentiality is considered a fundamental right that, in the absence of adequate protections, could be jeopardized by the free circulation of information (Dempsey and others, 2003; Haro, 2000; Cifuentes, 1997).

As part of its project to assess the economic dimension of e-government, the European Commission (2006) stressed the importance of protecting personal information and privacy for the development of e-government, and recommended revising relevant national legislation, since issues in this area could be a serious obstacle to establishing common indicators of e-government performance. In order to ascertain citizens' confidence in their governments' management of personal information, the European Commission created new follow-up measurements and indicators, such as the percentage change in the "number of users who express satisfaction with the management of security and privacy on government websites" (indicator 72).

Beginning in the 1970s, when e-government first appeared in Latin America and the Caribbean, at the "bureaucracy and ICT" stage, privacy and confidentiality provisions were created in a number of the countries' constitutions. This marked the beginning of a period of special legislative interest in creating guidelines on the protection of personal information that entered electronic files often not accessible to the individuals whose information was being archived. In the near future, as e-government reaches the "bureaucracy, ICT and interoperability" stage, it will be possible for different government agencies within a country, and even those in different countries, to exchange such information.

In the developed countries, this new mode of communicating personal information led to the creation of new instruments and institutions (Bali, 2007).[12] With the growth of the Internet, more attention was devoted to the protection of personal information. In 1995, the

[11] The entities that received the greatest number of information requests, in order of number of requests, were the Mexican Social Security Institute (IMSS), the Secretariat of Health, the Secretariat of Transportation, the Secretariat of Communications, the Secretariat of the Environment and Natural Resources, and the Secretariat of the Treasury and Public Credit (http://www.ifai.org.mx/textos/stats.xls).

[12] Examples of privacy mechanisms are the Younger Committee on Privacy in the United Kingdom and, in the United States, the Data Privacy Act.

European Union defined standards for the confidentiality of personal information, underlining the importance of democratic governance in the cross-border flow of personal information, viewing this as a reflection of the development of e-government in each country.

Online access to government applications poses the problem of how to ensure that citizens will be able to control the flow of information to prevent improper use of their personal data. Responses to this have taken the form of legislation to protect the privacy of personal information, i.e. "the set of principles, rights and guarantees established to protect persons who could be harmed by the treatment of personal data relating to them, in order to ensure a balance of power and democratic participation in information and communication processes by a discipline governing systems for obtaining, storing and transferring data" (Bali, 2007, based on Pérez Luño, 1989).

In the international context, the right to the privacy of personal information applies to all information that describes a person's physical, physiological, psychological, economic, cultural or social identity.[13] International provisions also seek to provide guarantees regarding the treatment of such data, i.e. "any operation performed upon personal data "whether or not by automatic means, such as collection, recording, organization, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, blocking, erasure or destruction" (Bali, 2007).

Mechanisms for the protection of "sensitive data" in some of the region's countries reflect different definitions, scopes and levels of protection (e.g. in Argentina, Chile, Colombia, Paraguay and Uruguay). It is not easy to ascertain a priori what information applies to an individual's private life. The definition of private information depends on cultural, religious, political and economic factors (Remolina, 2005). Nevertheless, there is agreement that sensitive data occupy a special status, and are subject to greater restrictions and prohibitions than simple personal data Such restrictions or prohibitions may be suspended when some legally recognized public interest is affected, or in extreme situations where the life and health of the person in question is at risk. These exceptions are justified on the basis that the right to privacy is not absolute, and can be flexible under certain circumstances, depending on the purpose involved in the handling and disclosure of the information.

Another important factor is consent to the compilation of the information by the person in question, especially when this affects some right of that person (Remolina, 2005). Consent makes it possible to establish the boundaries between the right to privacy and the right to information,

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13 This legal model, which is the law in Europe, has been increasingly adopted in other countries' regimes, including those of some Latin American countries, such as Argentina.

which creates the obligation to disclose and use the data possessed by the government entities involved. Even when such consent is present, there are provisions limiting the cross-border transmission or transfer of information.[14]

In summary, technological progress and expanding interoperability in e-government projects have generated strong interest in protecting personal information and in restricting its transfer, both domestically and internationally. The consent of the person to whom the data refer is considered essential, barring exceptional circumstances —with such exceptions typically specified in the authorities assigned to government agencies, and with exceptions provided to allow for the proper functioning of government and for the protection of human life and health.

(c) Electronic signature

Signatures are a tool that build trust by demonstrating an individual's physical presence and role in creating a document —whether in a personal or official capacity— as well as the individual's intent with respect to the document's content. A signature plays a number of legal roles in reflecting the will of a physical person or public servant:[15] it provides a link between the signatory and the document, proves that the person has been involved in its content, as well as in signing it, vouches for the content, specifies the place and time of signing, establishes obligations, demonstrates a signatory's belief in the importance of the document, and demonstrates the person's consent and oversight.

A digital or electronic signature consists of a set of electronic data used to create security and build trust for purposes of commerce and electronic communication. In its most advanced and secure form, which generates the greatest trust, its function can be compared with that of a safe deposit box with two separate combinations or secret passwords that are required for access. One is known only to the owner of the box, the other to other authorized parties. Should an unauthorized person decipher the external combination, the box may be opened, but nothing can be taken from it, since the internal combination is still lacking.

The frame of reference for adopting electronic signatures in the European Union establishes three types of signature with different levels of legal validity (based on the work outlined in European Union Directive 1999/93/EC of December 1999):

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14 Since it is not absolute, the right to the protection of personal information must be somewhat flexible when "other fundamental rights such as information or effective judicial protection, or constitutionally protected public interests such as government transparency, health protection, national security and other legally defined issues of public interest, are involved" (Ibero-American Data Protection Network, 2005, p. 6).

15 ADB/IDB/IBRD, 2004, p. 6.

(i) An electronic signature, also known as simple electronic signature, consists of “data in electronic form which are attached to or logically associated with other electronic data and which serve as a method of authentication”. This type of electronic signature can be used to identify the signer. An example of this is the combination of “username” and “password” that applications employ to authorize access to a system. Each authorized user has a unique combination that is equivalent, in practice, to an electronic signature. The authentication program establishes that the person attempting to gain access is presenting a valid electronic signature, but it cannot determine whether he or she is the person who originally was granted the right to access the system.

(ii) Advanced electronic signature is associated exclusively with the signer and can identify the individual. It is created in such a way that the signer can maintain exclusive control over it, and it is linked with the data accompanying it. Any change in the data can be detected. Advanced electronic signature guarantees the integrity of the text that accompanies a signature, as well as the authenticity of the signature itself.

(iii) Certified advanced electronic signature is based on certification by a qualified authority employing a secure mechanism to create signatures. The strong advanced electronic signature, also known as strong digital signature or secure digital signature, is based on standards and optimal practices defined by an advisory committee to the European Commission (Electronic Signature Committee).

An ECLAC study analysing the use of electronic signatures in electronic government procurement in 16 Latin American countries in the August-October quarter of 2006, as well as their laws on the use of electronic means of authentication and identification (Moreno, 2007), concluded that in 2007:

- Only one country (Brazil) uses certified advanced electronic signature, while two others (Costa Rica and Mexico) use advanced electronic signature.
- Simple electronic signature is used in Argentina, Chile, Ecuador, Guatemala, Peru and Uruguay.
- The Bolivarian Republic of Venezuela, Colombia, Nicaragua and Panama the have electronic signature legislation, but do not yet use it in their electronic government procurement systems.
- El Salvador, Honduras and Paraguay have no legislation in this area.

The use of electronic signatures is still in the formative stage in the region. Coordination is needed so that citizens and government agencies in one country can execute transactions with parties in another country, with the same security and trust guaranteed for both parties. The variety of existing types of electronic signature represents a serious obstacle to interoperability in e-government.

(d) Public sector procurement

One of the most efficient uses of ICT to improve the transparency of public administration is in public procurement. The well-known risk is that government officials will collude with vendors and purchase goods of lower quality, or at a higher price, than would result from honest negotiation. The use of ICT —particularly the Internet— for government contracting with providers of goods, works and consulting services has contributed to reducing collusion and diversion of funds, making government contracting faster and more efficient, and reducing the cost of goods and services.

Table IX.3 shows the savings generated by electronic procurement in Brazil's COMPRASNET system. Analysis of these data shows that there was extensive opportunity for corruption before the system was implemented. The table shows that in 2005, for example, the government was able to procure all required goods and services for 28% less than the initially budgeted BRL 4.7 million, which is the equivalent of US$ 600 million in savings in only one year. Under the current system, all participants (citizens, officials, providers and oversight bodies) have access to more precise and timely information online, leading to an optimization of supply and demand by digital means.

COMPRASNET is a procurement website created by the Ministry of Planning, Budget and Management. It publishes information on federal government contracting and promotes the development of electronic contracting. Along with these executive functions, COMPRASNET automates various administrative stages of the contracting process, using electronic systems to carry out operations that previously required paper documents. Its task includes the release of a catalogue of goods and services, publication of reference prices, furnishing records of framework agreements regarding reference prices, providing an electronic channel of communication between purchasing entities and officials, making electronic requests for price quotes, and sending information to the official government record (*Diario Oficial de la Unión*) for publication.

Table IX.3
COMPRASNET: SAVINGS IN ELECTRONIC AUCTIONS IN RELATION TO ESTIMATED BUDGETS, 2002-2006
(In BRL millions, and in percentages)

Year	Authorized amount [a]	Budgeted amount	Savings	Percentage saved
2002	70	95	24	26
2003	187	242	55	23
2004	534	777	242	31
2005	3 384	4 678	1 293	28
2006, first half	2 238	2 819	581	21

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the Ministry of Planning, Budget and Management, Secretariat of Logistics and Information Technology, Department of Logistics and General Services, *Os sistemas eletrônicos de compras públicas do Brasil*, quoted in G. Suárez and R. Laguado, *Hacia la transparencia en la contratación pública*, 2007.
[a] The lowest price quoted in an electronic auction or other form of bidding.

COMPRASNET is an example of all stages —informational, interactive and transactional— of public e-contracting, and represents an advance towards integrating systems. In addition to the informational role that it plays vis-à-vis citizens and providers, the website runs the equivalent of a reverse electronic auction, and has introduced a simplified process for the procurement of low-value goods (see tables IX.3 and IX.4).

Table IX.4
INDICATORS OF THE IMPACT OF COMPRASNET

Total of goods and services contracted through the Integrated General Services Administration System (SIASG) (2005)	BRL 20.7 billion (US$ 9.7 billion)
Number of purchasing units in the SIASG (2005)	2 171
Amount contracted via auction (first half of 2006)	BRL 2.2 million (out of BRL 7.7 million)
Number of electronic auctions (first half of 2006)	6,974 (Between 2001 and 2005, the number of electronic auctions in the first six months of the year tripled.)
Electronic auctions as share of total contracting	28%
Public bidding published in the COMPRASNET System for Electronic Posting of Purchases (SIDEC) (first half of 2006)	16 000 versus 10 000 in the *Diario Oficial de la Unión*
Visits to COMPRASNET per hour	Maximum: 670
Maximum number of daily transactions on COMPRASNET	850 000
Savings generated by the auctions (2006)	20% of the reference value of the goods/ services
Suppliers registered in the Unified System for Pre-registration of Suppliers (SICAF) (2005)	235 098
Contracts processed by SIASG (2005)	320 000

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the Ministry of Planning, Budget and Management, Secretariat of Logistics and Information Technology, Department of Logistics and General Services, *Os sistemas eletrônicos de compras públicas do Brasil*, quoted in G. Suárez and R. Laguado, *Hacia la transparencia en la contratación pública*, 2007.

ChileCompra is an advanced interactive and transaction-enabling information system for electronic government contracting, and is used by all government agencies in Chile. Although traditional media may be used in certain cases, all phases of the public, private and direct bidding process are generally required to be conducted through ChileCompra. Law 19.886 extended this universal mandate to the universe of providers, all of whom are now required to bid exclusively through the system.

ChileCompra is the official mechanism for publicizing the procurement process. It also provides notification of action taken on the administrative end of the contracting process. It includes a registry of providers (ChileProveedores), with which individuals or firms wishing to do business through the system must register. This serves two purposes. First, it accredits providers as users of the system, enabling secret passwords that function as (simple) electronic signatures, allowing them to take action and express their intentions electronically. The second one is an additional service, for which it charges a fee. It provides accreditation and verification of legal information on the providers (financial standing and tax status, copies of company by-laws, powers of attorney and identity documents). It also determines whether providers are qualified to participate in the procurement process and to contract with the government. This alleviates a provider from repeatedly submitting the documentation normally required for government contracts. When initially registering with ChileProveedores, a provider presents documentation in physical or electronic form. The system then systematizes and classifies the information and produces a Unique Electronic Provider's Certificate, which purchasing entities can consult if they wish to verify legal information about the provider. Table IX.5 shows the variables that track the impact of ChileCompra.

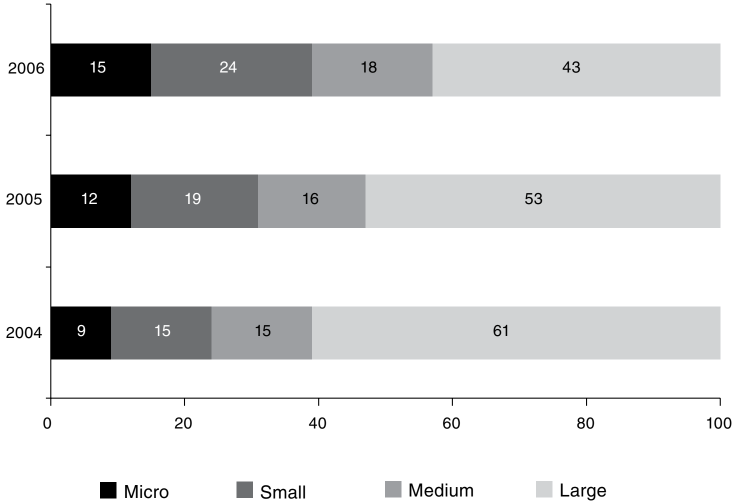
One advantage of the ChileCompra system is its benefits to smaller firms, since the barriers of entry to the procurement process are lowered by the decreased cost of participation. According to the Santiago Chamber of Commerce, the system increased the proportion of transactions involving micro, small and medium enterprises (MSMEs). A full 15% of the total purchased in the first quarter of 2006 was sold by microenterprises, 24% by small firms, 18% by medium-size firms and 43% by large firms (see figure IX.2). In all, MSMEs represented 57% of total transactions, or 10 percentage points more than in the same period of the previous year.

Table IX.5
INDICATORS OF IMPACT OF CHILECOMPRA

Chilean government contracting market	US$ 2.5 billion
Purchasing entities registered in the system	900 (100% of public entities)
Suppliers registered in the system	200 000
Suppliers in the market	200 000
Registered firms that actually bid through ChileCompra	35%
Average supplier participation (%)	1.7% before the reform 6.5% after the reform
Total transacted via ChileCompra	US$ 1.573 billion
Total of ChileCompra Express transactions	US$ 64 million
Products registered with ChileCompra Express	114 000
Number of purchase orders processed in the system	660 000
Savings generated by increased efficiency in public contracting	US$ 14.3 million
Savings through better prices (%)	7% (US$ 80 million)
Savings through better prices due to the use of framework agreements (%)	14% (US$ 5 million)
Number of business opportunities (monthly average) publicized through the system	434 152

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on G. Suárez and R. Laguado, *Hacia la transparencia en la contratación pública*, 2007.

Figure IX.2
SALES OF DIFFERENT SIZED FIRMS AS A SHARE OF CHILECOMPRA TRANSACTIONS
(In percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the Santiago Chamber of Commerce, report of May 31, 2006, quoted in G. Suárez and R. Laguado, *Hacia la transparencia en la contratación pública*, 2007.

(e) Impact of e-government at the subnational level

The use of e-government instruments in the state of São Paulo (Brazil) exemplifies the benefits that can be generated at the subnational level. The State of São Paulo, which was one of the first subnational administrative entities in Latin America to implement an e-government strategy, was also a pioneer in assessing the economic effects of this modernization process. The savings generated by technological and process innovation in 10 e-government programmes totalled over US$ 9 billion (Ferrer, 2006). This represents annual savings of US$ 1.727 billion, or roughly 1% of the state's GDP and 6% of its annual budget (see table IX.6).[16]

Table IX.6
SAVINGS GENERATED BY E-GOVERNMENT PROGRAMMES
IN THE STATE OF SÃO PAULO

Government programmes	Period	Savings (millions of dollars)	Average annual savings (millions of dollars)
Registry of subcontracted services	Jan/95-Jan/06	5 797	527
Auction (*Pregão*)	2003-Mar/07	2 169	789
Automobile ownership tax (IPVA)	2003-Jan/07	775	251
Automobile registrations and *Poupatempo* ("time saving") programme	2003-Aug/06	183	69
Electronic procurement system (Bolsa Electrônica de Compras, or BEC)	2000-Mar/07	192	31
Electronic issuance of drivers' licences	2001-Aug/06	124	22
Certification of/absence of criminal record	2003-Aug/06	82	22
Citizen ID	2003-Aug/06	53	14
OpenOffice software in Metro offices	1999-Aug/06	4	1
Electronic complaints	2004-Aug/06	2	1
Total		9 380	1 727

Source: Updated data from *Consultora Estratégia Pública*, based on information published in *O Relógio da Economía*, online at: www.relogiodaeconomia.sp.gov.br.

These programmes involve the use of computer applications in the São Paulo government as a means of improving citizen services and administrative processes. The registry of subcontracted services, which can be consulted online, consolidates information on all government contracts with third parties, thus facilitating the handling of contracts, as well as providing useful information for future contracts with providers. The electronic procurement (BEC) and auction (*pregão*) system processes government procurement of goods and services, streamlining the

[16] Figures are calculated on the basis of information from the Brazilian Geographical and Statistical Institute (IBGE) and the Secretariat of Economy and Planning of the State of São Paulo, using as a baseline the state's 2003 GDP (equivalent to US$ 226.979 billion) and its 2004 budget (equivalent to over US$ 30.058 billion).

procedure and increasing transparency. Some citizen transactions (payment of automobile taxes and issuance of vehicle registrations) have also been improved. Priority was placed on computerizing certain services that are of major importance to the population, such as the provision of identity cards, certificates of lack of criminal record, and drivers' licences. Given the magnitude of the savings provided by these programmes, it would be instructive to perform an analysis to determine the extent to which the incorporation of ICT in governmental processes plays a contributing role.[17]

The simplified vehicle registration process, as a result of computerization, generated an 89% reduction in the cost to the Government for each such transaction (US$ 6.80), with correspondingly lower costs to citizens. The total savings, for 24 million transactions, were on the order of US$ 160 million. Another example of improved efficiency is the procedure for providing certificates of lack of criminal record, which formerly took from 2 to as long as 30 days, and required the citizen to appear in person at certain offices. The *Poupatempo* ("time saving") programme, which was implemented in 2006, enables citizens to access the website of the State Secretariat of Public Security and request the certificate online. The request form is completed and submitted via the Internet, and the entire process takes place on an electronic platform. If there is no criminal record, the programme instantaneously issues a certificate that can be printed by the user. The cost of providing these certificates has dropped by 99.7% as a result of a reduction in infrastructure and personnel needed to service the public.

These data demonstrate the potential of digital applications for the provision of public services at the subnational level. In addition to these gains, there are a number of benefits that are more difficult to quantify, including the reduced amount of time needed to carry out formalities, improved service, and increased well-being for citizens —all of which are associated with these changes.

3. Local e-government

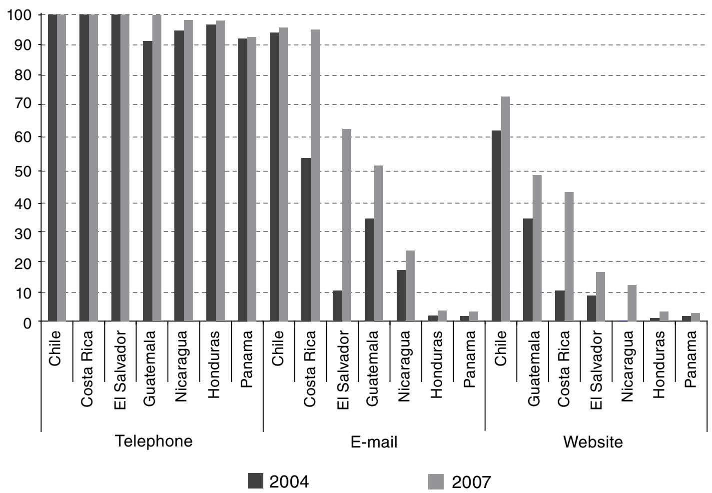
Citizens have closer contact with local government than with other levels of government. Therefore, municipalities play an important role in the comprehensive programme to modernize public administration. The mentioned challenges of interoperability and the potential gains in efficiency and transparency are relevant to all —including municipal—

[17] The results of the savings generated by the government of the State of São Paulo, due to implementation of modernization measures and e-government programmes, are publicized through a technological tool called the *Relógio da Economia* ("savings clock"), which reflects the difference between the cost of the traditional processes and that of the modernized ones, reporting periodically on savings to the state and to society. See: http://www.relogiodaeconomia.sp.gov.br/.

levels of government. Given the dispersed nature of local governments, one of the main challenges is the continuous financial challenge to maintain an up-to-date ICT infrastructure throughout the country. Below is an examination of a number of advances in connectivity and in the content of e-government in the region's municipalities.

Connectivity facilitates local governments' relations with the central government, as well as its ability to provide services to its citizens. In 2007, almost all of Latin America's local governments provided telephone services (see figure IX.3). Use of the Internet, however, lags behind, despite the advances made in recent years in some countries, such as El Salvador and Guatemala, where over one half of municipalities saw a significant expansion of their e-mail coverage between 2004 and 2007. Though Chile and Costa Rica have the highest levels of municipal connectivity, their less populous municipalities have few websites, and fewer of their employees have access to e-mail. The type of Internet connection used is also important, since it determines the municipalities' ability to offer online services and applications. In Chile, 47% of municipalities have dedicated Internet access lines, and 25% use broadband ADSL, allowing them to be continuously online. Although information is lacking on the other countries' municipalities, it is estimated that the majority lack broadband (OSILAC, 2007b).

Figure IX.3
AVAILABILITY OF TELEPHONE, E-MAIL AND WEBSITES IN THE MUNICIPAL GOVERNMENTS OF SELECTED COUNTRIES (APRIL 2007)
(In percentages)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on information published on websites of national entities.

Note: Number of municipalities: Costa Rica: 81; El Salvador: 262; Guatemala: 331; Honduras: 297; Nicaragua: 153; Panama: 75.

The creation and maintenance of a functional website is the next step in the evolution of local e-government. Despite advances made since 2004, fewer than 15% of municipalities in El Salvador, Nicaragua, Honduras and Panama had a web presence in 2007, and local governments lack a common strategy regarding websites. In some countries, such as Chile and Colombia, most municipal web pages have their own URLs, which is often based on a readily available website packet that is offered by the national government. This solution not only helps local authorities to set up their first website but also leads to economies of scale, resulting in nationwide financial savings and an informal standardization of the design of local websites. This last point facilitates the life of citizens that move around and prepares for the inevitable challenge of establishing an interoperability framework among municipalities. In other countries, municipalities' online presence depends on private initiatives by civil society or NGOs, which link them to the websites of other institutions (OSILAC, 2007b). In these cases, the municipal web pages coexist with those of third parties.

Progress in this area is conspicuously uneven, varying as a function of the municipalities' populations. There is a pronounced gap between those with over 10,000 inhabitants and those with less. For example, in 2007, 63% of municipalities in El Salvador had e-mail. This figure was 72% for municipalities with over 10,000 inhabitants, and 52% for those with fewer than 10,000 inhabitants. The situation was similar with respect to websites: in Chile, 82% of municipalities with populations over 10,000 had web pages, while this figure dropped to 52% for the other municipalities (OSILAC, 2007).

C. Conclusions

The region's governments are conscious of the need to modernize their management, and realize that ICT can be a useful instrument for achieving this. Nearly a decade after the first e-government projects began, there have been significant results in some countries.

The three benefits of e-government include improvements in effectiveness, efficiency and transparency.

Effective public administrations follow and implement existing laws in a way that minimizes the burden on citizens. Rules and regulations have to be followed, but wait times and formalities can be minimized by digital means. There is often no need to use the citizen as a vehicle for transporting papers from one authority to another and most regulatory requirements can be implemented internally, without the need for involving the citizen.

Efficient public administration reduces the cost of the required processes. An initial investment is necessary to install digital systems to adjust organizational processes and to retrain civil servants, but the potential cost-savings are clearly superior to this initial cost.

Transparency of public administration. Digital transparency not only limits opportunities for corruption (and therefore contributes to the efficiency goal) but also provides legitimacy and accountability to the executive branch of the State, which leads to trust and confidence and is an important building-block of the democratic State that is based on the rule of law.

Chapter X

Business

ICT are transforming economic activities by increasing the efficiency of firms' production processes through the creation, dissemination, accumulation and exchange of information and knowledge. Electronic business is not limited to the marketing of products and services over the Internet (e-commerce), but, rather, constitutes a comprehensive strategy designed to digitize business, with the goal of maximizing the value of the client and the profitability of the business, by optimizing internal and external processes through the use of ICT. This approach has rapidly been adopted by firms in various economic sectors, and plays an ever larger role on the world stage. Thus, ICT use has become a prerequisite for competitiveness in many economic activities, especially where globalized markets are involved.

This section describes the status of electronic business (e-business) in Latin America, examining its nature, the conditions surrounding its development and the practices of some of the region's firms in this regard.

A. General context

Electronic business strategy attempts to improve business process management and through the digital institutionalization of information flows and coordination, reduce uncertainty and strengthening control over administrative and productive processes, while at the same time increasing their flexibility. It becomes a source of value by optimizing marketing and communications channels that link firms with clients and providers. This approach employs a combination of technologies to store, translate, exchange and process large quantities of information in real time relating to different aspects of the business. It includes applications such as supply chain management (SCM), customer relationship management (CRM), business intelligence (BI), knowledge management (KM) and enterprise resources planning (ERP).[1] ERP digitizes the heart of the firm, connecting its SCM on the incoming side of its providers with the CRM on the outgoing side of its customers. ERP generally plays the most important role for firms, can create a virtuous circle of increasing productivity and investment in other specific applications for each business process (Aral, Brynjolfsson and Wu, 2006).

These types of software are complementary, and interoperability among them is the basis for synergy between the different components of an enterprise. There are many solutions for different types of components, varying in size, functionality and price. All are designed to achieve comprehensive computerization of information processes within a firm and between it and other firms. They can be adapted to units of different sizes in different types of markets, and to differing business customs in various parts of the world.

These information systems are connected to closed networks (electronic data interchange, or EDI) or open ones (Internet) and facilitate relations between different business areas. Digitizing information and communication processes between economic agents opens the door to coordination mechanisms operating on networks characterized by: real time communication; the non-rivalry nature of digital information; the abundance of means to work with text, voice and images (moving, as well as static); the possibility of opting for synchronic or asynchronic communications; and the multidirectional nature and functionality of one-to-one, one-to-many, many-to-one and many-to-many communication through the same channel. Thus, the digital economy is organized differently from the unconnected economy, in that it reduces information asymmetry, increases control and accuracy in negotiation, and accelerates coordination between different agents.

Available evidence suggests that the digitization of economic transactions significantly reduces the cost of marketing and coordination for firms in developed countries. These benefits have long been detected. For example, the cost of a banking transaction via the Internet in 1998 was approximately US$ 0.01 —and as much as US$ 1.07 when conducted at a bank branch (United States Commerce Department, 1998). Costs have been reduced sharply in the air transport industry, as well. Computerized

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[1] ERP is a management information system that integrates and manages production and distribution operations, as well as administrative processes, so as to optimize them.

reservations systems used by travel agencies cost the airlines approximately US$ 8 per reservation, but this cost drops to US$ 1 when clients make reservations directly with the airline.[2]

Digitizing information processes not only reduces costs in current business models, but also involves changes in the organization of markets. It can be expected to have two opposite effects. It will increase the capacity for internal control and strengthen firms' hierarchical structure by broadening its reach of control and incorporating a greater number of productive processes (Williamson, 1981 and Stiglitz, 1987). At the same time, it will reduce transaction costs between agents, which will facilitate the management of productive chains between firms, as well as the outsourcing of internal processes not directly related to a firm's basic business. Consequently, it could contribute to reducing the optimal size of firms, which would operate through a network of small autonomous agents whose activity would be coordinated in real time. The first argument advocates digitization of control mechanisms and therefore for the emergence of much larger firms. The second argument suggests the digitization of coordination mechanisms between firms and therefore for the existence of small firms, which are independent but tightly coordinated in flexible networks. Today, both phenomena can be observed in different industries.

In addition to these effects, which have already been seen at the operational level within firms, there are effects of a different type. First, digitization can increase costs by generating an excess of information. This requires firms to devote more and more resources to information processing, until their structures adapt to the new system (Cordella and Simon, 1997; Cordella, 2001). This process of adoption is at the heart of every innovation and has been coined with the catchword "creative destruction" by Joseph Schumpeter. Second, the digitization of commercial transactions in developing countries could lead to a loss of markets for local producers unable to compete with the online products offered by their virtual competitors in the developed world (Hilbert, 2001). Online channels conveniently open the door for ready-to-use business-to-customer services (B2C, like Amazon) as well as transparent business-to-business activity (B2B). of course, this also accounts the other way around, as firms in the third world are able to offer their products worldwide. However, experience shows that providers in the developing world have difficulties in competing with global leaders from the North (with notable exceptions confirming this general rule). The resulting negative trade balance could outweigh the cost reductions generated by digitizing sales transactions online. Third, in an environment in which buyers act with

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2 Thus, it is not surprising that as of the end of 2007, the International Air Transport Association (IATA) decided to eliminate all paper ticketing among its member airlines.

limited rationality and sellers manifest opportunistic behaviour, online transactions may prove more costly because of the uncertainty involved in acquiring an unknown product (Kazumori, 2003). Fourth, digitizing operations may create a supply of —and demand for— a greater variety of products, since the cost of finding them in the marketplace is reduced (Brynjolfsson, Hu and Simester, 2007). This creates new market niches. Finally, besides reducing costs, digitized transactions can generate non-quantifiable benefits for users, such as the increased convenience that comes with the possibility of purchasing airline tickets or making banking transfers at any hour of the day from any location.

It is difficult to weight the effects of all of these factors. However, although any modernization involves an adjustment period and can affect efficiency in the initial stage, for the medium and long term, digital methods of doing business can be expected to be more efficient than traditional ones.

The incorporation of ICT in the business sectors of developed countries began with the systematization of internal processes (see recount in European Commission, 2002-2007). With the growing presence of computers in the 1980s, firms began to computerize their administrative processes (accounting and finance, human resources management, resource planning and optimization), in an information-management model that generated intangible assets (Brynjolfsson, Hitt and Yang, 2002). The first interfirm networks were administered by large firms that created their own networks of clients and providers in their own area of business. The rise of the Internet produced an abrupt decline in the cost of interconnection, eliminating the need for private networks. The creation of different types of electronic market websites led to electronic products and services transactions, or e-commerce. This developed at a dizzying pace because of its ability to reduce marketing costs, increase market transparency, optimize intermediation between supply and demand and facilitate access to new markets (Laseter and others, 2007). Connecting internal management systems with interfirm networks led to a gradual integration of internal and external processes through the convergence of information management systems. Thus, as the use of these technologies is extended to more business processes, the demand for a particular product on behalf of the business's client is directly connected with the provider's supply side of the firm. The result is a virtual digitization of supply and demand in an ever more fine-tuned process of adjustment in real time. Value is created by increased efficiency in managing the production chain, by optimizing quality and by reducing prices through intelligent management of resources and knowledge.

The financial sector was one of the first to incorporate these technologies (with the ever-changing prices of the stock market reflecting the digitized adjustment of supply and demand), and the securities markets were the first electronic market to function in real time (European Commission, 2002, 2007). Other, less advanced sectors of the economy were forced to adapt to the inevitable trend of digitizing information and communication processes —reflecting the practical superiority of the bit as the most efficient way to present information (see chapter I). Other information-intensive sectors (notably, tourism services, retail sales and air transport) are progressing rapidly in computerizing and automating their processes.

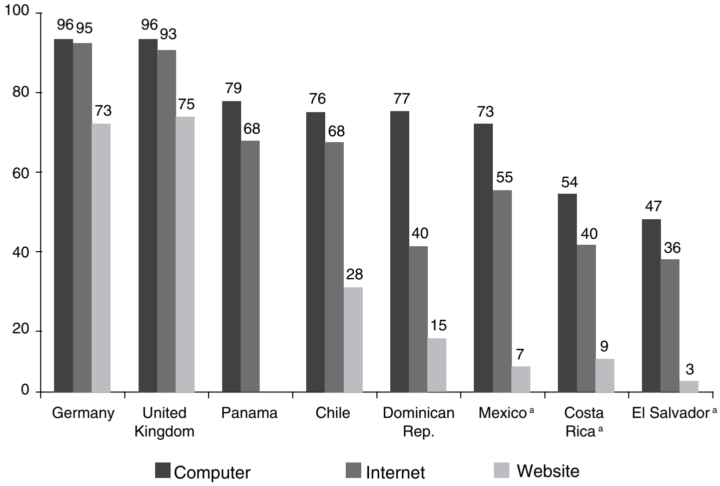
B. Progress

The evolution of electronic business in the developed countries has been extensively studied,[3] though the same cannot be said for the Latin American and Caribbean nations. Surveys of the region's business community have shown that the emerging e-business culture has positive effects. Latin American firms recognize the positive changes that have come about through the incorporation of ICT, principally in terms of customer satisfaction, cost reductions and increased revenue. Seventy percent report that customer satisfaction has risen by an average of 32%; 45% have achieved cost reductions averaging 15%; and 32% have increased their revenue by an average of 11% (Cisco Systems/ICA, 2005). They also recognize the potential for small and medium-sized enterprises to move into new niches and markets (Ueki, Tsuji and Cárcamo, 2005). Below is an examination of some of the progress that has been made to date, and the associated empirical evidence available.

Figure X.1 shows that already by the mid-2000 firms with over 10 employees in various Latin American countries had almost closed the digital divide with firms in developed countries, when the divide is defined in terms of Internet availability (80% versus 90%). The gap between the two groups of countries in the adoption of ICT relates, rather, to the amount and quality of computers and services in each firm, and to the effective use of network solutions such as websites and the Internet.

3 Between 2002 and 2007, the European Commission published an annual report on e-business in Europe, including information on its use by firms, as well as the challenges and obstacles that it creates (European Commission, various years).

Figure X.1
USE AND AVAILABILITY OF INTERNET BY FIRMS IN SELECTED COUNTRIES, 2006
(In percentages)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on surveys of Latin American firms with 20 or more employees, and EUROSTAT surveys of such firms in European countries; Panama: DIGESTYC, firms with five or more employees; Chile: Office of the Under-Secretary of the Economy, firms with sales of over 2,401 *Unidades de Fomento* (UF); Dominican Republic: National Statistics Office, firms with sales of over RD$ 100,000; Costa Rica and El Salvador: Central American survey of SMEs, 2004, firms with 10 to 249 employees.

Note: Data represent the most recent year for which information is available.

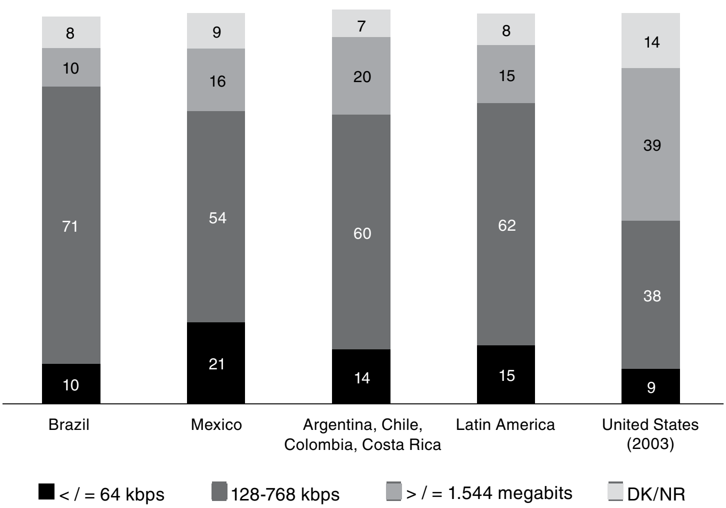
[a] For Mexico, Costa Rica and El Salvador, the data are from surveys conducted during the 2003-2004 period.

The difference in effective adaptation can be understood when analysing the evolutionary process of ICT adoption in developed and developing countries. Around the year 2000, 90% of European firms already had computers, 21% had Internet access and roughly 10% participated in closed and interfirm networks (Intranet and EDI, or electronic data interchange) (EUROSTAT, 2002). When digital communications networks became available to firms in developed countries, these firms had already undergone a learning process, and had computerized a large portion of their internal information flows using un-networked computers. In Latin America and the Caribbean, in contrast, the digitization of internal and external processes occurred simultaneously. For example, in 2001, 64% of Chilean firms had computers and 44% had Internet access (Undersecretariat of the Economy, 2002). This means that, from the start, most of the computers were connected to the Internet.

This can explain much of the current development of electronic business in the region. Digitizing internal processes, installing databases and reorganizing business processes constitute the most resource intensive challenge. In the developed countries, this process was already fairly advanced when it became possible to interconnect computers and, thereby, firms. In Latin America, many firms send their first e-mail message and installed their first web page before they creating their first database. In other words, they begin to interconnect before they have digitized their internal flow of information. This limits the quality of the information that can be transmitted over their digital networks. The gap between internal and external information management is a major obstacle to comprehensive digitization of business processes. Catalogues, inventories, procurement processes, client databases and production coordination need to be digitized and mechanisms are to be developed to maintain these databases and systems. The quality and benefits of external digital transactions will be limited as long as internal information flows are based on pencil and paper.

A positive result of this historical development is the fact that Latin American firms were quick in connecting to the Internet. As early as 2005, approximately 77% of firms with over 25 employees in the region of Latin America and the Caribbean have broadband connections, although for the most part these are slower than 1.544 Mbps (see figure X.2).

Figure X.2
FIRMS WITH INTERNET ACCESS, BY CONNECTION SPEED, 2005
(In percentages)



Source: Cisco Systems and Institute for Connectivity in the Americas (ICA), "Net Impact 2005 Latin America", 2005.

Note: The data reflect a total of 1,212 firms with over 25 employees in Brazil (401), Mexico (405), and in Argentina, Chile, Colombia and Costa Rica (406). Of the firms surveyed, 25% have between 25 and 99 employees, 25% between 100 and 249, 25% between 250 and 499, 14% between 500 and 999 and 11% have 1,000 or more. The firms are in the manufacturing, retail distribution and financial services sectors, as well as the public sector (government and healthcare).

Summing up, two challenges of electronic business can be identified. One is the digitization of the client-vendor relationship, or e-commerce, in which data are made available on a website that functions as a sales window through the digitization of front office activity. The other is the digitization of internal processes. The possibility of conducting sophisticated virtual transactions is limited when internal organizational (back office) processes remain non-digitized. These processes include internal administrative activity, financial and human resources management, production management and handling of information on providers and clients. Electronic businesses can only realize their full potential when both internal and external processes are digitized.

1. Digitizing the front office: e-commerce

E-commerce in Latin America is in its early stages of development and is growing rapidly, although interfirm business predominates (B2B), given the low household penetration of the Internet (Ueki, Tsuji and Cárcamo, 2005). The products and services offered must, from the consumer's perspective, be appropriate for online marketing; there must be catalogues showing their features; and prices must be such that they encourage buying and compensate for the risk associated with this type of transaction. All of this requires marketing and distribution strategies especially designed for electronic channels. In the marketing of products for personal use, such as clothing and footwear, there is a lack of good catalogues. This presumably accounts for the fact that there are fewer transactions in these areas than for generic products such as books, video games and airline tickets (eMarketer, 2006). One possible explanation for the problem is that little time has elapsed since the first computers were introduced in the region's firms, and digitizing management and supply of products and services rapidly is a costly proposition. Given a dearth of catalogues, most e-business models in the region are based on demand, rather than supply. This is quite different from many e-business models in developed countries, where providers present their product catalogue to consumers, as is the case with leading firms such as Amazon.com. In Latin America, it is not supply that drives e-business, but requests from the demand side, that might (or might not) be answered by some particular business that participates in the e-marketplace. Quite different from Amazon.com, which offers a supply-based product catalogue, the more successful model in Latin America is rather similar to a "craigslist" of "looking for" requests from the demand side.

The strategies of firms dealing in passenger air travel are a good model for gauging effective e-business techniques in the region. In ICT, airlines found a tool to reduce the cost of nearly all of their activities, from sales to the public to baggage handling, for in all of these areas paper is saved, processes are optimized and new business models are developed using innovative sales channels. In a very few years, ICT have expanded from a small number of airlines, where they formed the foundation of companies' business strategy, to the entire industry. In 2004, the International Air Transport Association (IATA)[4] launched its "Simplifying the Business" programme, which aims to generate productivity gains by using ICT. The industry recognizes that the advantage of these technologies centres on reducing operating costs.[5] Airlines are rapidly adopting e-ticketing. During the four years between 2004 and 2008, e-ticket penetration rose from 19% to 100%, saving the industry US$ 3 billion annually. An additional US$ 5 billion are saved annually by the digitization of 20 internal paper documents, including Customs, several declarations and manifests and invoices.

These data demonstrate the importance of ICT applications in reducing costs in the air transport industry. Latin America's airlines are an important part of the region's service economy. In 2006, they transported 92 million passengers and generated over US$ 16 billion in revenue.[6] The impact of ICT use is clear if one considers, for examples, the profits at LAN Airlines, whose strategy emphasizes these technologies as a means of creating value.[7]

LAN installed its first online tool for ticket purchases in 2000. Only five years later, approximately 15% of domestic and 10% of international

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4 IATA represents some 250 airlines responsible for 94% of scheduled air traffic. See: http://www.iata.org/index.htm.

5 The cost of processing an e-ticket is estimated to be US$ 1, as opposed to up to US$ 10 per paper ticket. The use of bar-coded boarding passes saves $US 3.58 on average for each remote check-in and US$ 5.34 for each check-in without baggage, while radio frequency identification (RFID) permits improved baggage handling, which in turn reduces the cost of baggage handling and of recovering lost baggage. Electronic tickets offer additional advantages, since they make new sales channels available (Internet), facilitate ticket management by permitting online changes and reimbursement, streamline check-in (which can occur online, via telephone or at self-service machines (the latter generating additional savings of approximately US$ 2.50 per check-in), streamline the flow of passengers at airports and eliminate airport counter procedures for passengers without baggage.

6 Asociación Latinoamericana de Transporte Aéreo (ALTA), press release of 9 February 2007 (www.alta.aero). The organization's members are: Aerolitoral, AeroMexico, Aeropostal, AeroRepública, Aerosur, Aires, Air Jamaica, Aserca Airlines, Avianca, Caribbean Star, Caribbean Sun, Cayman Airways, Cielos Airlines, Click, Copa Airlines, Cubana, GOL, Icaro, LAB, LAN, LanEcuador, LanPeru, Mexicana, Pluna, Santa Bárbara Airlines, Sky Airline, TACA, TACA Peru, TAM, TAM MERCOSUR, TAME, Volaris and Varig.

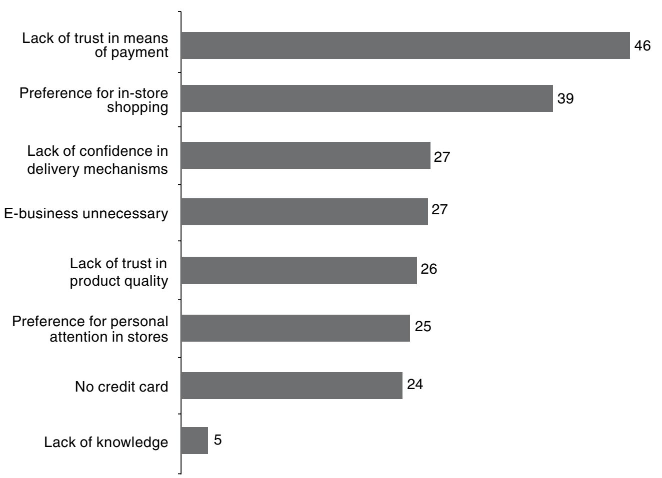
7 LAN Airlines S.A. (LAN Chile, LAN Peru, LAN Ecuador, and LAN Argentina) is among the 20 highest revenue-generating airlines in the world, with US$ 3.3 billion (2% of Chile's GDP) in 2006 and net profits of US$ 241 million. It is one of the pioneering companies in the region in incorporating ICT in its business model in the form of electronic ticketing and online sales, a process that optimizes the purchasing process and reduces costs (Financial Statements of LAN Airlines S.A., http://www.lan.com/files/about_us/lanchile/fecus_2006_12.pdf).

tickets were being sold in this way. The use of this tool created a saving of 54% in the airline's airport facilities, and 63% in its own offices. Costs related to travel agencies fell 70% due to the decline in commissions paid and reduced costs for the use of world travel management systems. In terms of international tickets, cost reductions totalled 52% in the airline's airport facilities, 60% in its own offices and 80% in travel agency costs.

To promote its Internet sales and encourage passengers to use self check-in, LAN began charging for service at points of sale where the client receives personalized attention, such as its offices and call centres. This represents a saving of US$ 15 per ticket domestically, US$ 25 for travel within South America and US$ 40 for flights to other parts of the world.

Although this case illustrates the potential of e-commerce as a cost-saving tool, a number of factors could be obstacles to the widespread use of digital commercial transactions. E-commerce requires ICT infrastructure, as well as a support infrastructure. For example, clients involved in electronic transactions must have appropriate means of payment. Although, in Latin America, 63% of these transactions are carried out with credit cards —the preferred payment method for online commerce (eMarketer, 2006)— the penetration of credit cards in the population is still low in comparison with the developed countries. Figure X.3 shows the major obstacles to the development of e-commerce in the region. Lack of confidence in electronic processes, cultural factors that favour in-person shopping, and the importance placed on receiving personalized attention, are major factors.

Figure X.3
OBSTACLES TO E-COMMERCE IN LATIN AMERICA, NOVEMBER 2005-JANUARY 2006
(In percentages)



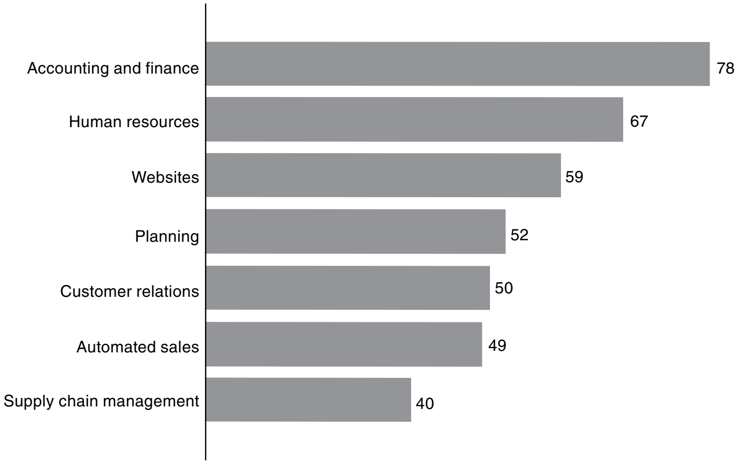
Source: eMarketer, *Latin America Online*, August 2006.
Note: The sample includes Argentina, Chile, Colombia, Peru and the Bolivarian Republic of Venezuela.

2. Digitizing back office processes: e-business

The digitization of commercial transactions between clients and vendors is only one aspect of the digital economy. Fully incorporating digital systems in firms' productive processes means completely reorganizing internal organization. Creating a website is no more than the digital "tip of the iceberg", with full reorganization requiring additional efforts. The amount of automation provided by a website, and ultimately the quality of service, is limited by the type of applications that the firm uses internally. Accordingly, 62% of business technology investments in Latin America are designed to promote the automation of internal processes (Cisco Systems/ICA, 2005).

Automation in Latin American firms has so far concentrated on digitizing simple processes, principally administrative ones rather than productive ones, i.e., accounting, finance and human resources management. As figure X.4 shows, due to the rigours of the learning process required to reorganize internal processes, fewer than half the firms using digital applications have begun to use SCM or CRM tools. Approximately 44% of medium-sized and large firms surveyed by Cisco Systems/ ICA (2005) stated that their principal obstacle was a lack of training of personnel in use of the new technologies, while 25% said that the main difficulty was the lack of interoperability between the systems available on the market. Only 18% said that they lacked adequate connectivity to make the transition to a digital business model.

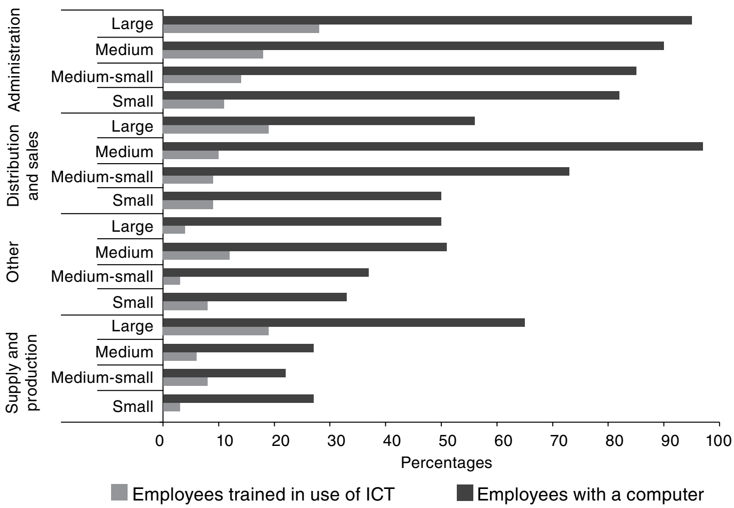
Figure X.4
ORGANIZATIONS WITH NETWORK APPLICATIONS, BY AREA, 2005
(In percentages)



Source: Cisco Systems and Institute for Connectivity in the Americas (ICA), "Net Impact 2005 Latin America", 2005.
Note: The data reflect organizations in the private and public sectors with over 25 employees.

The information gathered in Chile shows that most employees are being trained in the use of the new technologies. Taking together all sizes of firms and all jobs, only between 5% and 20% of employees have received no systematic training in ICT (see figure X.5). In terms of access to ICT, there are no significant differences between large and small firms, although the former have made more progress in using ICT in the areas of supply and production. In a given firm, once more than half of the employees have access to a computer, network externalities quickly push connectivity to the remaining half. This point has already been reached in administrative areas, whereas distribution and sales are close to this critical mass, showing a notable level of connectivity in medium-sized firms.

Figure X.5
EMPLOYEES WITH A COMPUTER AND WITH TRAINING IN ICT IN CHILEAN FIRMS, BY FUNCTIONAL AREA AND SIZE, 2006



Source: Under-Secretariat of the Economy, "Encuesta acceso y uso TICs en empresas", 2006.

Notes: The percentage of employees with training is the same as the percentage of employees with a computer. Firm size is defined on the basis of annual sales volume: small: US$ 86,000-US$ 896,000; medium-small: US$ 896,001-US$ 1.8 million; medium-sized: US$ 1,800,001-US$ 3.5 million; large: over US$ 3.5 million.

C. Conclusions

Unlike firms in developed countries, for firms in Latin America and the Caribbean the process of digitizing internal and interfirm processes occurs nearly simultaneously. This is because a large portion of the internal processes in the developed countries were already computerized when the Internet appeared and made it possible to use interconnections for multiparty commercial transactions. Some firms in the region still lack internal management software and databases and are just beginning to explore the opportunities offered by digital channels of communication. Although the cost savings through electronic channels are already considerable, especially in service sectors such as air travel, the ability of the region's firms to take full advantage of the potential of e-business will only be realized once they bring their internal processes into the digital age. This means that the magnitude of the task facing user firms is equalled by the challenge faced by software producers, who must provide ERP, SCM and CRM solutions that are adapted to the region's culture —and at a reasonable price. Computerizing processes, reorganizing management and training human resources require time and money. Systems of financing are needed to allow small and medium-sized firms to make the transition.

The region's firms must not only incorporate technological change —importing solutions and business practices developed in more advanced economies— but must also be in a position to operate in the new environment with the appropriate tools. The challenge for the countries of Latin America and the Caribbean is to understand the competitive potential of electronic business. It is impossible to remain outside this global trend. To address the challenge, the productive sector must gain a full appreciation of the need for these technological changes. National ICT strategies are tools to promote connectivity, which is the basis for this process of change, but they must be supplemented by creating the other necessary conditions, such as the formulation of legal and regulatory frameworks that generate confidence and security in electronic transactions, and by incentives for banks and financial institutions to provide small and medium-sized firms with the required credits to master the "creative destruction" implied by digital innovation. This last challenge is especially important in times of a global credit crunch that emerged around 2008, which decreased the availability of affordable financial mechanisms that are indispensable for most firms to finance the required up-front investment that is needed to eventually reap the fruits of e-business.

Chapter XI

Health and disaster management

Health and disaster management are two service sectors that are crucial for development. At the same time, both are extremely dependent on information and communication processes. A few seconds can make the difference between life and death. Thus, technologies that permit real time interaction are essential. Both sectors also have the need to analyse massive volumes of information, and quality of service is dependent on the intelligence that can be extracted from stored data. ICT facilitate the development of these sectors, by helping to institute new management and support models, assisting in the supply of advanced patient- and citizen-centred services, and providing the means to streamline communication and collaboration among system professionals and providers.

A. E-health

ECLAC maintains that: "good health is crucial to the well-being of individuals, families and communities, and it is also a prerequisite for human development with equity" (United Nations, 2005b). A number of Millennium Development Goals relate to health. They include improving maternal health, reducing infant mortality and combating diseases such as HIV/AIDS, malaria and tuberculosis. Health spending in the Latin American and Caribbean countries accounts for between 6% and 9% of GDP, and thus also plays a significant role in the region's economy.

There is evidence that ICT exert a strong influence on nearly all healthcare processes and enhance their efficiency and effectiveness

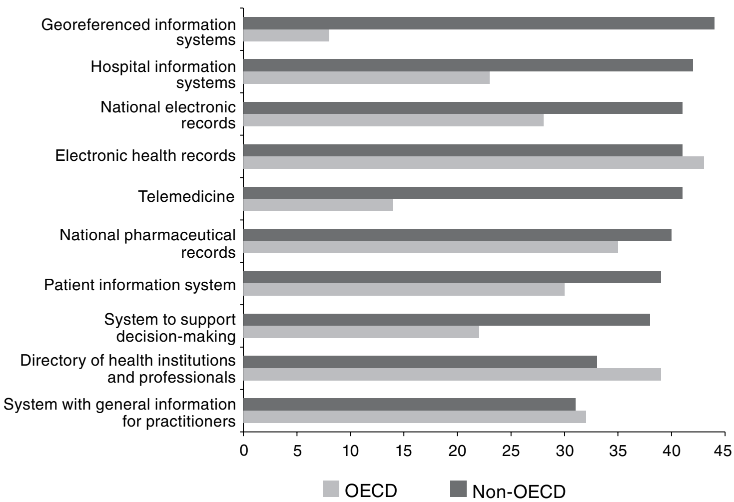
(Fundación Telefónica, 2006). The sector is in a good position to take advantage of advances in ICT, since it generates large volumes of information of various types (clinical, administrative, etc.) that must be processed. As with other sectors of the information society, e-health attempts to manage information so as to increase efficiency and ensure access to information from any location. Given the complexity of the health sector, this process is not easy and requires overcoming several technological and institutional challenges, as well as human resistance (Empirica, 2008). Notwithstanding, important cost savings have been identified in e-health systems in developed countries. A long-term impact study in Europe has analysed the economic impact of 10 e-health sites over 15 years (including vaccination and prescription services, patient and medical records, dispatch service for ambulances, and inventory investments in the health sector. Over the period 1994 to 2008, the summarized annual present value of benefits grew continuously from below €20 million in 1994 to about €200 million in 2004 and some €400 million in 2008. Conversely, the associated costs stay broadly stable after the initial planning and implementation phases and do not reach beyond €100 million per year. This resulted in the fact that since 1997 annual savings have by far surpassed necessary investments. But it is not only cost that matters. ICT also helps to improve the quality of services. The increased availability and timeliness of information is also important for the development of the medical profession and to improve decision-making on the part of management (Fundación Telefónica, 2006).

Emphasizing the use of ICT should not be construed as suggesting that e-health is an alternative or additional form of healthcare; rather, the use of these technologies offers different ways of providing conventional services. In many cases, it is the most efficient and effective —and most equitable— means of providing service, due to its potential to improve access, provide rapid care, shorten response times, generate warnings, save costs, speed the diagnostic process, make diagnosis and therapy more effective, and improve the quality of service (Jadad and Gómez, 2006).

In developing countries, ICT have great potential to improve health services. As figure XI.1 shows, the usefulness of digital tools is more highly valued in developing countries than in OECD member countries (WHO, 2006). In developing countries, the demand for instruments to support clinical and administrative functions within healthcare systems affects nearly all activities in the sector's value chain. This underlines the need for the sector to progress more rapidly in transitioning to the information society, and highlights the importance of this process in development programmes.

In the 1990s, the concept of e-health was associated with telemedicine (remote medical care). For telemedicine and distance health services to become viable, the digital broadband divide will have to be overcome and in order to bring part of the "hospital to the household", adequate high-quality content an digital records will have to be developed (front-office digitization). In some developed countries, citizens themselves have started to perform many of the activities previously carried out in hospitals, even doing so remotely through digital networks (Norris, 2002). Besides these distance-health front-office services, digitization of the back-office has become the major centre of attention. For the purpose of creating a patient register or a clinical form, as well as for the maintenance of the inventory of drugs and supplies in hospital, patients do not necessarily need direct contact with ICT. What is important is that the correct information reach the correct place in time to provide life-saving solutions, regardless of whether the patient is aware of the communications taking place. This means, among other things, inventory management, maximizing drug quality and quantity at the lowest possible prices, and having an internal system to allow for consultation with specialists in different locations. The possibility of providing service online depends in large part on systematizing internal processes, utilizing available ICT solutions tailored to the needs of the sector. The latest major advances in diagnostic equipment and software are also important in this regard.

Figure XI.1
MOST USEFUL TOOLS IN THE HEALTH SECTOR, 2005
(In percentage of countries)



Source: Global Observatory for eHealth, "*eHealth, Tools & Services, Needs of the Member States*", 2006.
Note: The data reflect 78 non-OECD countries and 30 OECD member countries.

1. General context

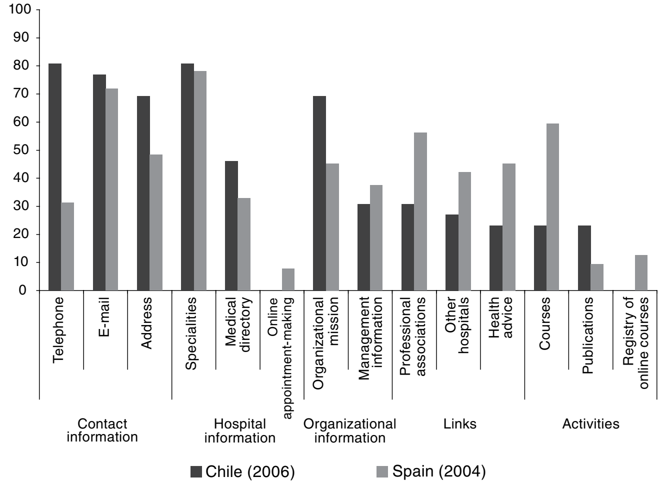
Considering the opportunities offered by the new technologies, it seems appropriate to assess the progress that has been made by the region's health sector. Generally speaking, it will turn out that the health sector in Latin America and the Caribbean has been slower to incorporate ICT than have a number of other sectors, such as education and public administration.

The availability of statistics on ICT access and use in the health sector is more limited than in any other sector of the information society. However, it is estimated that over 90% of the region's hospitals and doctors' offices have telephone service, while connectivity with more advanced communications networks is still in its infancy. Available information on the online presence of hospitals and their access to e-mail indicates that by 2006 around half of Chile's establishments had e-mail and their own websites, while the corresponding figures for Cuba are 16% and 1%. In both countries, a web presence is created either through the institutions' own sites or (as is the case for the majority of institutions in Chile) via links on third-party websites (OSILAC, 2006).

With regard to ICT applications, a comparison of the website content of Chile's healthcare institutions with analogous content for Spain's healthcare institutions shows that the information provided by Chilean institutions relates primarily to health facilities and information about their services, while the Spanish sites are interactive, with online courses and tools for making appointments (see figure XI.2).

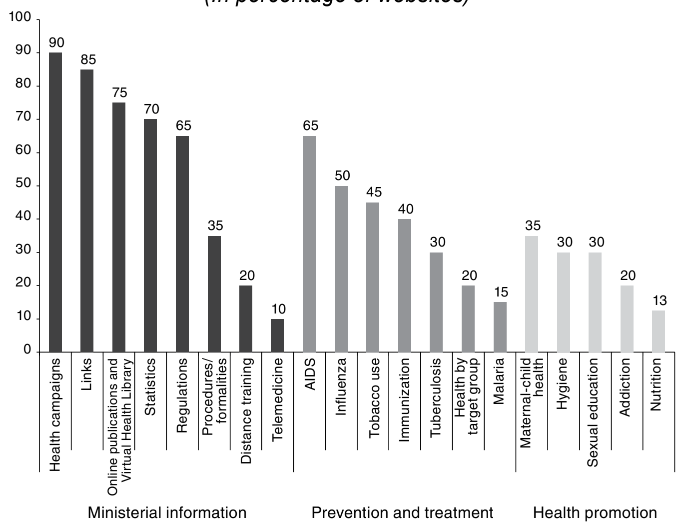
The websites of the region's national health authorities focus on publicizing information on the relevant ministries, rather than on actual health issues. In 2006, 38% of the countries' ministries had no website. Thus, the health sector lags behind other sectors such as public administration and education and constitutes the lagging tail of the information society modernization effort. Of the remaining roughly two thirds of ministries, only 35% provide information on maternal-child health, 65% provide information on HIV/AIDS, 30% on tuberculosis and 15% on malaria (see figure XI.3). These low percentages are particularly worrisome in view of the fact that the three diseases cited, plus maternal health, are given special emphasis in the Millennium Development Goals (goals 5 and 6). In short, even though the health authorities in Latin America and the Caribbean have officially committed to development goals like the MDGs, most of them do not mention those topics on their websites. The use of ICT to improve healthcare services falls far short of what is possible.

Figure XI.2
WEBSITE CONTENT OF HOSPITALS IN CHILE AND SPAIN
(In percentage of websites)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC). Chile: based on information from the institutions' websites; Spain: based on information from "eEspaña 2005, la eSalud", Fundación Auna.
Note: For Chile, the data reflect the total number of hospitals with websites, based on the listing in the National Health Services System. The data for Spain reflect the percentage of those that have a website, out of a total of 171 institutions that are registered with the Ministry of Health and Consumer Affairs.

Figure XI.3
WEBSITE CONTENT OF HEALTH MINISTRIES IN LATIN AMERICAN AND CARIBBEAN COUNTRIES, DECEMBER 2006
(In percentage of websites)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on information from 20 Ministry of Health websites in the region's countries.

The content on the websites of the region's health authorities consists primarily of information on their respective health campaigns, with links to other public entities, as well as statistics and information on relevant laws and regulations. Between 2004 and 2006, health ministries even significantly strengthened the provision of administrative information on their sites —a contrast with the stagnation, and even reduction, in interactive educational and training content (OSILAC, 2006).

2. Progress

Although there have been some positive experiences in the region, the general situation leaves much to be desired. @LIS (Alliance for the Information Society), a project of the European Commission, has conducted a number of interesting pilot projects (@LIS, 2007), such as the T@lemed project,[1] which centres on treatment of diseases that are typical in the poor areas of Brazil and Colombia (e.g., malaria) and on the use of ultrasound for pregnancy and urology examinations and for cardiovascular diagnosis. Electronic health networks facilitate communication between health institutions in the large cities and those in areas with greater needs. This has already benefited thousands of patients and has significantly reduces the cost of care.

In the area of telemedicine, the Hispano American Health Link project (Enlace Hispano Americano de Salud, or EHAS) demonstrated that ICT use can improve public primary healthcare in rural areas. The project calls for implementing a communication network in each of the countries in which the organization has a presence —e.g., Peru (Cuzco), Colombia (Pacific Coast areas) and Cuba (Guantánamo)— with a system of 36 rural healthcare establishments, 12 in each country. Combined voice and data programmes are transmitted via radio in cases where telephone service is not available. The installed infrastructure supports remote information services, questions and answers, epidemiological monitoring, the ability to make appointments, and access to medical information. Voice and data communication also permits distance training of healthcare personnel (doctors, nurses and technical staff), automation of the epidemiological monitoring system, remote consultation, cross-referencing of patient information, and improved systems for emergency evacuation and distribution of medications.[2]

In other countries, the situation varies widely, making it difficult to draw systematic conclusions. In Brazil, applications are developed in the academic community, but are not incorporated in any national strategy. The objective of Mexico's e-Health Action Programme is to improve healthcare coverage and service, primarily in marginalized areas. This bears some

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1 See: http://www.alis-telemed.net.

2 See: http://ehasalis.ehas.org/.

similarity to the objectives of Peru's INFOSALUD website. In 2005, Chile prepared a so-called "Blue Book" plan, but it was never implemented. In general, the few existing applications are not specifically designed for the health field, and are primarily for institutional management purposes. There are interesting private or public-private initiatives, but their scope remains limited, and they have not been incorporated in national strategies. These include EviMed in Uruguay, which offers a platform for distance courses, meetings, information, search tools and weekly bulletins; the Hospital Italiano system in Argentina, which has developed a system for operational processes and a distance training platform; websites of private hospitals in Chile that offer nutritional and healthcare information, as well as a tool for making appointments via the Internet; and projects such as the Electronic Clinical History and Telemedicine projects at the Equinoctial Technological University, in Ecuador, and the Hospital Clínico project at the University of Chile.

In contrast, there has been considerable growth in the use of ICT by private sector pharmacies, where investment in digital content is economically driven. Pharmacy websites provide information on illnesses, medicines and prevention. The economic motivation of pharmacies consists in obtaining part of the revenue that patients would pay to visit a doctor. The money that patients save by self-diagnosing themselves using the pharmacy's website could be spent directly at the pharmacy. In light of the importance of these sites for public health, the quality and validity of the information provided on pharmacy websites merits study.

Finally, the spread of mobile telephony has facilitated new services to improve communication with patients, while enhancing communication among health professionals. This has led to new health services that improve patients' quality of life by eliminating the barriers of distance and access —a response to the increasing mobility of both patients and healthcare professionals. This increased mobility in providing services has also led to improvements in health management procedures.

B. Electronic disaster management

The natural disasters of the last few years served as a reminder of the global impact of these events and the need for contingency planning, warning mechanisms and preparatory measures for threats and extreme events that involve prolonged recovery periods (Zapata, 2006). Above all, they made it clear that intervening in the natural environment can have disastrous consequences if vulnerability factors are not properly considered, and that national development policy must explicitly address the issue of risk mitigation.

1. General context

Because of their repercussions, disasters are a concern to government authorities, humanitarian organizations, to the financial and insurance industries, and to the academic community. The development of a number of Latin American and Caribbean countries has been affected in recent times by phenomena such as hurricanes Emily, Stan and Wilma in Mexico, Ivan in Granada and Barbados and Stan in Guatemala and El Salvador, the eruption of Ilamatepec and the Peruvian earthquake, from which damages and losses are estimated to have totalled more than US$ 8 billion (Zapata, 2006). Given the adverse consequences of increased hydroclimatic activity, the countries must take measures to adapt to the changes taking place, and this means finding tools to mitigate and transfer risk.

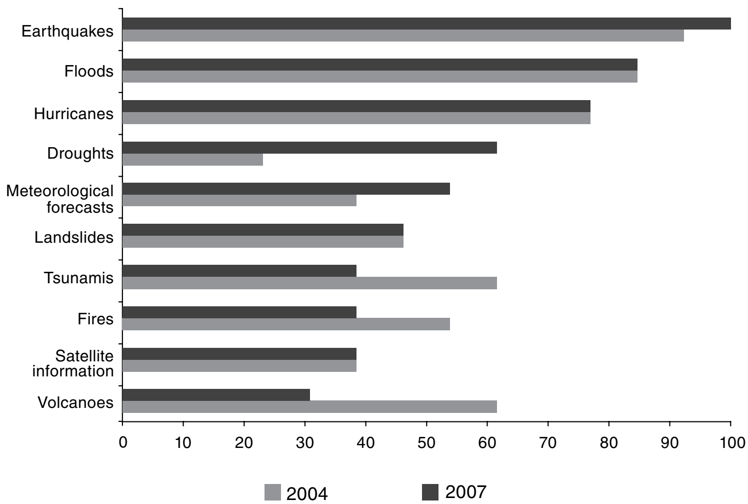
Recent experience shows that digital tools are useful in supporting rescue efforts, as well as for regional and global mitigation of natural disasters. One of the most notable cases in this regard is the December 2004 tsunami in the Indian Ocean (ITU, 2005a). That event highlighted the failure to use available information for early warning and immediate response, and demonstrated that once such an event has occurred, ICT can take the place of (and work better than) traditional channels of communication. The devastation caused by the tsunami reflected a failure to communicate scientific information to decision makers and communities. Seismologists in Australia and the United States identified the earthquake on the Indonesian coast immediately and, based on previous experience, predicted a powerful tsunami. Due to the absence of direct channels of communication between scientists and decision makers, however, the information did not reach the tens of thousands of people who could have been saved (Dickson, 2005). After the disaster, digital tools played an essential role in rescue and response. The massive use of mobile telephones and the Internet (including e-mail and short message service, or SMS) facilitated aid operations and coordination between humanitarian organizations and volunteers. The Internet enabled people to connect with their families, and digital photos helped to identify people who were lost, and to reunite families. Donations were solicited through the websites of humanitarian organizations, and individual contributions were collected through real-time electronic transfers.

A number of regional organizations in Latin America and the Caribbean play an important role in disaster management, primarily by promoting the regional management and coordination of aid. These include the Regional Disaster Information Centre (CRID) for Latin America and the Caribbean, the Latin American Social Studies Network for Disaster Prevention (LA RED), the Central American Coordination Centre for the Prevention of Natural Disasters (CEPREDENAC), the International Strategy for Disaster Reduction (ISDR), the Caribbean Disaster Emergency Response

Agency (CDERA) and the Andean Committee for Disaster Prevention and Relief (CAPRADE), while the Pan-American Health Organization (PAHO) and ECLAC are active in assessing the impact of disasters. These institutions provide assistance in finding information, and help to increase electronic access to documents and other sources of information (OSILAC, 2007b). They distribute technical information on disasters, provide inter-institutional links, manage projects for the use and management of information, and facilitate the sharing of documents and information sources.

There are also national centres for disaster management. As figure XI.4 shows, the 13 centres in Latin America and the Caribbean with websites provide digital information on floods, earthquakes and hurricanes, as well as (to a lesser extent) on volcanic eruptions, droughts and tidal waves. Content generally focuses on the types of disasters that most affect the country where the particular centre is located. Despite the increasing intensity and number of natural disasters in the region between 2004 and 2007, the content has not changed significantly. While the provision of information on droughts and meteorological forecasts provided through this medium, often in real time, has increased, there has not been a corresponding increase in providing digital information on flood and hurricane threats. Moreover, there has been a surprising decrease in information on tsunamis, fires and volcanoes.

Figure XI.4
WEBSITE CONTENT OF DISASTER MANAGEMENT CENTRES IN LATIN AMERICA AND THE CARIBBEAN, 2004 AND JANUARY 2007
(In percentage of sites)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on information from the websites of official national disaster management centres.

Note: Includes Argentina, Belize, Bolivarian Republic of Venezuela, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Mexico and Panama.

2. Progress

The Latin American and Caribbean countries face common challenges in managing disasters, given that they are exposed to a wide range of threats and that social vulnerability is a major problem —as evidenced by high poverty indices, intense urbanization, deficient infrastructure and environmental degradation (ECLAC, 2005b). This situation and, particularly, the cross-border nature of many disasters, calls for the development of regional cooperation for the entire disaster management cycle, including mitigation, preparatory efforts, response and recovery. ICT can play an important role in each of these phases (Stolzenburg, 2007).

Like natural disasters, digital networks are not limited by national borders, and this makes them a useful tool for integrating the different geographical levels of disaster management (national, regional and global). This process entails: adjusting both the institutional framework and the technology, requiring, in turn, the establishment of international agreements on standards; promoting interoperability between national and local systems (in the absence of which it becomes difficult to compile data), dissemination of information and effective use of ICT; strengthening and enhancing the reliability of ICT infrastructure (including installation of solid bases for radio frequency antennas and repeaters for the most important land-based channels of communication); and identifying and incorporating the most appropriate technologies, including mobile telephones, satellite telephones and fixed wireless communication systems (Stolzenburg, 2007).

Development of these conditions is still in its early stages in the region, and knowledge on the effective use of ICT for disaster management must be strengthened. There is consensus in the international community that it is possible, under present conditions, to improve today's systems by integrating and providing compatibility between existing networks and capacities (EWCII, 2003). This includes implementing international interoperability standards. Regional and subregional platforms must complement national and global initiatives (ISDR, 2005). The regional context is often an appropriate forum for disaster mitigation, preparation and response. International agreements such as the Tampere (Finland) Convention and collaboration between governmental organizations and the private sector are also important in paving the way for incorporating the new technologies in national regional disaster management schemes (ITU, 2005b). Adapting the system to the region's requirements and needs goes beyond reorganizing administrative procedures; it also involves a change in mindset, on the part of the society as a whole, regarding these types of events (ECLAC, 2005b). Some ICT, such as mobile telephony, which is used by most of the region's inhabitants on a daily basis, offer an opportunity to familiarize citizens with these problems, create links, provide for frequent communication of information, and build awareness of these public safety issues (Stolzenburg, 2007).

C. Conclusions

E-health and electronic management of natural disasters are in a phase of development comparable to that of electronic business and e-government several years ago. Both trail behind in the digital revolution. The potential of ICT in these areas is great, and makes intuitive sense. The major problem in e-health initiatives has been the presence of other, more tangible and traditional priorities. In this context, it is difficult to argue that databases are more important and urgent than increasing the number of beds for patients or improving primary care by providing more care facilities. However, the important saving argues for prioritizing ICT in order to liberate funds to continue to work on their urgent components of the health agenda. The demonstrated improvements in service quality and reach also argue in favour of making e-health a leading component of healthcare. An additional problem is the sector's lack of statistical information on ICT access and use. This makes it difficult to analyse progress and assess effects. Indicators for healthcare institutions are not yet a part of sectoral statistics, and more important still is the fact that programmes lack leadership and continuity.

As with e-health, natural disaster management could garner major benefits from ICT. Unfortunately, the region's disaster management centres, and the relevant authorities, have not taken advantage of these opportunities. The situation is aggravated by a lack of coordination among governmental entities, non-governmental organizations and communities, as well as by poor collaboration between organizations dedicated to helping victims, and research and training institutions (ECLAC, 2005b).

Part four

ICT policy for development

Chapter XII

National and regional strategies

A. Introduction

The digital revolution and the emergence of its information societies has impelled Latin American and Caribbean governments to develop initiatives and policy instruments to maximize the social and productive benefits of ICT. This process began in a number of the region's countries in the 1990s, with attempts to increase the technologies' impact on economic and social development through initiatives such as universal telecommunications programmes, school computers (and, later, Internet connections), policies regarding radio and television broadcasting, measures to encourage the development of software (and in the larger countries also hardware) industry, and computerization of administrative, financial and accounting processes in public administration at the central government level.

Since then, ICT have gained a far greater horizontal (and more complementary) role in various areas of the economy and of society, as it has become increasingly clear that they are a prerequisite for modernization and development. In line with this trend, initiatives have been started to formulate public policy aimed at coordinating the activities and ideas of the different government agencies involved, in an attempt to convert the previous pattern of isolated efforts into a coherent strategy. Thus, in the last few years, most of the countries have defined strategies, plans, policies or digital programmes to implement public ICT policy to further their efforts to construct information societies.[1] At the regional and international levels, declarations eventually were formulated with respect to an information society strategy for Latin America and the Caribbean. This strategy involves a sequence of regional action plans known as eLAC.

The present chapter discusses policy strategies for creating information societies, both nationally and regionally, emphasizing the need for government policy, and describing specific features of such a policy. It then proceeds to examine how this process has unfolded in individual countries, as well as in the region as a whole.

B. The need for ICT policy

Public policy consists of the set of objectives, decisions and actions that a government adopts to solve the problems that are considered to be of high priority at a particular time by the government and citizens (Tamayo, 1997). Social or economic concerns are often the driving force behind the creation of public policies or national development strategies. The concepts behind public policy and national strategy have social implications. If a particular group adopts them, they become part of a social or systemic programme, and various elements of the programme become a matter of concern to the society and, thus, a topic of debate in a range of venues. Whether these different elements come together to form a public or institutional programme depends in large measure on a collision of interests and their respective weights, with the principal players consisting of groups with varying degrees of influence. The pressure of interest groups —as well as cultural factors, the influence of tradition, and the attitudes and values of public decision makers— generates a bias in the ability to access the institutional agenda. The inclusion of a given problem in an institutional programme does not guarantee that the issue will be addressed on the policy level, since there may be a dissipation or incubation of issues. In other words, the issues may remain part of the programme, but not receive attention from institutional stakeholders. Reasons may include a lack of leadership, loss of interest, or the appearance of new, more important or more urgent problems. If action is to be taken, there are two main options when it comes to the implementation of public policies: (1) regulation, which takes the form of negative feedback that results in the attenuation of the unfolding dynamics and the stabilization of the system (new legislation and the regulation of industries fall into this category); and (2) incentives, which consist of positive feedback that encourages the proliferation of a desired

[1] This chapter uses synonymously the terms ICT/digital policy, strategy, agenda and programme, to refer to public policy that is designed to promote information society development. Different terms are used for similar efforts throughout the region.

phenomena within the system (special projects and subsidies fall into this category). Regulation and incentives are the two broad options available when designing public policy. ICT policies share these features with all public policy. The following will be a review of how the governments in the region have incorporated these issues in their policy agendas.

As analysed in chapter I, the digitization of data through the use of ICT has had profound effects on the generation, storage, processing, exchange and dissemination of information, making ICT an essential resource in every economic and social activity. This situation gave rise to the concept of the information society as a form of organization in which the efficient use of this resource (ICT) can help optimize processes and create greater economic and social value, with beneficial effects on national development. Taking account of this opportunity, and of the fact that Latin America and the Caribbean lag behind the developed countries in ICT access and use (the so-called "digital divide") (see chapter II), the region's countries have moved to formulate public policy to reduce the negative effects of the divide and to maximize the positive opportunities of the digital revolution. The motivation for this is clear, given the impact that these technologies have on growth (see chapter III), and the fact that the gap will widen unless steps are taken to join the global mainstream.

ICT are general-purpose technologies and can be applied to all activities that require the handling of information. This includes productive activities, social actions aimed at improving quality of life and the formation of human capital, public services, administration of justice, and education and health. This general applicability of ICT has two consequences. First, the spread of these general purpose technologies has effects similar to the positive externalities produced by education. From a social perspective, it is desirable that people not only be able to use ICT but also understand their scope and potential in everyday activities. Using ICT effectively becomes an enabling activity for all other kinds of social and economic activities, similar to basic education. It is widely know that the supply of such goods with positive externalities generated strictly by a free market falls short of what would be desirable in terms of broader social interests (Stiglitz, 2002). It is therefore of interest to the public sector to foster the spread of such goods. This is especially challenging because of the rapid innovation cycles of ICT. Given that the digital divide breaks up anew with every digital innovation and given that the divide in terms of capacity to process information is widening every year (see chapter II.A), strategies have to be found that enable developing countries to short-cut (or "leap-frog") the innovational patterns of the digital revolution. Authorities of Latin America and the Caribbean have long recognized this challenge, as stated in the Declaration of Florianopolis (July, 2000): "allowing the evolution of the information and knowledge-based society to be guided solely by market mechanisms entails the risk of an amplification of the social gaps existing in our societies, the creation of new modes of exclusion, an increase in the negative aspects of globalization and a widening of distances between developed and developing countries". Public ICT policy is therefore a necessity, both to reduce the international digital divide and to promote greater social integration in the domestic setting, in order to ensure that no one is excluded from the benefits of these technologies. In other words, policies that foster the access to knowledge and use of ICT as a tool in daily life, must not be limited by the economic capacities of individuals. This points directly to the distributive role of the State, which should take steps to address the digital divide, in order to avoid an expansion of the existing social divide which is already aggravating the region's problems of distributive inequality.

The second consequence of the general purpose applicability of ICT is the necessity to set up policies that aim at their incorporation in economic and social organization across all sectors. This not only calls for multisectoral horizontal policy, but also requires specific policies in individual sectors. Since the benefits of ICT derive from their ability to optimize transactions between different agents, it is not sufficient for each sector, individually, to adopt them. Rather, the development must occur simultaneously in the various sectors, in order to establish the complementary processes needed to bring together the society's different forms of organization. E-government is of little use if citizens do not have access to the Internet, and if firms do not create mechanisms for secure online payment. In both cases, if the technology does not have horizontal application throughout the society, the benefits of technology are diluted or their potential remains unrealized. Since different economic and social sectors incorporate ICT at different times and at different rates, areas of inefficiency emerge in the form of duplication of work and incompatibility between systems. Policies have to be coordinated to maximize synergies and assure the creation of the required complementarities.

In a number of sectors that are considered "engines" of the information society, markets work poorly and require special attention from policymakers. For example, some segments of the telecommunications sector have monopolistic or concentrated oligopolistic markets that generate inefficiencies, high prices and insufficient investment in infrastructure required to obtain the socially desirable levels of access. The example of the telecommunications market shows that the policy challenge does not consist of a dichotomy of "free market versus government intervention". It is largely recognized that the success of mobile telephony has been market driven, propelled by the innovative power of private agents. However, the competitive markets driving that successare constantly monitored and assured by governmental telecommunications regulators. These kinds of competitive markets are not the textbook laissez-faire markets of anarchic freefight, but rather the result of meticulous regulation, and they would quickly transform into inefficient monopolies without constant oversight. This applies to markets in Europe, the United States and Japan, as well as in developing countries. The market failures of the telecommunications market make public policy a necessity, primarily in the form of regulation and pro-competition measures (as detailed in chapter VI).

Conceptually, the objective of information society policy is to complement and correct the course of development taken by the market, and to maximize the positive effects of ICT-related activities. Such policy aims to exploit the synergies that arise from the knowledge and capacities of each governmental authority and each private and civil society actor. The ultimate collective benefit will be greater if the participating parties coordinate their actions, since this generates a multiplier effect. In countries like those of Latin America and the Caribbean, the scarcity of certain resources and the high cost of transitioning to the information society make it essential that national strategy be informed by close collaboration.

Identifying objectives through consensus, and developing a common plan of action, can enhance the consistency of governmental and private-sector action, strengthening strategic alliances that optimize resources by fortifying initiatives that take advantage of scale effects and synergies. Given that the digital revolution affects all aspects of economic and social development, formulating a digital programme entails significant coordination efforts and the creation of a common understanding of all the different underlying issues and how their mutual interdependence. While this reasoning seems logical, it turns out that actors in many countries are still not completely convinced that collective efforts will achieve better results than will isolated initiatives, which is then also reflected in unstable political will and a true collective commitment to the creation and pursuit of a coherent national agenda in this topic.

C. Features of ICT policies

The formulation and implementation of a digital strategy must take into account the particular characteristics of the technologies. Five points should be borne in mind. First, digital development is shaped by the horizontal and multisectoral nature of its applications. Second, the novelty of the issues involved and, third, the uncertainty inherent in rapid technological progress mean that decision-makers walk a fine line between finding enough support and having concrete policy alternatives at hand. Fourth, it is important to take into consideration that technological change is mostly exogenous to the countries of the region, as seen by the limited scope of ICT production industries (see chapter IV). Lastly, digital networks go beyond natural borders, while, at the same time, there are decisive differences from country to country.

Creating an information society involves changing various aspects of social life —a process that tends to be incompatible with centralized decision-making. The horizontal nature of the changes involved makes them ill-suited to the traditional sectoral structure of government institutions —such as the ministries of education, transportation, health, industry and commerce. If differing interests are to be brought together in a productive manner, with well coordinated actions involving the various stakeholders, new forms of organization and collaboration must be developed within public administration. This means that the national strategy must be horizontal and multisectoral in nature.

Although there are precedents in some areas for policy discussions on the incorporation of ICT (e.g. telecommunications and mass media), the topic is only beginning to be discussed in the public policy arena in relation to creating the information society. Thus, there are few existing patterns to guide policy formulation and execution; rather, the process is one of learning by doing as governments attempt to find appropriate forms of organization, with solutions varying according to each country's needs and policy objectives. In view of these challenges, such policy can hardly be expected to achieve short-term effects comparable to those in areas with more long-standing policy in place, such as health and education. Moreover, these traditional policy areas already have their own established institutions. ICT represent new terrain, and it can be difficult to maintain policies if they do not demonstrate immediate and measurable results. This calls for an experimental attitude when finding the right structure of the strategy.

The element of uncertainty also plays a decisive role. As seen in chapter I, ICT have seen exponential growth over the last few decades: from the outset, the curve of ICT development was, and continues to be, steep, and there is no reason to believe that this trajectory will falter or flatten out any time soon. Microprocessor capacity doubles about every two years —a pattern that has repeated itself for over four decades (Moore's law)— and one can assume that the next two years will yield progress that is equal, in absolute terms, to the gains made since the beginning of the digital paradigm (this is the nature of exponential growth). The unknown changes entailed by this rapidly evolving field create an uncertainty that is difficult for policymakers to manage.[2] As a result, strategies should be flexibly

[2] As Kurzweil (2001) suggests, people tend to expect erroneously that change in the future will proceed at the same pace as in the present. Even among those who have lived long enough to know, from their own experience, that change accelerates over time, there is an erroneous tendency to feel, intuitively, that progress will continue at its present rate. For example, if the power of a microchip grew from 50 to 100 over the past two years, we tend to expect it to grow to 150 over the next two years and to 200, 300 and 350 during the subsequent decade. Policies often require looking a decade ahead, and as a result of our expectation, we design policies accordingly to this linear growth projection. Exponential growth, however, accelerates technological progress of the microchip from 100 to 200, and

designed and have relatively short timelines, with plans of action limited to at most five-year periods. Because of this fast pace, there is a need for continual monitoring, which allows to adjust to changing and unpredictable needs. This can also be strengthened by technological foresight studies, such as is common in the European Union (e.g. Popper and Miles, 2004).

In Latin America and the Caribbean, the process of technological progress is exogenous, since it depends on forces that are largely beyond the control of the region's public and private-sector decision makers. Policy options for incorporating technological systems in the society's structure are endogenous, and are well within the reach of policymakers. It is therefore essential for public policy to take an active role in orienting the society to future events, as well as in helping to reduce uncertainty and generating the information necessary for sound decision-making. One of the best ways to confront a challenge is close cooperation with the transnational private sector, which might have a better insight into future development sand trends.

Finally, the wide economic and social differences between and within the countries of Latin America and the Caribbean work against initiatives to establish a coherent public policy agenda. There is no one size-fits-all solution. As a result of these inequalities, different approaches to digitization will be needed, with differing levels of abstraction in addressing the issue (local, national and international). A country's policy must take account of its particular needs and capacities if it is to achieve its multiple objectives. Any regional agenda for Latin America and the Caribbean must have greater specificity than that of a world agenda such as the Geneva Action Plan, approved in 2003 at the first World Summit on the Information Society (WSIS), which included a broad spectrum of countries, ranging from the Group of 8 to some of the poorest nations in the world. A global agenda cannot replace regional and subregional (much less national or local) agendas, but is indispensable given the borderless nature of digital networks. Notwithstanding, there is a need for a high degree of complementarity between individual agendas conceived at widely varying levels of abstraction. The result is a need for constant dialogue among local, national and international levels.

In summary, decisions on developing the information society in Latin America and the Caribbean must be based not only on the region's characteristics —namely, a high degree of internal heterogeneity, and the fact that technological progress is determined by forces outside the region— but also on the characteristics of the digital revolution itself. These include the uncertainty created by the pace of technological change, the horizontal way in which the technologies are used, and their innovative nature.

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from there to 400, 800, 1600, 3200. The difference between a technology with power 350 and 3200 is quite decisive, so are the differences in respective policy options.

D. National agendas

During the past decade, the countries of Latin America and the Caribbean have been attempting to define coherent and multisectoral ICT policies. They have progressed at different rates, and have achieved varying levels of success, and therefore are at different stages of political maturation. After a number of years of consensus regarding the benefits of the technologies, most of the countries have moved beyond the initial stage of recognizing the importance of ICT as a subject of public policy, and have worked on addressing the subsequent phases of formulating, executing and evaluating policy.[3] Some countries have even instituted a second generation of ICT policy. Given the fact that these policies have had time to mature, it becomes important to assess the degree of progress countries have reached in their efforts to develop and implement policy agendas.[4]

1. The status of national strategies

The process of adopting and implementing digital policy is affected, at its various stages, by both exogenous and endogenous factors, that is, factors that are outside and within the reach of decision makers (Hilbert, Bustos and Ferraz, 2005). Thus, countries differ in the pace at which they are advancing. Exogenous policymaking factors include a country's level of development, stability and political orientation, and the degree to which the importance of the information society issues are recognized. Endogenous factors, which are subject to political and executive branch decisions, include the degree of participation and consensus being sought,

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3 There are four analytical stages in public policy, and these are not necessarily consecutive: identifying the problem, formulating policy, executing it and monitoring or evaluating it. Creation or identification is the process by which certain problems attract serious ongoing government attention as potential objects of public policy. Design or formulation consists of more or less related activities within a process involving numerous and varying types of decisions by different governmental and non-governmental stakeholders interacting as they develop and shape the basic decision involved. Policy formulation includes identifying goals and objectives, defining alternatives for action to achieve them, evaluating the possible effects of the different alternatives and selecting a combination of these. Execution or implementation consists of putting a plan into practice. Monitoring or evaluation is a process through which Government and civil society judge the real merits of the processes that have been put in place (Campero, 2000 and Aguilar, 1996).

4 In the analysis below, information society policy is understood to include only those initiatives that develop the concept comprehensively, i.e., that promote mass access to ICT, provide training of human resources and foster the creation of electronic content and applications in the various sectors of a society. Even when a country has e-government strategies in place, if a country's ICT policies on education or software development are executed in isolation rather than as part of an integrated policy, the country cannot be considered to have national ICT strategy as such. A country is considered to have a digital agenda if one has been explicitly formulated and set forth in a specific document, or if the agenda is contained implicitly in a broad-ranging, high-level document, such as a national development plan (Lahera, 2002).

the hierarchical level at which policy decisions are made, the specific institution selected to oversee such decisions, the quality of administrative management, and the availability of resources.

The environment surrounding a country's national strategy is shaped by its level of development. This includes traditional socio-economic metrics (per capita income and human development indices), as well as a country's degree of awareness and preparedness for creating an information society.[5] The level of awareness among the political class is a vital component, not only in the phase of policy formulation, but throughout the entire process. It ultimately provides the driving force for implementing specific policy actions. Other factors exogenous to policy itself —such as growth trends, macroeconomic conditions and overall political stability and orientation—affect the continuity of the process, the priorities of government and the importance that a government places on digital policy at each step of the national strategy process.

Endogenous factors include the level of participation of different stakeholders, which can affect the perceived legitimacy of the consensus achieved at the policy-formulation stage, thus determining the long-term viability of the process. Another endogenous decision concerns the level in the government hierarchy at which to install the entity charged with coordinating or executing the national strategy also affects the ultimate outcome, as does the degree of institutional development of that body. Both of these realities —hierarchical position and institutional development— shape the ability to successfully carry out the assigned task. A further and significant factor is the nature of the policy document that emerges, specifically, whether it is legal or administrative in nature. A policy set forth in a legal instrument is more binding than an administrative decree. The resources available to support the strategy also play a role at the various strategic stages and includes decisions on how these resources are managed and deployed at the operational level and whether clear procedures for coordination between the different stakeholders are established.

With these factors serving as a backdrop, table XII.1 shows the status of efforts, as of January 2009, to define and execute public policy for the creation of the information society in 25 of the region's countries. It indicates stages of progress, summarizes the characteristics of current policy documents and identifies any previous, related documents, as well as describing the institutional framework established to carry out the strategy.

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[5] For example, the World Summit on the Information Society 2003-2005 (WSIS) stimulated debate in the initial stage of identifying the problem, and contributed to greater governmental awareness of the importance of the digital paradigm for countries throughout the developing world. It reflected the global consensus that ICT should be an object of public policy. This is an exogenous factor that influences national policy making in this field.

Table XII.1
NATIONAL DIGITIZATION STRATEGIES IN SELECTED LATIN AMERICAN AND CARIBBEAN COUNTRIES, JANUARY 2009

Country	Characteristics of current document			Background and stage of progress		Institutional framework of current strategy		
	Title of document	Period of effectiveness	Type of document	Previous document and year produced	Phase of ICT policy	Principal coordinator	Strategic responsibility	Operational responsibility
Argentina	Digital Agenda Strategy Argentina	2008 undefined	Definitive	National Programme for the Information Society, 2000	First generation (Execution)	Secretary of the Cabinet and public management	Technical Secretariat of the Presidency	n.a.
Bahamas	Policy Statement on Electronic Commerce and the Bahamian Digital Agenda	2003-Undefined	Definitive	No previous document	First generation (Execution)	Ministry of Finance (Office of e-Business Development)	Inter-agency commission	Ministry of Finance
Barbados	Barbados National ICT Strategic Plan	...	Draft to initiate policy process	No previous document	First generation (Formulation)	National Advisory Committee on ICT	Inter-agency commission	Ministry of Commerce, Consumer Affairs and Productive Development
Bolivia (Plurinational State of)	National Plan for Digital Inclusion 2007-2010	2007-2010	Draft to provide policy continuity	Bolivian Information and Communications Technology for Development Plan (ETIC), 2005	First generation (Formulation)	Agency for the Development of the Information Society in the Plurinational State of Bolivia (ADSIB) and Vice-Ministry of Science and Technology of the Ministry of Planning and Development	Inter-agency commission	Technical Commission (Interagency)
Brazil	None	n.a.	n.a.	Information Society Green Book 2001	First generation (Formulation)	n.a.	n.a.	n.a.
Chile	Digital Strategy 2007 - 2012	2007-2012	Definitive	Digital Agenda 2004 - 2006	Second generation (Execution)	Committee of Ministers for Digital Development	Inter-agency commission	Executive Secretariat housed in the Ministry of the Economy (interagency)
Colombia	Connectivity Agenda	2000- Undefined	Definitive	No previous document	First generation (Execution)	Institution known as the “Connectivity Agenda”	Office of the President of the Republic	Board chaired by the Ministry of Communication
Costa Rica	None	n.a.	n.a.	National Science and Technology Plan 2002-2006	First generation (Initial stage)	n.a.	n.a.	n.a.
Cuba	Umbrella Programme for the Digitization of Cuban Society	...	Definitive	Policy for the digitization of the society	First generation (Execution)	Office for Digitization, Ministry of Information and Communications Technology	Council of Ministers	Office for Digitization, Ministry of Information and Communications Technology
Ecuador	National Connectivity Agenda (Action Plan 2005-2010)	2005-2010	Definitive	None	First generation (Formulation)	National Connectivity Commission	National Connectivity Commission (inter-agency)	National Connectivity Commission through Special Technical Committees
El Salvador	The e-country Programme	2007-2021	Definitive	None	First generation (Execution)	National Commission for the Information Society	Office of the President of the Republic	Organization
Granada	ICT Strategy and Action Plan 2006-2010	2006-2010	Definitive	ICT Strategy and Action Plan 2001-2005	Second generation (Execution)	Central Information Management Agency	Central Information Management Agency	Office of the Prime Minister
Guatemala	National Information and Knowledge Society Agenda	2007-2015	Definitive	None	First generation (Execution)	Not established	Not established	Not established
Guyana	ICT4D Guyana, National Strategy, Final Draft	...	Draft	National Development Strategy 2001-2010, chapter 6	First generation (Execution)	Office of the President of the Republic	Inter-agency commission	Office of the President of the Republic

Table XII.1 (concluded)

Country	Characteristics of current document			Background and stage of progress		Institutional framework of current strategy		
	Title of document	Period of effectiveness	Type of document	Previous document and year produced	Phase of ICT policy	Principal coordinator	Strategic responsibility	Operational responsibility
Honduras	None	n.a.	n.a.	n.a.	First generation (Initial stage)	n.a.	n.a.	n.a.
Jamaica	E-Powering Jamaica 2007-2012	2007-2012	Definitive	NICT Strategy 2002-2006	Second generation (Execution)	Central Information Technology Office	Interministerial (Strategy Steering Committee)	Independent, with ties to the Ministry of Commerce, Science and Technology
Mexico	National Development Plan 2007-2012, National e-Mexico System	2007-2012	Definitive	National Development Plan 2001-2006	Second generation (Execution)	National e-Mexico System	Secretariat of Communications and Transportation	Secretariat of Communications and Transportation
Nicaragua	None	n.a.	n.a.	National ICT Development Strategy, 2005	First generation (Initial stage)	n.a.	n.a.	n.a.
Panama	None	n.a.	n.a.	National Agenda for Innovation and Connectivity 2005	First generation (Initial stage)	n.a.	n.a.	n.a.
Paraguay	None	n.a.	n.a.	National Plan for Development of the Information Society 2002 2005	First generation (Initial stage)	n.a.	n.a.	n.a.
Peru	Peruvian Digital Agenda	2005-2014	Definitive	None	First generation (Execution)	Multisectoral Commission for Monitoring and Evaluation (interagency)	Presidency of the Council of Ministers	National Electronic Government and Information Technology Office (ONGEI) of the Presidency of the Council of Ministers
Dominican Republic	National Strategy for the Information Society, Strategic Plan 2007-2010	2007-2010	Definitive	None	First generation (Execution)	National Commission for the Information and Knowledge Society	Technical Secretariat of the Office of the President of the Republic	Technical Support Unit (UTEA) headquartered at INDOTEL
Trinidad and Tobago	Fast Forward	2003-2008	Definitive	None	First generation (Execution)	Steering Group of the National Information and Communications Plan	Ministry of Public Administration and Information, with interministerial coordination	Steering Group
Uruguay	Digital Agenda Uruguay 2008-2010	2007-2008	Definitive	Sin documento anterior FALTA TRADUCCIÓN	Second generation (Execution)	Agency for the Development of the Electronic Management Government and Information and Knowledge Society (AGESIC)	Office of the President of the Republic	Agency for the Development of the Electronic Management Government and Information and Knowledge Society (AGESIC)
Venezuela (Bolivarian Republic of)	National Telecommunications, Information Technology and Postal Services Plan 2007-2013	2007-2013	Definitive	National Information Technology Plan, 2001	First generation (Execution)	National Information Technology Centre	Ministry of Science and Technology	Ministry of Science and Technology

Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on information from the Observatory for the Information Society in Latin America and the Caribbean (OSILAC).

The fact that 20 of the 25 countries are in the initial phase of creating their national digitization strategies (first generation agendas) highlights the fact that these issues have only recently been recognized as a subject for public policy. At the beginning of 2009, nearly one fourth of the countries did not even have a preliminary document to guide a digitization programme, and one third had defined such a programme only within the previous two years. Eight countries have been in the initial stages of conceiving and formulating first-generation policies for some years, i.e., they have yet to begin implementing any policy. Another ten countries are currently executing their first generation of digital agendas (Argentina, Bahamas, Bolivarian Republic of Venezuela, Colombia, Cuba, the Dominican Republic, El Salvador, Guatemala, Peru, and Trinidad and Tobago). Only five (Chile, Granada, Jamaica, Mexico and Uruguay) are in the second-generation stage, having completed implementation of their first-generation ICT strategies.[6]

The disparate pace of progress in the countries' ICT policy process is due to the exogenous and endogenous factors cited above, as well as to their impact on the different phases of the policy formulation and implementation process. Following the figure (below) is an examination of the effects that these factors have on the stages of identifying, formulating and executing programmes.

(a) Initial stage: identifying the problem

In the initial stage, it is essential that public authorities be fully convinced that ICT are an appropriate subject for public policymaking. Absent that conviction, the process will never progress to subsequent stages. The level of awareness among policymakers is mostly an exogenous factor in the development of digitization policy. However, it can be endogenously fostered by influential individuals or interest groups that have access to high-ranking decision makers. In cases where ICT as a policy issue has not yet matured —among the political class and in other sectors where the technologies could be incorporated— pressure from sectors closely associated with ICT and, therefore, fully convinced of their benefits (e.g., telecommunications regulators, science and technology officials and promoters of e-government) has sometimes led to partial national strategies that lacks the political support necessary for it to thrive. This occurred in Paraguay, where various efforts were made to define a digital strategy. The strategy ultimately remained in the proposal stage, as the result of a lack of acceptance among decision makers in various sectors

[6] With the exception of Mexico, explicit policies predominate in Latin American and Caribbean countries. The analysis here views the e-Mexico system as a national strategy that is implicit in the framework of a State policy, as set forth in the National Development Plan 2001-2006.

(e.g., education, health and the productive sector) whose participation is essential to the creation of an information society.

(b) Formulation: creating consensus

The formulation stage is highly complex, in that it requires reaching a consensus on policy objectives, as well as agreement on what actions should be taken. The legitimacy of the consensus is a direct function of how fully the interested parties have participated, and the duration of this phase of the process depends on the degree of that participation. The multisectoral nature of ICT can vastly prolong this stage, given the very different priorities of the participants involved. Peru, for example, began formulating its national strategy in 2003. Only in 2005 did it complete the process, with implementation getting under way in 2006. The complexity of coordination and consensus building, necessitated by the multiplicity of stakeholders and officials involved, can not only cause delays, but can actually lead to a stalling of the entire process. In Brazil, the presence of a large number of entities each competing for its share of leadership, and the intervention of subnational governments, created additional obstacles to reaching consensus on the adoption of a national programme.

Notwithstanding the complexity of the participatory process, the involvement of all relevant actors in the process of building consensus is a prerequisite to establishing the perceived legitimacy of the proposed strategy. Failure can prevent the process from moving to the next phase or make any agenda extremely unstable. In order for strategies to have continuity over time, shared responsibility must be a basic criterion, and there must be a bottom-up approach that draws on decentralized collective intelligence, along with a simultaneous top-down approach that relies on support from authorities at the highest level of the public sector.

The top-down element is of special importance, given that external factors such as political and economic stability can have strong repercussions on policy formulation. In Argentina, the crisis at the beginning of the 2000 decade changed political priorities, and ICT were relegated to a secondary status, although Argentina has been a pioneer in adopting measures in this area. Only in 2008 was Argentina once again in a position to continue where it left off in 2000. Progress in countries currently involved in defining digitization policies has also been affected by external factors associated with changes of government, since such shifts place new individuals in vital positions. Ecuador and the Plurinational State of Bolivia established their initial strategies in 2005, but the policies remain stuck in the formulation stage while the proposals of previous governments are revised and reshaped. In Chile, lack of continuity in the leadership of the team responsible for the 2004-2006 digitization programme delayed the formulation of a second-generation programme.[7]

The case of the Plurinational State of Bolivia demonstrates the ability of a bottom-up model to produce results that retain their legitimacy even with a change of government. The country's ICT strategy (ETIC, 2005) is an example of the best practices in participatory policy formulation. The process, involving consultation and the defining of needs, lasted 14 months, involved 3,176 individuals from over 700 organizations, and enjoyed active participation from all sectors. Although the bottom-up approach led to an excessively dispersed set of objectives and areas for action, it gave the strategy a degree of legitimacy that has kept it in place to the present time. However, the growth in collective awareness was not sufficient to implement the policy —a move that requires the propulsion provided by top-down forces.

Thus, the position in the hierarchy and the state of institutional development of the entity responsible for the policy are decisive elements in the success or failure of the policy. Table XII.1 also identifies the authorities responsible for coordination, strategic management and operations. Most of the region's countries have implemented digital strategies based to a greater or lesser extent on coordination between government, the private sector and civil society. The strategies of the various countries follow different patterns of organization and coordination, ranging from decentralized models in which authorities from particular sectors participate in an environment of institutional interdependency that facilitates cooperation and coordination, to centralized models in which one agency dominates.[8]

(c) Execution: drawing from decentralized resources

Having a set of public ICT policies does not, in itself, guarantee effective execution. In fact, only 16 of the 19 countries in the region with digitization policies are in the execution phase. Policy implementation gives rise to numerous opportunities and expectations, brings different powers and interests into play, creates greater burdens of work and responsibility, and necessitates new operations and decisions, all of which makes execution a complex and conflict-ridden process. In such a context, it

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7 The Digital Agenda 2004-2006 enjoyed strong leadership from a group of advocates within the public sector (Grupo Acción Digital, 2004). The result was a coherent programme that featured specific actions, a focus on priorities, and monitoring procedures to evaluate progress. Although the programme's viability was never questioned, debate on a new strategy did not occur until the second half of 2007, with a strategy finally being adopted in January 2008.

8 Hilbert, Bustos and Ferraz (2005) emphasize the practice of assigning responsibility for strategic planning and for operations to different agencies. Strategic planning agencies generally report to the highest sectoral authorities, while the task of operational execution comes under the purview of more technical bodies.

is difficult to create and implement a coordination mechanism to reconcile differences and generate harmonious, effective collective action (Campero, 2000). Success or failure at this stage depends on factors such as the commitment of the stakeholders concerned, the institutional framework for coordinating the multiple players involved in consensus decision-making, and the resources available. The degree of commitment is a function of the level in the political hierarchy at which responsibility is assumed. Thus, within the countries of the region, ICT have been of major importance because of the fact that the countries' digital policies are often embodied in the guidelines of national development plans, giving them a higher position in the hierarchy. The plans of Bolivarian Republic of Venezuelan, Chile, Colombia, Jamaica, Mexico and the Plurinational State of Bolivia, as well as those of Guyana and Trinidad and Tobago, are part of the respective national development plans of those countries, while in the Dominican Republic, Ecuador, El Salvador, Peru and Uruguay, they are more specific in nature and are not necessarily part of broader national plans.

In terms of implementation, the legal status of the policy-concept document is also important. It is difficult to implement policies if the agreed strategies and action plans do not have a legal foundation, as evidenced by examples where the national strategy is merely an administrative decree of a particular ministry or sectoral authority. Only Colombia, Ecuador and El Salvador have documents that give legal status to a strategy detailed in an administrative document. However, these documents alone do not guarantee the continuity of the process from the definition stage through to execution. In Ecuador, a centralized vertical decision in November 2002 led to the formulation of a National Connectivity Agenda. However, at that stage the absence of sufficiently broad participation prevented it from having the legitimacy needed to enlist the efforts of those stakeholders who had not been included in its formulation. Thus, having a legal instrument is effective only insofar as it serves to validate a consensus that reflects the interest of a broad segment of the population.

Despite progress in coordination, there have been difficulties in execution, due to institutional weaknesses and an absence of the political support necessary to implement horizontal actions. Most commonly, leadership takes a collegial form, consisting of different types of committees. At times, a particular individual, with political backing and interministerial cooperation, serves as a coordinator. The most successful cases are ones in which the process has support from the country's highest political officials, for unless they fully appreciate the importance of ICT, the strategy is doomed to failure.

In addition to the inherent difficulties involved in these initiatives, there are problems of bringing to bear the necessary resources, which generally must come from the meagre budgets allocated to the agencies involved. In some countries, such as Colombia and Ecuador, ICT projects executed by different government entities have been subject to audits covering the provision of computers to schools, investments in databases for the health sector, payment of salaries of ICT personnel in government offices, etc., though it seems appropriate that spending for large social projects and private initiatives should also be included. Chile's Ministry of Finance is the only entity in the region that has ever made ICT spending a part of the government budget. In 2004, it required agencies to itemize ICT expenditures in their annual budgets (DIPRES, 2005).[9] The exercise showed that it was actually not necessary to obtain any additional or new funds for the implementation of the goals set forth in the Chilean digital agenda. The resources were available, however, distributed among the budget lines of different public authorities. The total spending came to US$ 205 million, many times higher than the US$ 5 million assigned to the much-cited Chilean telecommunications development fund in the same period. Roughly three quarters of the funds were allocated to regulation and only a quarter to incentives (Hilbert, 2010). In some countries, the ICT budget (including foreign assistance contributions) of the entity charged with policy formulation or execution is a matter of public knowledge. This is the case in Paraguay, Peru and the Plurinational State of Bolivia. However, most public resources allocated for digitization programs have no corresponding item in the budget of the relevant institution. Since all government entities allocate a portion of their budgets to ICT, coordinating these resources should be one of the central elements of any national strategy to develop an information society. Monitoring and auditing the decentralized funds that are allocated to ICT in the diverse departments of the public sector is the first step in coordinating those resources in order to create synergies. Without such an effort, policy documents all too often turn out to be empty structures, without any meat on the declarative bones.

The level of participation and commitment of the stakeholders, the institutional strength of the organizations involved and the availability of resources not only determine whether the execution phase will begin, but how effective it will be. Most of the countries in the region have fallen short in advancing every aspect of their programmes. Priorities have taken over. In Colombia, for example, execution centres on e-government —an area that has been made a priority for the country— while in Peru some activities associated with regulatory amendments were delayed in favour of infrastructure and connectivity.

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9 The exercise showed that approximately 2.3% of Chile's public spending is dedicated to ICT. Excluding regional and local government, this totalled approximately US$ 205 million in 2004.

2. Quality of the agenda

The formulation of a good public policy must address not only implementation and economic factors, but also the political and social underpinnings, institutional orientation and responsibilities, definition of clear objectives and plans of action, anticipated results, and monitoring and follow-up mechanisms. Below is an examination of some of these elements in Latin American and Caribbean countries that have government programmes or policies for information society development.

(a) Underpinnings

The formulation of public policy will contain a central conceptualization of the issue at stake, as well as an outline of the aspired vision and more or less concrete objectives to get there. The countries of Latin America and the Caribbean are, for the most part, well aware of the role and importance of ICT in developing an information society. Policy that is formulated in an explicit way will cite elements such as the horizontal nature and basic purpose of ICT, and will incorporate the premise that this purpose should be development *with* —not simply development *of*— these technologies. This provides a realistic framework for viewing the various options in the region's countries. It focuses on a social and human approach that takes account of the need to address and remedy specific problems of poverty and inequality, and of the need to promote social rights. In the Dominican Republic, for example, these priorities are clearly established by merging an agenda for human development with the ICT agenda, which is one of the pillars of the country's Strategic Plan 2007-2010.

As indicated above, in only 3 of the 18 countries with ICT policies do related policy documents enjoy legal status. The remaining ones are relegated to an administrative status, making them far weaker tools for affecting public policy.

(b) Types of objectives and clarity in plans of action

In most of the countries in the region, agendas, and their associated objectives, are fairly specific and operational in nature, and are linked to plans of action.[10] As might be expected, programmes of this type include a strategic phase, i.e., a broadly conceptual element concerned more with vision and public policy expectations than with plans to be implemented. Proceeding on the basis of a policy that consists solely of strategy, without

10 The policies of the Bahamas, Colombia, Dominican Republic, Ecuador, El Salvador, Jamaica, Peru, Trinidad and Tobago and Uruguay include both strategic and operational objectives, while those of Barbados, Bolivarian Republic of Venezuela, Chile, Guyana, Mexico and Plurinational State of Bolivia focus exclusively on strategic objectives.

corresponding plans for concrete action, can be a risky proposition, since such policy is, in practice, little more than an expression of intent.

Existing action plans come up short in regard to one necessary component, namely, the need to have a clearly defined series of measures that make it possible to identify specific events that would trigger particular actions. In most cases, the guidelines in these plans have more to do with the allocation of responsibilities, and with the coordinating agencies, than with the details of actual tasks or means of implementing them. Jamaica's policy defines the priority activities for each sphere of action, thus giving clarity to the sequence of measures contemplated. The Dominican Republic has emphasized the need to create coordination mechanisms, and has established specific roles for the principal stakeholders; however, it has not provided any degree of specificity that could serve to catalyse and ensure future action.

(c) Estimating costs and funding alternatives

This is one of the areas in which the region's countries are weakest. In some cases, measures to address the issues simply do not exist. Except for Ecuador, the countries are not taking steps, within the policy formulation phase, to deal with cost estimates or budgets. Surprisingly, these factors are not considered a fundamental part of formulating an agenda.

In cases where there is mention of funding, the approach is vague and centres primarily on the question of funding sources. Colombia's programme, for example, states that it will "combine State funds, telecommunications funds and international cooperation", without any further specifics or estimated amounts. The Bolivian plan is comparable in this respect, though it adds, as sources, "international loans, funds from the Technological Development Bank, the National Regional Development Fund and the Global Digital Solidarity Fund of Geneva". While the Dominican Republic and Peru take a similar approach, Chile and Jamaica are introducing a number of additional specifications to reflect the requirement that each entity responsible for a given area of ICT policy is to be accountable for its work.

(d) Factors used to evaluate effects and management

Like all public policy, ICT policy should make provisions for evaluation right from the start of the conceptual and design stage. In fact, the design itself may, in some cases, be shaped by the evaluation of actions being contemplated. Among the region's countries, however, only Dominican Republic, Ecuador, Peru, Trinidad and Tobago and Uruguay include performance indicators in their programmes. Even those countries that are now in the second generation of their ICT policies have not advanced significantly in this respect. Chile's current formulation provides for a number of performance indicators, and sets forth specific actions associated with most of its goals. In the past, however, that country's monitoring consisted simply of surveys employing international indicators.[11] The region also lacks indicators to gauge the effectiveness and efficiency of policy management, such as cost-benefit indicators, average unit costs and indicators of whether specific norms or standards have been met.

3. Content of the agendas

Despite the novelty and complexity of ICT policies, initiatives in the region are maturing, and a learning experience is under way. Initially, the strategies had taken a technological approach designed to encourage the development of ICT. Their objective was to strengthen telecommunications infrastructure, the hardware and software industries, ICT equipment in schools and public offices, etc. In many cases, the objectives were unrealistic. This, added to the fact that the dominant rhetoric at the time focused on policy design and formulation, and led to initiatives that were insufficient to implement specific actions and projects. Consequently, a number of strategies remained stuck in the definition phase and are now being reformulated. The current approach is designed to encourage the development of different sectors through the use of ICT, as is the aim of second-generation agendas. Thus, the goal focuses not on ICT per se, but, rather, on incorporating them in productive and social processes, as instruments capable of enhancing efficiency and transparency and improving information management, while at the same time fostering the creation of knowledge.

The countries' agenda items reflect a tendency to use ICT more as a means of achieving social integration and development than simply as a means of promoting economic development. Although both elements are present in all of the programmes, an analysis of the issues that they address shows an emphasis on content relating to social inclusion and improved quality of life. The subjects found most commonly in the agendas of the 17 countries with ICT policies for which information was available are: e-government and developing access and infrastructure, followed by formation of human capital and content creation. The subjects associated with the productive sector, such as e-business and development of the software and hardware industries, are less in evidence (see figure XII.1).

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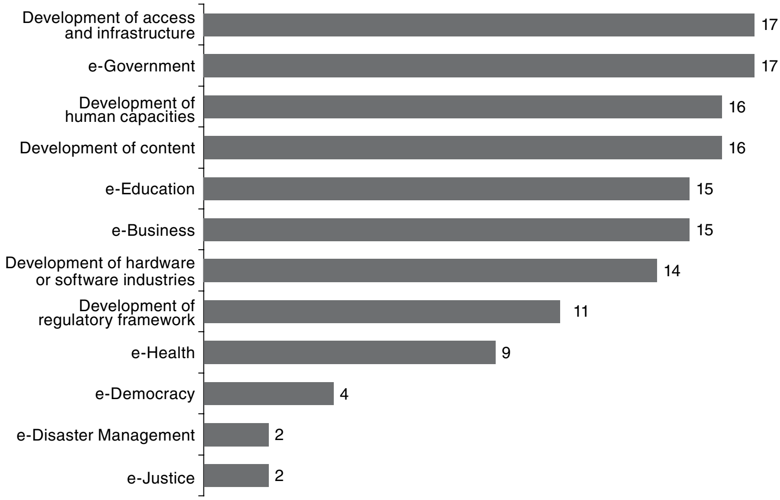
11 Chile's first-generation agenda had quantifiable goals that were periodically monitored.

Figure XII.1
SUBJECTS INCLUDED IN NATIONAL AGENDAS FOR THE INFORMATION SOCIETY, JANUARY 2008
(In number of agendas)



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), 2008.

Note: Includes the Bahamas, Barbados, Bolivarian Republic of Venezuela, Chile, Colombia, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Mexico, Peru, Plurinational State of Bolivia, Trinidad and Tobago and Uruguay. Information on Granada was not available.

Education is one of the areas in which the potential of ICT is most clearly recognized. Initiatives in this sector are long-standing, and it is one of the first to have distanced itself from a purely technological approach (Jara, 2007). Policy guidelines in the health and administration of justice sectors are less developed, reflecting a less pronounced recognition of the benefits of ICT, despite the fact that these are information-intensive sectors. The Caribbean countries focus predominantly on economic development, and their programmes emphasize actions to promote e-commerce and e-business, an approach consistent with their patterns of development that is heavily based on international trade.

The specific objectives set forth in the countries' agendas are undergoing a transformation. Strategies focus on increasing access to ICT by providing shared facilities (telecentres) —combined, in some cases, with computer literacy programmes. Only once this objective has been achieved, the focus shifts to content and quality of access, emphasizing the variety and quality of services, construed primarily in terms of bandwidth.

The development of e-government (see chapter IX), one of the areas in which the region has made the greatest progress, initially focused on the issue of creating a web presence, with initiatives first concentrating on establishing websites for particular public agencies. They then moved from informational websites to interactive sites that offer information and permit a degree of participation, such as downloading forms and carrying out online procedures. The belief that it is necessary to focus on processes in order for ICT use to create value led to improvements in management of the State, and to more efficiency of public services. In these cases, efforts targeted the central government, focusing on processes for which operational costs could be reduced and transparency increased. Examples of this include tax collections, issuance of invoices and receipts, customs procedures, fiscal accountability and public procurement. At the same time, advances were made in achieving interoperability between different government sectors.

In the education sector (see chapter VIII), all of the region's countries implemented government initiatives to strengthen Internet access in schools (in some cases providing broadband) and, to a lesser extent, efforts to reform educational processes and improve teacher development. The overriding objective was to increase students' equality of opportunity. Actions therefore centred on ICT access, sometimes as a complement to universal access programmes. Also of note are initiatives to promote the development and distribution of educational content, of which the Latin American Network of Educational Portals (RELPE) is an example.

In the 1990s, the concept of e-health (see chapter XI) was associated with telemedicine applications. Today's projects are oriented to the management of healthcare systems, principally in the area of electronic clinical histories and information systems. The two major impediments to developing e-health initiatives have been conflict with other priorities that demanded immediate attention —such as increasing the number of beds or improving primary care by providing new facilities— and the absence of effective leadership to build awareness of the potential of ICT for the sector.

4. Advances in critical areas and the status of policy development

Having analysed the current state of digital policy, the next step is to ask about the impact of those policies. This section looks at the impact in certain basic sectors of the information society: ICT infrastructure development and e-government. These two areas have been chosen since they are the areas in which the greatest number of long-standing initiatives have been in progress for the longest time.

To analyse infrastructure development, the ICT infrastructure and access sub-index of the ICT Development Index, developed by the

International Telecommunications Union (ITU), has been used (ITU, 2009).[12] This is a sub-index of five indicators of the penetration of ICT services, and reflects the population's access to these technologies. The indicators employed are: fixed telephone lines per 100 inhabitants, mobile cellular telephone subscriptions per 100 inhabitants, international Internet bandwidth (bit/s) per Internet user, proportion of households with a computer, proportion of households with Internet access at home. The higher the index value, the greater is the development of the infrastructure and ICT access.

Figure XII.2 shows levels of access to ICT infrastructure and the state of development of digital policy in various countries within the region, according to different criteria. A distinction is made between countries that are in the first generation of ICT policy and those that are in the second generation. In addition, first-generation countries are classified according to the stage of ICT policy (initial stage formulation or execution), and according to the intensity of their ongoing projects. For this purpose, the "high" or "low" intensity of projects is construed as the execution of programmes, projects or initiatives with a strong ICT component, which may or may not be integrated in sectoral digitization policies. The countries also differ according to the length of the time period during which their actions have matured, i.e., how long they have been working on a national ICT agenda. To simplify the analysis, the countries are divided into two categories, those with efforts that are ongoing for more than five years and those with more immature strategies.

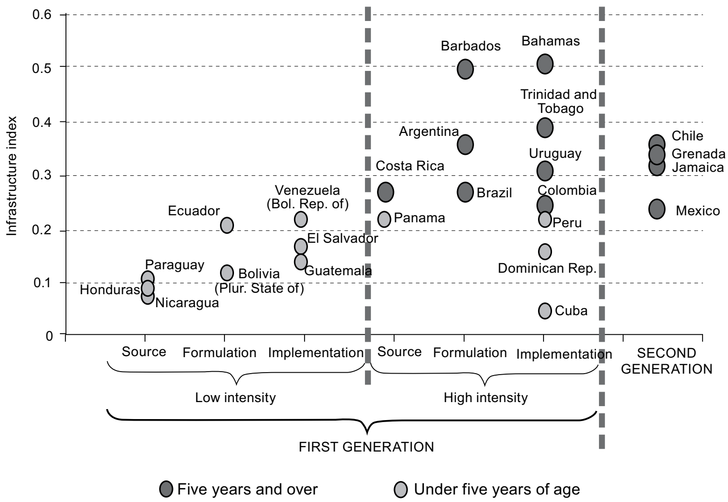
As the figure shows, the greater the number and longer the duration of a country's actions to promote ICT, the better is its access and infrastructure. Although advances in these areas are inter-related with level of economic development, some countries with similar per capita incomes show different levels of development in this process (e.g., Chile vs. the Bolivarian Republic of Venezuela, and Colombia versus El Salvador). In this respect, the most advanced countries are those with more mature digital policies and with the highest intensity of ICT projects on the ground.

The development of e-government is assessed with help of the Web Presence Index, developed by the United Nations Online Network in Public Administration and Finance (UNPAN). It is a subindex of its World e-Government Preparedness ranking and measures the online presence of national government websites, along with those of the ministries of

[12] The ITU ICT Development Index is composed of 11 indicators, grouped in three sub-indexes: ICT infrastructure and access, ICT use and intensity of use, ICT skills and the capacity to use ICT effectively.

health, education, welfare, labour and finance of each State.[13] The Web Measurement Index ranks these sites according to their sophistication, ranging from those that provide basic information to those that are interactive and transactional. Here, too, the higher the index, the greater is the government's online presence.

Figure XII.2
DEGREE OF DEVELOPMENT OF INFRASTRUCTURE IN 2007, AND STATUS OF DIGITAL POLICIES, INTENSITY AND AMOUNT OF TIME IN PLACE, OF ICT ACTIVITIES, DECEMBER 2007



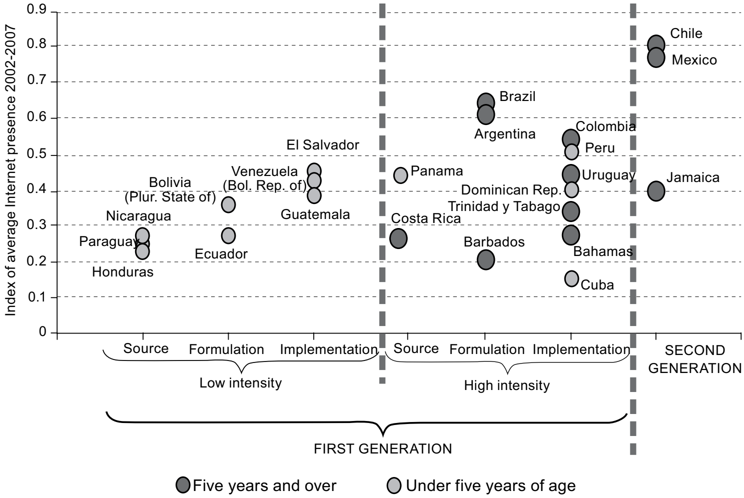
Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on the Digital Opportunity Index of the International Telecommunications Union (ITU). Note: In this figure, national agendas are assessed according to their development stage in December 2007. This differs from table XII.1, which assesses strategies in January 2009 (one year later). The earlier date has been selected to make the state of development comparable with infrastructure statistics (the 2009 statistics were not available at the time of writing).

Figure XII.3 shows the degree of development of e-government Websites and the stage of development of national ICT policy agendas in the region's countries. The classification criteria follow the same criteria used for figure XII.2. As with infrastructure development, the development of e-government increases with the intensity of projects

13 The world e-government preparedness index is designed to indicate the state of development in this regard among United Nations member countries. It reflects countries' capacity and readiness to use ICT tools to provide public services, and is based on web presence indices (assessing the sophistication of government websites), telecommunications infrastructure and human capital.

and maturity of the ICT policy agendas.[14] Examples are the experiences of Argentina, Brazil, Chile Colombia, Mexico and Uruguay. The fact that Chile and Mexico had already adopted their second generation of policies strengthens the hypothesis that better results are achieved when actions conform to guidelines on which there is broad consensus, and where there has been long-standing coordination in integrating these in digital policies and agendas.

Figure XII.3
INDEX OF ONLINE PRESENCE OF E-GOVERNMENT, STATE OF DEVELOLPMENT OF DIGITAL POLICIES, AND INTENSITY AND MATURITY OF ICT-RELATED ACTIVITIES, 2008



Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC), based on information from the online United Nations Public Administration Network. Note: In this figure, national agendas are assessed according to their development stage in 2008. This differs from table XII.1, which assesses strategies in January 2009 (one year later). The earlier date has been selected to make the state of development comparable with e-government statistics (the 2009 statistics have not been available at the moment of writing this report).

Finally, a high intensity of projects is vital in achieving digital development. Even when it proves impossible to define a coherent national policy agenda, it remains indispensable to take action. However, the countries that are in the best position to create an information society are those that have had the most coordinated and enduring ICT programmes. Countries that have had a national strategy in place for over five years

[14] The Caribbean countries are more highly developed in the infrastructure area than in e-government. None has an index above 0.5.

show the best results.[15] Although there are recognizable differences between countries depending on the stage of development of their policy and intensity level of related activities (figure XII.3), it is interesting to note that these differences are not as pronounced as in the case of infrastructure (figure XII.2). This suggests that the development of e-government is not as complex, not as inertia-dependent, and surely not as resource-intensive as the deployment of ICT infrastructure. Even countries with only few initiatives and incipient strategies were able to leapfrog into the e-government age and show tangible results after a very short time.

The results presented point to a virtuous circle between the consolidation of a coherent national strategy and progress achieved, although the possibility of inverse causality (i.e., that prior progress leads to the creation of a strategy) cannot be dismissed.

5. Lessons from national experiences

The development of public ICT policy in Latin America reveals disparities. Initiatives to implement ICT policy have been influenced by various factors —some inherent to the process, others exogenous. The endogenous factors include the institutional weakness of the organizations responsible for the policies. In combination with certain failures of coordination, institutional weakness can make it impossible to achieve a successful outcome. The lack of specifically allocated resources and the frequent use of the current budgets of each individual ministries have led to fragmentation in funding, with insufficient resources for combined activities. In some cases, lack of participation and of commitment by major stakeholders has deprived the process of legitimacy. This has led to changed priorities and serious discontinuity over time. Added to these factors are exogenous ones such as changes of government or of the individuals responsible for execution.

After years of failed attempts, a process of consolidation is beginning, and the region's national strategies have achieved greater maturity. They are more integrated with national development plans, and focus on incorporating ICT as an instrument of development rather than as a policy objective in themselves. The national strategies and agendas emerging from these initiatives stress areas such as e-government and education, without in any sense minimizing the issue of access and the need to strengthen capacities. Because of the innovative nature of the policymaking involved, results have often been achieved through individual leadership. This leaves open the question of whether the resulting policies will have ongoing viability, even with support from the highest levels of government.

[15] This includes the period between the presentation of formal initiatives and the definition and implementation of the agenda.

The sustainability and soundness of the national strategy are inextricably linked with the functionality and operational feasibility of ICT initiatives. Both need to be considered simultaneously.

Despite the progress made, the task of putting coherent, effective and operational national strategies into practice is still far from complete. The most important challenge is gaining the participation of the relevant public stakeholders and assigning them an active role in formulating national strategy. The countries best positioned to create an information society are those with the longest-standing coordinated initiatives in this area —even if, as is true in some cases, the actual effects of the initiatives are not yet visible in terms of performance. The abundance of initiatives is a positive sign, but if these were more closely coordinated under a single national strategy, they would produce better results, and would do so more rapidly.

It is clear from this overview that each country must determine the particular combination of variables that will best suit its own realities. There are multiple paths to the information society; which particular path is chosen will depend on the status of development in a given country, and on the factors that affect the creation, dissemination and adoption of ICT. Despite the importance of national differences, three general policy recommendations can be offered to increase the chance of success in establishing national digital agendas.

(a) Exploiting collective intelligence

The involvement of the community at large plays an indispensable role in constructing an information society, which includes the participation of leaders from all areas and sectors. In some countries, particular sectors tend to view the subject of ICT as their exclusive domain, and feel that allowing new actors and perspectives into the debate merely complicates the process. This can lead to situations in which, for example, the telecommunications authority and software industry determine the State's modernization strategy or decide which teaching methods should be used for digital education in the schools. While the experience of ICT experts is of vital importance, the knowledge of people who actually work in the sectors in which ICT are capable of having a major impact is equally important.

Moreover, the digital paradigm is still new, and is not always visible in the public agenda. Even in the most successful cases, a change of government can interrupt the process of national coordination. Working to create consensus and include all sectors in the process helps to ensure that the national strategy is not merely the programme of a particular government, but, rather, represents a genuine State strategy. ICT, themselves, can serve as an effective instrument for promoting this participation and for coordinating different initiatives.

Lastly, given the dynamic nature of ICT, and the fact that policy cannot always keep pace with rapid changes in the technological environment, there is no single "best" path. The collective intelligence, along with access to information and the ongoing education of decision makers, can help to reduce the uncertainty inherent in a process that continuously needs to adjust to a rapidly changing environment.

(b) Encouraging "advocates"

A successful outcome requires that the authorities involved in the digital agenda be included in the process. Creating awareness of the issue, and of its importance, is also essential in gaining the necessary commitment and cohesion. This requires the participation of opinion leaders capable of explaining why ICT are important for economic and social development, and who can translate often highly technical issues into clear, understandable and convincing messages targeted to different political and social sectors. These "advocates" may come from civil society, business, academia or government. Their participation can benefit all parties with an interest in digital development: telecommunications firms and other businesses, public officials concerned with e-government, educators, legislators and citizens. Given the fact that the topic is still a largely unfamiliar one, the involvement of opinion leaders is an important element. However, attempts should be made to ensure that leadership struggles and turf wars do not prevent the basic message from making its way onto the development agenda.

(c) Coordinating resources

National ICT spending can be considered from two perspectives: spending on specific and newly set up ICT projects, and ongoing spending by individual government entities on ICT goods and applications. The process begins with determining precisely what resources the country will invest in these technologies —an area not yet addressed adequately in national accounts. An even greater concern, however, is the lack of information on the proportion of their overall budgets that particular entities have dedicated to digital development. This deficit of information regarding actual ICT spending leads to underestimations of its role in the overall budget.

While software and telecommunications firms have a precise knowledge of what —and how much— they sell to the governments, the government itself often lacks a corresponding record of its purchases. This leads to a failure of coordination in incorporating the technologies, with resulting adoption of incompatible standards that leads to lack of interoperability between government agencies. This, in turn, requires costly modifications, sapping available resources. Fragmentation in the contracting and procurement process can also erode the government's bargaining power.

By identifying and disseminating budget information, the coordination of activities can be improved, while greater transparency in government accountability can reveal overlapping initiatives and enhance the process of negotiating with ICT providers. Sectoral authorities need to have access to project information from other entities, so that they can coordinate activities, set priorities for resource allocation and avoid duplications. It must be borne in mind, however, that although the centralization of information provides benefits, managing ICT resources should not take place on a centralized basis. Thus, ministries of education, for example, should continue to be responsible for deciding how to incorporate ICT in national curricula and schools, and telecommunications authorities should continue to assess and make decisions on what technology to use for providing connectivity in remote areas. At the same time, each entity must know what the others are doing, and what their resources are, so as to avoid redundant efforts and take advantage of existing synergies. For example, the installations of computers in schools can lead to important synergies with the establishment of telecentres in remote areas. Moreover, the entity responsible for overall coordination and execution of the national agenda should possess this information so that it can make effective recommendations on investment in ICT projects.

In short, the success or failure of an information society strategy depends on its organizational architecture and on its information and communication mechanisms. The strategy should establish and operate channels of communication with all sectors, while ensuring that the opinions of those overseeing the national-level strategy are taken into account. In order for activities to be effectively coordinated during the strategy's operational phase, there must also be adequate information on the resources that have been allocated.

E. The regional dimension

1. Its importance, origins and characteristics

The Regional Plan of Action for the Information Society in Latin America and the Caribbean (eLAC) is a policy agenda established at the regional level. In attempting to address the importance of ICT for the economic and social development of the countries, it seeks to further the process of adopting these technologies, through cooperation and sharing of best practices. The programme emerged from the World Summit on the Information Society (WSIS, 2003-2005), at which 175 countries signed a joint declaration that includes a political commitment. The declaration set forth 67 guiding principles, along with a Plan of Action containing 167 goals to be reached by 2015. Since most of these goals were not developed specifically for the Latin American and Caribbean region, there was clearly a need to formulate and develop a regional action plan to reflect the particular needs and realities of the Latin American and Caribbean countries. Out of this need, eLAC was conceived as the result of prolonged efforts by national authorities. It represents an operational tool for working to achieve both the global WSIS goals and the Millennium Development Goals.

The Regional Plan of Action is designed to achieve the following: create the conditions for implementing policies that coordinate and further existing initiatives; ensure that ICT are incorporated in the societies' different areas of activity; and take advantage of the economies of scale and cost reduction opportunities that ICT provide. The underlying idea in formulating eLAC was to identify the most urgent and important needs of the region. The result was the eLAC2007 Plan of Action, which includes 30 goals and 70 activities for the 2005-2007 triennium.[16] For the following three-year period, eLAC2010 was developed, with 83 goals to be achieved between 2008 and 2010. The purpose of these efforts is to create a bridge between the region's current realities and the goals of the world community, thus aligning the needs of the region's countries with global ambitions.

2. Objectives and characteristics of eLAC

To successfully work towards linking desires and regional realities, eLAC established guidelines corresponding to three types of objectives aimed at nuturing progress in different but complementary ways, namely:

- Strengthen regional projects. This objective was formulated to help shore up regional initiatives and cooperation projects, using collaboration and coordination as a means of generating the necessary synergies. Regional organizations specializing in specific areas are used, and where specialized organizations are not available, regional integration and cooperation ad hoc forums are organized. This type of goal aims at the creation of international synergies and at tackling problems that go beyond national borders.
- Set benchmarks. The aim here is to encourage initiatives and achievements in specific areas by establishing lines of action and defining indicators to measure progress towards the information society. This type of goal aims at showing progress and identifying best practices among countries.

[16] See http://www.ECLAC.org/SocInfo/eLAC.

- Explore critical issues. Efforts aimed at increasing knowledge and comprehension of elements that are critical to defining, designing, implementing and evaluating policy Studies that are conducted by working groups associated with relevant entities in each sector with the aim of producing a better understanding of new and complex issues. This type of goal aims to create a common understanding of issues that are relevant for all countries in the region.

The plan's goals can be categorized based on these guidelines. Most of the goals of both eLAC2007 and eLAC2010 are action-oriented and are designed to strengthen regional projects and increase understanding of critical issues. The goals are defined in terms of both specific actions and particular, quantifiable results. The region is making clear progress in its ability to establish measurable objectives. While only 10% of the goals in eLAC2007 met this criterion, 22% of the eLAC2010 goals were defined in such a way that quantifiable results can be tracked.

Considering the highly dynamic nature of ICT, eLAC takes an integrated view that combines long-range vision (a 2015 horizon) with short-term actions linked to a specific action plan. This innovative approach makes it possible to review progress towards objectives, and to reformulate goals in response to new needs (see diagram XII.1). Accordingly, ECLAC is constantly reviewing progress in terms of the eLAC goals (for eLAC2007 see OSILAC, 2007).

ECLAC also conducted a multisectoral Delphi survey on policy priorities, between April 2006 and September 2007. The goal was to assess the importance assigned to the eLAC2007 goals and to define a new regional programme for 2007-2010. The effort drew on contributions from 1,454 individuals from academia, civil society and the public and private sectors and is believed to be the most extensive online participatory policy-making foresight exercise in the history of intergovernmental processes in the developing world to date (Hilbert and Othmer, 2007; Hilbert, Miles and Othmer, 2009).[17] The document announcing the findings served as input for the negotiations that culminated in February 2008 at the Second Ministerial Conference on the Information Society in San Salvador, where a new action plan, eLAC2010, was developed. Of the 83 goals in eLAC2010, 60% were the result of multisectoral surveys.

Only 20% of the eLAC2010 goals have a high degree of similarity to those contained in eLAC2007. Although 50% of the 2010 goals relate to previous ones, they reflect adjustments to changing realities and modifications in light of progress in moving towards information societies.

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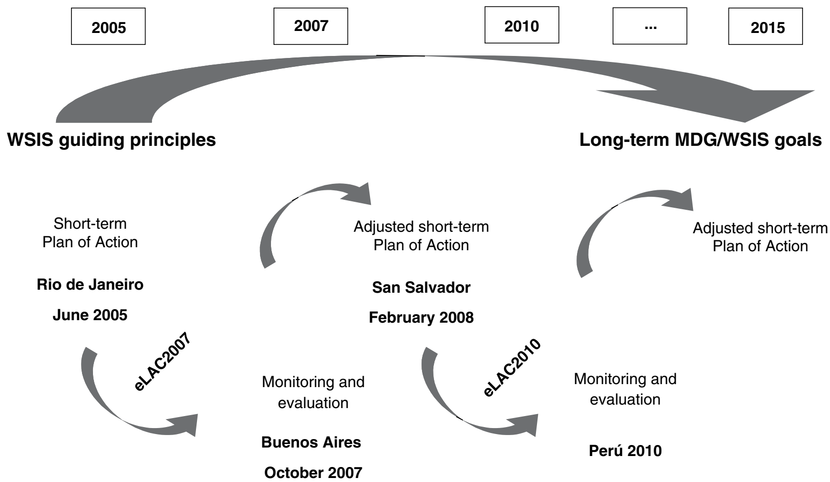
17 According to available information, the Delphi exercise is the largest online process of policy formulation in the history of inter-governmental activities in Latin America and the Caribbean.

Thirty percent of the goals identify new challenges for the 2008-2010 period. This exercise suggests that three years is a reasonable period for reviewing the goals of an ICT policy agenda, given that over half of the goals required revision, and that nearly one third of the new plan addresses issues that did not even appear in the regional policy proposals three years earlier.

Diagram XII.1
CONSECUTIVE SHORT-TERM PLANS FOR MEETING LONG-TERM OBJECTIVES, IN THE CONTEXT OF UNCERTAINTIES



Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on the eLAC Regional Follow-up Mechanism, *Bulletin* no. 2, eLAC2007.

Another innovation in eLAC is its emphasis on coordinating public and private action. Creating inclusive and efficient information societies requires that all interested sectors collaborate in public policymaking. The complexity of the task and the transnational nature of digital networks call for multilateral action strategies designed to encourage and shape the integration of the different countries as information societies.

Most of the initiatives outlined in eLAC2007 had already been ongoing for some years and counted with sustained public and private funding. The Plan of Action consolidated these and made them a point of reference for public and private efforts, with the goal of coordinating initiatives and creating synergies, thus avoiding overlapping efforts and freeing resources for new projects. Much of the activity contemplated in eLAC2007 has been carried out by the private sector and by civil society organizations in cooperation with government, which makes decisions on specific actions and on measures for coordination. The Plan of Action strengthens the functionality of the existing multilateral system by introducing certain features of direct democracy. This shapes a new style of multilateral action that provides room for both civil society and government (Maurás and Ferrero, 2007; O'Brien and others, 2000; Cox, 1997).

3. Progress on a multisectoral challenge

The Observatory for the Information Society in Latin America and the Caribbean (OSILAC) has conducted an inventory of the implementation of eLAC2007. The research studied 27 of the region's 30 most important thematic areas established in the Regional Action Plan. The monitoring report revealed progress and strong progress in 15 of the 27 thematic areas evaluated. The other 12 areas, however, showed insufficient or only moderate advancement (table XII.2). Note that each area includes a range of activities, and that levels of performance may differ widely from one country to another.[18]

Table XII.2
PROGRESS IN RELATION TO eLAC2007 THEMATIC AREAS

Area of concern	Goal	Progress
A. Access and digital inclusion	1 Regional infrastructure	Progress
	2 Community centres	Strong progress
	3 Online schools and libraries	Progress
	4 Online health centres	No progress
	5 Employment	Moderate progress
	6 Local government	Strong progress
	7 Alternative technologies	Moderate progress
B. Capacity-building and knowledge creation	8 Software	Moderate progress
	9 Training	Progress
	10 Research and education networks	Strong progress
	11 Science and technology	No progress
	12 Firms	Progress
	13 Creative and content industries	Progress
	14 Internet governance	Progress
C. Public transparency and efficiency	15 Electronic government	Progress
	16 Electronic education	Strong progress
	17 Electronic health	No progress
	18 Disasters	No progress
	19 Electronic justice	Moderate progress
	20 Environmental protection	Moderate progress
	21 Public information and cultural heritage	Progress
D. Policy instruments	22 National strategies	Progress
	23 Financing	No progress
	24 Universal access policies	No progress
	25 Legislative framework	No progress
	26 Indicators and measurement	Strong progress
E. Enabling environment	27 Follow-up to the World Summit and execution of eLAC2007	Strong progress

Source: Observatory for the Information Society in Latin America and the Caribbean (OSILAC) (2007).

[18] "Progress" in a category of activities does not mean that progress has been uniform in the region's 33 countries, or in all relevant areas of activity, nor does "no progress" necessarily exclude the possibility that there was progress with regard to specific aspects of the goals or in particular cases.

This research indicates that progress in strengthening capacities and knowledge, and in digital access and inclusion, has been greater than in the area of public transparency and efficiency and policy instruments. The latter area includes 5 of the 7 goals on which there has been no progress, while the former two include 9 of the 15 on which there has been either progress or strong progress.

There have been notable advances in connectivity, with installation of public ICT access centres, connectivity for local municipalities and government, and interconnection of research and education networks (primarily among the region's universities). Use of electronic applications in the health sector and use of digital tools for natural disaster management, by contrast, have stagnated. As pointed out in chapter XI, the digital age has not yet reached these sectors —sectors that are critical for development. The region's countries still face many unexploited possibilities in these areas. In terms of policy instruments, progress in funding and universal access policy, as well as implementation and functioning of legislative frameworks, has been in a state of paralysis. The dilemma of the universal access funds, as explained in chapter VI, not one of adopting legislation and legal/regulatory frameworks, but, rather, one of enforcement.

4. Lessons for regional coordination

The region's governments requested that ECLAC "develop indicators to facilitate ongoing evaluation and dissemination of the region's progress, particularly in regard to the eLAC2007 goals", and to monitor implementation of the plan.[19] Evaluation is especially important for formulating future, short-term plans. Progress in such plans needs to be monitored so that any necessary adjustments can be made. OSILAC conducted a second evaluation of eLAC in mid-2007 (OSILAC, 2007). Five conclusions provide feedback beneficial for future work, also for ICT policies at the national and local levels.

(a) Conceptually separating access, capacities, applications and policy can lead to a partial and fragmented approach to digital development

The analytical separation between access, capacities, applications and policy follows an approach to technology that has proven useful in researching and analysing information societies. This model is helpful in understanding the phenomenon, its dynamics and the inter-relationships between the different components of its development. However, while these analytical benefits are undeniable (Hilbert, 2010), monitoring of eLAC2007 indicates that the use of this type of conceptual framework for policy formulation can lead to a lack of integration in digital development,

19 Resolution 629 (XXXI), at: http://www.ECLAC.org/pses31/.

since there is a danger that access and capacities will be viewed as ends rather than as complementary means that lead to a common result.

This suggests that the approach to digital development policy should be based on the beneficiaries and target groups. In each sector, the development of elements such as access, capacities, applications and policy should be considered holistically. This is all the more important given the need to generate a virtuous circle among the different sectors of government. Access promotes use, which requires capacities; capacities, in turn, increase the demand for access. Thus, it is important to deal with these different areas simultaneously, through integral policies that address the specific needs of each sector of the economy and of society. ICT development should adapt itself to a society's current organization, not the reverse. Digital action plans should be structured with their beneficiaries and target groups in mind, and should promote development of access, capacities, electronic applications and policy in an integrated fashion.

(b) There are major benefits to using a digital action plan as a public-private meta-platform for regional cooperation

eLAC2007 was designed as a platform for public and private activities. Many of the actions it called for were executed by private entities and networks, with governmental support. The characteristics of digital development, as well as the horizontal and generic nature of ICT and the speed of the innovation cycle, make close public-private cooperation essential. Such cooperation facilitates significant advances in the activities that drive organizations and networks in civil society, academia, and among businesses and foundations. Considering the inter-relationships and points of similarity between public-sector and private-sector digital development, cooperation can have beneficial effects even in areas that are in the public domain. Thus, a plan of action for digital development can be an effective platform for public-private cooperation.

(c) The marked differences in public sector digital development from one country to another can serve as a basis for regional cooperation

OSILAC (2007) has found more heterogeneity among countries in public sector initiatives than with areas that are led by the private sector. Inequality of ICT connectivity of local governments and public schools is much more pronounced than differences between businesses and private schools. The fact that some countries with comparable levels of general development —and similar income per capita have advanced more rapidly than others, shows that although income levels are one determinant, they do not constitute an insuperable barrier. One of the major benefits of eLAC2007 has been the identification of best practices and an exchange of experiences between different governmental entities. In such a situation, these differences can be used as a means of promoting progress. OSILAC therefore recommends intensifying monitoring of activities as a way to identify best practices and facilitate sharing of experiences among the region's governmental entities.

(d) Activities designed to achieve quantifiable results are less useful if the indicators used to measure them are imprecise or are measured in relative terms

Few of the region's countries have conducted solid analyses of progress due to the lack of a systematic process for establishing quantitative indicators. Thus, the results-oriented goals in eLAC2007 had to rely on imprecise indicators such as "a considerable increase in…" or relative indicators such as "to double the number of…". One of the lessons learned is the importance of quantifiable goals in absolute terms as a means of advancing the policy dialogue. Despite the fact that some of the quantitative goals of the Plan of Action were articulated in 2005, when there was a total lack of data on progress in the region, the mere establishment of quantifiable objectives led to the creation of adequate indicators, and such, to evaluations of relevant phenomena that provoked greater debate. The vicious circle between lacking statistics and imprecise policy formulations has to be broken at some point. For example, eLAC2007 Goal 2.1 was to reduce the average number of potential users of community Internet access centres to "20,000 per centre" (making no distinction between public-sector and private-sector facilities). An (admittedly non-exhaustive) inventory showed that the average number of potential users per public access facility in 2005 was 2,345 (Maeso and Hilbert, 2006). In other words, the region had already passed the target by a considerable margin at the time the goal was established. Since then, some countries, such as Brazil, Chile, the Dominican Republic and Guatemala established national observatories to monitor this variable, and have obtained more precise results. The lesson learned, is that although there was little basis for establishing a measurable goal in absolute terms, it was more important to articulate the goal than to accurately determine a numeric value for it. The mere step to set up "some qualified goal" triggered a virtuous circle between the monitoring and the formulation of policies, thereby increasing available knowledge on the subject.

When formulating quantifiable goals, it needs to be considered that those should represent a (national or regional) average value. Different local districts or countries will naturally spread around this average. From the regional eLAC perspective, goals expressed in absolute values are not interpreted as a "minimum" for the region's 33 countries, but rather as a target average for the region (Hilbert and Othmer, 2007). The "minimum" criterion would not be useful, since it would be based on the least developed country;

this would mean that the region's quantifiable objectives would be defined on the basis of conditions in the most poorly positioned country.[20] Interpreting the goals as averages, around which there is a statistical dispersion, can provide a context for regional sharing of experiences, helping authorities to identify best practices and determine solutions to challenges similar to ones they themselves face. This can provide a basis for developing technical cooperation. It therefore follows that goals relating to quantifiable activities should be defined in terms of regional averages, and in absolute rather than relative terms.

(e) Action-oriented activities achieve greater progress if there is a clear definition of the partners and mechanisms of action

The most successful action-oriented activities are those that attempt to reinforce regional projects and increase knowledge. This is accomplished most effectively when implementation involves precisely defined mechanisms. The most significant progress occurs when plans specify the party that is to be responsible for the action —a working group, an organization or a specialized regional network (acting as a partner), whose resources, contacts and institutional soundness are capable of enhancing the effectiveness of the undertaking. The activities most successful in increasing knowledge are those that take advantage of the synergies created by working with an established institution, which can assist in appropriately channelling the initiatives. The eLAC Regional Follow-up Mechanism (2007) points out that formal cooperation with existing regional mechanisms does not conflict with an individual country's interest in presiding over discussions of particular issues. Indeed, an alliance of public entities and private institutions operating in the region can create synergies, providing the additional benefits that come from continuity and shared resources between national governments and international organizations from the public and private sector and civil society.

These lessons, drawn from the experiences of the countries of the region, are reflected in the new eLAC2010 Regional Plan of Action. This plan is a meta-platform for public-private activity, which seeks to integrate the initiatives of different actors specializing in varying aspects of information society development, in order to exploit the synergies generated. This spirit is embodied in annex 2 of the new plan, which lists 88 regional organizations in different sectors operating in areas related to the specific goals. Its sectoral approach —which focuses on education, infrastructure, health, public administration, the productive sector and policy instruments— lends itself to identifying actions that the various entities can carry out to increase ICT access, strengthen capacities and create electronic content, thereby promoting integral development and fostering the creation of the region's information societies.

[20] This would be the only way of ensuring that all of the countries could reach the benchmark level.

Chapter XIII

ECLAC recommendations

The new technological paradigm implies massive capacity for storage, as well as for rapid capture, communication and processing of information. This leads to a profound economic and social reorganization, known under the catch-word of "information society" development. It is a "long wave" of technological change that creates new possibilities for economic and social integration. However, the wide range of opportunities this offers also carries risks, especially for developing countries. In view of this situation, the international community has devoted attention to defining strategies for advancing towards the creation of information societies. The major initiative in this regard was the World Summit on the Information Society, held in Geneva in 2003 and in Tunis in 2005.

Prevailing economic, social and cultural conditions in Latin America and the Caribbean strongly affect both the possibilities of benefiting from the information society paradigm and the paths available for reaching it. These conditions will guide the choice of strategies for stimulating the development and production of ICT, and for expanding access, use and appropriation of a broad range of applications. There are several milestones in the region's efforts to reach the objectives established by the international community, as expressed, for example, in the Bávaro Declaration of 2003 and the Regional Preparatory Ministerial Conference of Latin America and the Caribbean, held in anticipation of the second phase of the World Summit on the Information Society in Rio de Janeiro, in June 2005. The Conference approved the Plan of Action for the Information Society in Latin America and the Caribbean, eLAC2007. This was originally a three-year plan (2005-2007), although it was conceived with a longer time horizon (2005-2015), and was the object of a Delphi exercise in 2007, which confirmed some of the priorities and reshaped others. The second Regional Ministerial Conference on the Information Society, held in San Salvador (El Salvador) in February 2008, extended the plan for three additional years, to 2010, when it will be evaluated at another Ministerial Conference in Lima, Peru.

It was against this backdrop that the present book was written. Its aim is to contribute to the analysis of policy options, and to provide a basis for expanding knowledge and understanding of current dynamics in two areas: developing production of ICT-related goods and services ("development of ICT") and using and appropriating these technologies for development ("ICT for development"). The proposals set forth below give particular emphasis to those aspects of public policy that are closely related to the nature of the technologies, the type of infrastructure they require, and the organization of markets and firms they entail.

A. ICT and their impact

The horizontal nature of ICT, and the fact that they are general-purpose technologies, shapes many of the conclusions presented in this book. ICT have contributed to economic growth, aided efforts to modernize the State, and furthered the goal of achieving equity. Their horizontal nature makes them potential tools for development in different areas of economic and social activity.

Experience shows that digitizing information and communication flows has a positive impact on productive processes and, consequently, on economic growth. In terms of social inclusion, mobile telephony, which has spread with greater speed and on a more massive scale than any phenomenon in the history of Latin America and the Caribbean, has had a remarkable effect, and has contributed to improving the quality of life of the region's poor populations. In addition to mobile telephony, the region has set up a large number of public ICT access centres that provide access to Internet services for people of different social strata. ICT have also led to the modernization of the State, and e-government developments have quickly resulted in considerable improvements in the cost of public services and in the transparency of public administration. Even without direct access to ICT, citizens benefit from these advancements indirectly.

The magnitude of the economic impact of ICT, as well as the benefits of applying the technologies, depends on the capacity, efficiency and effectiveness of their use, and on the supply of complementary goods and services. The economic impact of these technologies varies greatly from one country to another —a difference seen even in countries with similar levels of access to technologies. Increasing their impact requires initiatives designed to work in tandem with the technologies themselves, in sectors such as education, in the research and development arena (R&D), as part of legal frameworks, and as an aspect of the productive base. In short, investments in ICT cannot be expected to produce significant productivity gains unless there are also certain complementarities to ensure that they are used effectively.

The effects of technology are far greater if the technology is conceived of as part of a whole —i.e., as part of the social and productive organization of the society— rather than merely as an additional sector. In the mere analysis of information societies, it has proven useful to adopt a conceptual approach that distinguishes between digital access, capacities, applications and content. For example, statistics often present the levels of ICT diffusion and ICT access, the educational level of the society at large, or the sophistication of specific Webpages. Such an approach aids in understanding the phenomenon, its dynamics and the inter-related factors involved in its evolution. However, in setting policy designed to incorporate ICT in different economic and social sectors, indiscriminate use of this conceptual framework can produce a fragmented form of digital development. Concentrating efforts in a single area, such as access (public Internet access centres) or applications (e-government) tends to limit the focus on creating the necessary complementarities. Policy should therefore be oriented to end users and to sectors in which digitization is occurring (e.g., education, health and government), rather than being based on technological distinctions. This will make it easier to determine what ingredients will ultimately produce the best results.

Designing policy with the user in mind means that both the formulation and execution stages must draw on the participation of specialists in each area of ICT use —business, public administration, healthcare, education, national security, disaster management, etc.— and not merely that of technology experts and institutions specializing in telecommunications and computing. These sectoral specialists will be well positioned to explore ways in which technology can modernize and enhance their work, and to determine how technological gains can be assimilated (through greater efficiency, speed and transparency, and the exploitation of economies of scale and network externalities). The present book argues that policy in the region should evolve from "development of ICT" approach.

B. Development of ICT: hardware

The Latin American and Caribbean countries play only a marginal role in producing the goods that serve as a foundation for the digital paradigm, although a number of governments have implemented policies to support and accelerate participation in this arena. Efforts to attract foreign direct investment have yielded positive results, increasing exports, creating jobs, and even enhancing research and development activities. Nevertheless, the sector has not shown the kind of strength in the region that it has in some Asian countries, which took advantage of growth in these industries in the 1980s and 1990s to become producers of ICT-related goods for the world market.

Only a few of the region's larger countries —notably Brazil and Mexico— have succeeded in moving into segments of the world hardware market. These two countries took different approaches. Mexico is a major exporter of products assembled for the United States and Canadian market. Brazil primarily targets its domestic market, though it has also increased exports. Hardware production in other countries is less extensive, and consists almost exclusively of assembling imported parts and components. The development of higher value-added activities, and more intensive use of technology involving activities such as semiconductor manufacturing, requires a level of export competitiveness that is often the result of long-term sectoral policies.

One of the important aspects of sectoral policy is to support local production of components without jeopardizing the competitiveness of the end products sector. An important question for policymakers is whether sectoral policies can be used, with profitable results, to attract and retain electronic components manufacturers. In considering this, it should be borne in mind that a successful strategy requires considerable investment of public funds, with its attendant opportunity cost. Unless structural factors impeding the sector's growth are remedied, the most probable outcome will be specialization in niche applications or in product (not component) design —a situation that will be unable to sustain operations at a scale capable of substantially changing the nature of the region's hardware industry.

While hardware development, design and production generate highly skilled jobs, making it possible to accumulate experience for subsequent phases of ICT development and use, a lack of productive capacity does not, in itself, prevent the digitization of economic and social structures, since the equipment needed to accomplish this is commercially available on the world market.

C. Development of ICT: software and related services

Although the use of imported hardware for ICT has not created problems in most of the region's countries, the situation is different with regard to software and related services. Software facilitates and formalizes information flows and communications between organizations of all types, including businesses, hospitals, schools and municipal governments. Thus, software —especially software for business or for specific sectors— is an essential tool for increasing productivity and exploiting the potential of information societies, given that the software's architecture shapes the new organizational and institutional forms adopted by those involved. These information management and communications processes play a major role in determining the organizational system and the mechanisms used for coordinating internal and external networks; thus, particular attention should be given to local priorities and culture.

Transferring and adopting software systems from another culture also involves the transfer and application of organizational forms and processes. The resulting indiscriminate adoption of tools designed for users with different living and working realities raises serious questions. It is far from clear that information technology systems designed for the needs of the developed countries will address the characteristics and priorities of Latin America and the Caribbean, which have their own processes, cultures and customs.

Development of the software and related services industry in the region occurred largely on its own. Public policy to stimulate the sector is still very incipient. The relative weight of the software industry depends not only on a country's level of economic development and its supply of skilled labour but also on the trajectory and nature of domestic demand, the industry's patterns of specialization and even on fluency in English, which is the language primarily used in interfaces.

Based on the new possibilities of decentralizing software production, the main transnational firms in the sector are expanding their centres of operation in order to reduce costs and gain access to skilled human resources outside their countries of origin. As a result, some of the region's countries have become production poles for the world market, attracting labour-intensive activities. Despite these advances, the region's software sales, as a proportion of GDP, remained relatively stable over recent years. Most remarkable is that the sector's businesses mainly increased their exports. However, software production for export does not contribute directly to the digitization of business processes or of processes in hospitals, schools, municipal governments and other public- and private-sector institutions. Consequently, exporting software might create employment, but it does not necessarily contribute to developing information societies in the countries of Latin America and the Caribbean.

Achieving the digitization, adaptation and innovation required by users represents an enormous challenge to the professionals working in the region's software and related services sector, who represent a mere

0.2% of the employed population. This contrasts sharply with the situation in developed countries such as Canada, where 2% of employed persons work in these activities. Thinking about the tremendous challenges faced when digitizing the information and communication processes in hospitals, schools, businesses and municipalities throughout a country, it makes a decisive difference if 1 in 50 or 1 in 500 of the national work force specialize in this task. Moreover, the spread of ICT has increased the demand for skilled professionals, who are essential to creating the region's information societies, not only in the software industry but also within user firms. The development of regional production networks in this sector could be an effective mechanism for creating the critical mass and sufficient scale needed to achieve significant outcomes.

In order to drive this sector, appropriate educational programmes must be integrated with national ICT development strategies. It is important to improve secondary education in areas such as mathematics, computer science and English. Even more important, however, for growing the software industry in the medium and long term is the formulation of tertiary education policies, as well as policies aimed at developing technical and scientific infrastructure. This involves training high-level human resources, investing in research and promoting international cooperation. Such efforts are essential, since, unlike hardware production, the successful application, adoption and maintenance of software systems require knowledge of local processes. A true information society cannot exist without a critical mass of local contributors from this industry.

D. Development of ICT: telecommunications providers and regulation

In developed countries, the engine of telecommunications growth is data transmission services and Internet access. This situation is similar in the developing countries, although, in these countries, mobile telephony has received priority attention. There has been a significant slowdown in the growth of landline subscribers and, therefore, in fixed telephony revenues. The convergence of fixed and mobile telephony, and the replacement of the former by the latter, has induced telecommunications providers to explore synergies between the two segments. Today, there is a proliferation of convergent multi-pack commercial offerings that eliminate the traditional boundaries between different industry segments. Consumers now generally pay less for more and better services, and benefit from the dismantling of barriers between markets, allowing users to choose among a greater number of service providers.

An analysis of trends shows that value creation lies in supplying connection infrastructure, and in the content transmitted over the networks. From the perspective of providers, the increased traffic associated with the massive expansion of broadband is one of the principal growth segments, and constitutes one of the major challenges confronting the region, given what remains, in most countries, highly limited coverage —particularly in terms of access by the lower income population and people living outside the major cities. Initially, providers were not given incentives to offer Internet protocol (IP) access, because of the risk that switched telephone traffic would be replaced by voice over IP (VoIP). Given the decline in revenue from traditional communications systems, however, providers were compelled to invest in modernizing networks and incorporating broadband Internet access technologies.

The growing demand from increased traffic brought on by the new technology options will force providers to adopt next-generation fibre optic networks. Much work remains to be done in this respect, especially in terms of connecting the large international backbone networks.

Firms that have taken advantage of synergies and have managed to balance voice, data and image services may survive the changes in the industry. The creation and strengthening of this modern infrastructure requires a new cycle of investment, along with the necessary financing.

The region is moving towards convergence, and providers are abandoning the segmentation of the late 1990s and working to integrate different sectors of activity. In this context, duopolies have been established in the vast majority of Latin American countries, where two players, Telmex-América Móvil and Telefónica, have developed successful business strategies aligned with the objectives of the region's governments, which are determined to increase the penetration of services. Given an environment in which technological realities and market forces make it difficult for more than a limited number of providers to function efficiently, public policy must focus primarily on regulation and on protecting competition. In a heavily concentrated market, regulators and authorities responsible for protecting competition play a fundamental role. Moreover, the continuing weakening —and disappearance— of technical barriers is forcing regulatory agencies to conduct periodic reviews of increasingly diversified, convergent and interconnected markets for specific services.

A number of the region's countries lack any solid legislation to provide for ICT regulation, and enforcement by existing institutions still lacks effectiveness. The speed of technological change affects the barriers that prevent new actors from entering the market, and poses a complex task for legislators and regulators faced with the need to anticipate —or at least stay abreast of— emerging regulatory needs. Technological convergence blurs the traditional divisions between the areas in which businesses operate and compete. This dynamic poses difficulties for regulatory agencies, although, given the slow pace at which the market for convergent solutions is developing in the region, it is unlikely that debate will focus on network characteristics, as is occurring in developed countries. At present, the region is more concerned with instituting regulatory changes to allow for multi-pack services, including telephony, Internet and television. At the same time, the regulatory authorities of some countries are assessing the characteristics of the new networks and the adoption of regulatory standards, which will have a decisive impact on the development of advanced infrastructure.

These regulatory changes pose major challenges, since many of the region's regulatory agencies are still new and have not yet established solid positions or clearly defined their operational agendas. In broad terms, the current situation calls for these agencies to promote efficiency in the sector, while at the same time taking into account the goal of achieving equity and universal service. These two aims can —at least in the short term— be contradictory, and the relevant agencies may simply not have the necessary analytical tools to define appropriate lines of action. The consequent lack of clear priorities may bring them to a state of paralysis. Hence the rationale for establishing an institutional separation between the entities responsible for promoting market efficiency and those responsible for social objectives and for ensuring equity in the provision of services. While the two functions are in many respects complementary, such a separation would provide for more sound and transparent decision-making.

Given these realities, the region's regulatory agencies, in order to function more effectively, need to be strengthened in three areas. First, they must be made fully independent. Second, their responsibilities in promoting efficiency in the sector and in ensuring that services are provided equitably need to be more clearly defined. Third, their technical capacities need to be enhanced. These measures are vital if the often contradictory and competing challenges associated with convergence are to be successfully addressed, which includes, among other things, preventing overlapping regulatory activity within sectors, shifting from ex ante regulation to ex post measures designed to protect competition, addressing the multiplicity of economic and social objectives that regulators may be called on to deal with.

E. The intellectual property rights debate

The countries of the region are developing new frameworks in an attempt to strike a balance that will allow innovators to appropriate the benefits of their activity, while at the same time ensuring that everyone has access to the benefits of innovation. This requires three types of action. The first involves developing intellectual property rights legislation that provides maximum flexibility, so as to facilitate the dissemination of knowledge and information at reasonable prices, while complying with international treaties. The second is developing complementary policy and legislation in particular areas —innovation, education, protection of competition and consumers' rights— that take full account of intellectual property rights. The third is establishing legal and institutional frameworks that allow for the expression of divergent interests: those of the owners of goods protected by intellectual property rights, and those of consumers or users.

Since greater protection of intellectual property rights alone will not provide all of the incentives needed to stimulate investment in developing new knowledge —which inevitably generates externalities— it is essential to reshape and strengthen policy in ways that foster national initiatives for research and development, technology transfer to small and medium-sized firms, training of highly skilled labour and development of high-quality systems for learning. It is particularly important for the countries to continue exploring and —based on public sector demand, providing incentives for— open source software. Thus, approaches to intellectual property rights issues must transcend the boundaries of regulatory legislation and institutions, focusing instead on institutions and policies concerned with education, protection of competition and innovation.

F. Development with ICT: education

In the course of the Delphi exercise on policy priorities of eLAC2007, contributors from the public and private sectors, academia and civil society singled out education as the most urgent issue. In nearly all of the region's countries, a similar consensus can be found within the community concerned with ICT for development. This consensus crosses lines of gender, educational level and occupation.

Although training in ICT use is increasingly important in the information society, many people still lack the basic skills needed. Therefore, most LAC-country ICT policies in the area of education include strategies to encourage ICT use by teachers and students. The goal is to provide students the skills they need to perform successfully in the information society. Nevertheless, many schools still lack computers, and an even greater number have no Internet access. In this regard, there are large gaps between public and private schools, and between the students themselves in the respective types of institutions. Private school students tend to come from higher-income families with computers and Internet access at home. Public school students therefore suffer from two types of gaps: one in school, the other at home. Public policy, to date, has failed to ensure that both groups of students have adequate ICT access and the basic skills needed to use the technologies. While ICT policy in developed countries emphasizes students' digital skills, along with teaching and learning processes, attention in developing countries still centres on access and basic use. Thus, the region is following a path similar to that of the expansion of basic education in the region, in which plain access, not quality, was the first issue to be addressed.

In addition to expanding the coverage and quality of ICT in schools, it is important to broaden and expand training strategies, in order to ensure that teachers have the capacities and skills to use these technologies in their teaching. Efforts must also be made to develop pedagogical approaches that follow integrated models for use of ICT. Demand for these new skills and capacities needed to create knowledge, generate change and innovation, and engage in life-long learning require that new curricula be developed and implemented.

ICT can improve education by changing the ways students learn and the way teachers teach. This can be accomplished by promoting student-centred pedagogy, and by encouraging commitment and ongoing interaction and dialogue. In order for ICT to be used effectively in education, there must be a coherent, enduring pedagogical framework, employing school and classroom practices that are consistent with a national pedagogical strategy. Unfortunately, many of the teaching models used in the region's classrooms have been developed without taking adequate account of the possibilities of digital technology. Moreover, no clear estimates are yet available as to the academic-performance benefits of ICT. To fill this gap, indicators that measure not only the incorporation and use of the technologies, but also their impact, must be developed and deployed.

In terms of content, the countries are seeking ways to offer state-of-the-art software solutions and applications that reflect current educational needs. One important initiative in this regard is the Latin American Network of Educational Portals (RELPE), through which content developed by national educational websites is freely shared, taking advantage of the low cost of reproducing and disseminating digital content.

The need to involve sectoral specialists is clearly evident in the field of education, where such specialists (i.e. educators) need to appropriate ICT as a means of improving content, strengthening teaching methods and promoting effective learning in individual subject areas. Although all of the countries in the region signed the Geneva Plan of Action (2003), with a commitment to adopt, by 2015, primary and secondary school curricula that address information society objectives, the reality is that

ICT development and education are often treated as parallel and separate initiatives, rather than convergent ones. The education sector must take on the challenge of making ICT an integral part of coherent educational reform focused not only on optimizing pedagogy through ICT use, but also on training future generations to use the technologies.

G. Development with ICT: e-government

The success of e-government depends on network interoperability. It is relatively simple and inexpensive to design and launch informational (front office) websites, especially when compared to the challenge of integrating the multiple digital systems that digitize the way the entities process information internally (back office operations). Without interoperability among different public information systems, it is impossible to provide one-stop-shop portals that allow all formalities to be handled at one website. The direct beneficiaries of such interoperability include citizens and firms, as well as government agencies, which thus are relieved of the need to locate and provide the same information multiple times. Interoperability also promotes transparency, since it facilitates stricter controls on fraudulent activity. In this regard, it is important that information be shared among different government agencies, to avoid the danger that individual agencies will focus solely on their own needs, creating "islands" of information that render information handling inefficient and disconnected, thereby impeding the smooth flow of information. All of this requires stronger governance measures with regard to e-government. Moreover, greater attention must be devoted to the standards and institutions necessary for effective information-sharing agreements, with parallel practices and common standards being adopted by the various public agencies.

A number of Latin American and Caribbean countries have made significant progress in ensuring the interoperability of their e-government solutions. The benefits of computerization and interoperability are also evident in relations between the countries of the region. For example, initiatives are under way in the MERCOSUR, Central American and the Andean countries to develop interoperable applications. These include initiatives to harmonize customs systems to facilitate international trade.

ICT should be used as a resource to develop coordinated mechanisms by which different countries can exchange information and integrate their processes. This will help reduce the cost barriers that have prevented the achievement of common objectives. Interoperability among e-government systems should be considered a tool for political integration and for the harmonization of standards in areas such as international trade, telecommunications infrastructure, regulation, migration, social assistance, health, education, technological innovation, the environment and macroeconomic cooperation. To this end, activities have been designed to ensure that, within a specific time period, the region has an efficient, legally secure, interoperability environment and common platform, with convergent standards and disciplines, and that it is making progress in regard to infrastructure and connectivity. The White Book of e-Government Interoperability for Latin America and the Caribbean, developed by the various authorities of the Latin American and Caribbean countries in cooperation with ECLAC, the Organization of American States (OAS) and the Inter-American Development Bank (IDB), represents an important step in this direction (ECLAC 2007). The coming years will be decisive for implementing these concepts and regulations.

At the same time, internal and external interoperability of national information systems requires clear policies for protecting people's privacy. The lack of such policy could discourage the use of electronic media for communicating with government, for fear that the information supplied may be subject to mishandling or fraud. Thus, initiatives for interoperability, and the related regulations to protect privacy, must be developed in tandem.

H. Development with ICT: e-business

In terms of businesses transitioning to an e-business model, the results of the Delphi exercise on policy priorities for eLAC2007 indicate that firms —those, at least, in the formal sector— are no longer experiencing major problems in accessing ICT. However, to ensure that businesses will be able to adapt to the digital age, training needs to be provided to entrepreneurs and workers.

Firms in the region must simultaneously computerize their internal and inter-firm processes. This contrasts with experience in developed countries, where most of firms' internal processes had already been computerized at the time the Internet emerged —a development that made inter-firm communication possible. The ability of businesses in Latin America and the Caribbean to fully exploit the potential of e-business will depend on computerizing their internal operations. This poses new challenges for software developers, who will have to provide appropriate and reasonably priced solutions. Computerization of process, reorganization of management and the corresponding training of human resources are time- and resource-intensive activities. To meet the challenge of this transition, small and medium-sized firms will also require systems of financing.

The region's firms must not only prepare for the new environment by incorporating technological change and importing solutions and business practices from more advanced economies, but must also have tools designed for their specific needs. This makes it indispensable to have a critical mass of technical professionals capable of modernizing local processes. For Latin American and Caribbean firms, the challenge consists of fully incorporating the competitive potential of e-business in their productive processes.

I. Development with ICT: e-health and disaster management

Information and communication processes are fundamental to the health sector, where ICT have many potential uses. Despite these possibilities, and the fact that the sector receives high priority in development agendas, health services in Latin America and the Caribbean have yet to move into the digital age. Hospitals and public health centres still suffer from limited technological resources. The process of computerizing different processes remains fragmented and weak, and content is scarce, with little evidence of coherent programmes and policies to remedy these deficiencies.

Bringing the sector up to date technologically is essential, and is urgent for purposes of human development. This process must not be postponed. Experience in other sectors, e.g., regional collaboration among different educational websites, can be helpful in this regard. A number of countries in the region are facing similar challenges in the health sector; thus, the development of networks to facilitate the sharing of information could be useful.

Various projects in the region have demonstrated the benefits of telemedicine and remote patient care. This is especially relevant for inhabitants of remote areas that have few health workers and medical professionals, and where diagnostic equipment is poor or nonexistent. It is also important to computerize internal processes within healthcare institutions. However, the lack of software adapted to local needs, as well as a lack of interoperability between systems, makes this difficult. Incorporating large databases and complex processes for supplying and managing resources represents an enormous challenge for the health sector. Common standards for interoperable systems should be in place at the outset, since introducing them later poses major problems.

Little progress has been made in the region with regard to privacy protection —an essential element of health sector interoperability. Making advances in this area requires that specialists in legislation, digital development and health bring their knowledge together through interdisciplinary dialogue —a process made difficult by the different "codes" employed by each profession. Here, again, detailed analysis of experiences in other regions will prove helpful.

A similar recommendation applies to natural disaster mitigation and management. Despite advances in institutional development and coordination in this area, much work remains to be done in terms of increasing knowledge of ICT and using them to full effect. This is particularly true with regard to strengthening regional cooperation in all phases of the disaster management cycle, including mitigation, preparatory measures, response and recovery.

J. Policies for development with ICT

Meeting the challenges of ICT policymaking requires a broad view of the technologies, as well as an understanding of other aspects of development. Because of its horizontal nature, the success of information society policy depends on an ability to establish and operate channels of coordination and communication with all sectors of the economy and society. The specific nature of the knowledge needed to computerize processes in education, business, health and government makes it impossible to centralize these policies. At the same time, the features of ICT themselves create opportunities for common learning, economies of scale and inter-dependent relationships that can be exploited to coordinate decentralized activities, provided that coherent strategies or programmes are brought to bear. The Latin American and Caribbean countries have progressed at different rates in defining and implementing policies to encourage the creation of information societies. Although many of them began this process in the early years of the new century, only in the last few years have these policies taken concrete form. Only four countries have advanced to second-generation digital strategies. This process has been affected by both endogenous and exogenous factors, creating delays and a lack of continuity.

Endogenous factors include the institutional weakness of the relevant entities, and the lack of specifically allocated resources, leading to a high degree of dependence on dispersed ministerial budgets, which are rarely adequate for the activities contemplated. Moreover, at times, a lack of participation and commitment on the part of the stakeholders involved affects the legitimacy of the process, creating a lack of continuity that is accentuated by factors, which are exogenous to the circle of influence of ICT decision makers, such as changes of government and changes in the officials responsible for implementing policy. In other cases, a dearth of knowledge about ICT within the political class has impeded the development of initiatives proposed by sectors associated with these technologies.

However, with the passage of several years, the beginnings of a consolidation of national strategies within the region, a more mature approach to ICT can be seen. In this new phase, digital strategies are being incorporated in national development plans, giving them higher status in the policy hierarchy. The issues most emphasized continue to be those of mass access and e-government, though attention is also being given to strengthening capacities. The smaller economies (such as those of the Caribbean nations) have made major progress in the area of access, but have failed to move forward on e-government, while in the larger countries (Argentina, Brazil, Colombia and Mexico) the opposite is the case.

Despite the progress achieved, the task of implementing coherent, effective and operational national strategies in Latin America and the Caribbean is still far from complete, and mechanisms for creating institutions that will have legitimacy, and continuity through changes of government, continue to be a high-priority need. The greatest progress in the region has been in enlisting different public sector actors to assist in formulating national strategies. However, given the innovative nature of the issues, efforts to implement these policies still depend largely on individual leadership —a situation that jeopardizes the continuity of the process.

Evidence suggests that having a large number of initiatives helps to stimulate development in certain areas. Moreover, achieving positive results seems to occur more rapidly if there is a comprehensive strategy in place to coordinate efforts. In other words, while the presence of a wide range of initiatives is a prerequisite to progress, coordination leads to greater synergy and better results.

ECLAC recommends that these strategies be defined and implemented in ways that increase coordination and lead to more efficient allocation of available resources, taking full advantage of the collective intelligence drawn from specialists in different sectors. To this end, there must be opinion leaders capable of explaining the importance of ICT for economic and social development and of identifying the resources that individual government agencies are dedicating to ICT —a task that, in nearly all of the Latin American and Caribbean countries, still requires considerable work. Lack of knowledge about allocation of ICT resources in the public sector —i.e., where they are being directed and what amounts are being allocated— seriously limits possibilities for savings, coordination and synergy.

In terms of regional policy, the eLAC Regional Plan of Action serves as a tool for intermediation between the urgent needs of the Latin American and Caribbean countries and the global commitments for 2015 made in the context of the Millennium Development Goals and the World Summit on the Information Society. The eLAC programme contains two innovative features. First, it is a short-term plan with a long-term vision; second, it brings together actors of all types who are interested in creating the region's information societies. This makes eLAC a "meta-platform" for coordinating actions in the public and private spheres. Though inspired by a long-term vision (2015), the Plan of Action consists of specific, short-term actions for the 2005-2007 and 2008-2010 periods, making it possible to periodically review the progress achieved and to reformulate objectives as particular goals are met, and as required in order to align them with the dynamics of ICT. Moreover, given the inter-relationships and similarities between digital development initiatives in the public and private sectors, it is essential to develop a framework for cooperation, so as to optimize the positive effects, even in areas that lie exclusively within the public domain. Close collaboration between the two sectors is essential, and eLAC must clearly identify and take into account all stakeholders —including their various objectives and activities— and facilitate exchanges between them.

As a regional policy process, eLAC has enjoyed broad support and recognition from Latin American and Caribbean governments. Since only in the long term will the true magnitude of the effects be measurable, the challenge is to keep the process alive and to achieve even more international synergies.

K. Conclusion

The digital divide is a fast-moving target. Experience shows that technical change and the impact of ICT in the coming years will be greater, and broader in scope, than the advances of the last few decades. This acceleration of technological progress creates a need for institutional frameworks designed to meet the challenge in a systematic and ongoing fashion.

ECLAC views the digital divide as consisting of two dimensions: breadth (extension of access) and depth (quality of access). Even if digital networks become available to all inhabitants, some will no doubt enjoy increasing bandwidth —and thus be able to make use of advanced multimedia services— while others will be limited to voice communications. This situation poses two challenges. Efforts must be made to increase efficiency, so as to ensure high-quality services as inexpensively as possible; at the same time, there must be an emphasis on equity, in order to ensure adequate coverage. Mobile telephony offers an instructive case study. The spread of this technology represents a record for the region. This historical success story has been possible thanks to the leadership of an innovative private sector, whose market forces were tightly regulated by government regulators that assured ongoing competition. With regard to equity, a number of countries have created funds to finance the expansion of infrastructure to support basic connectivity. Supplementary measures are still needed, however, to ensure that firms and individuals will be able, from the start, to benefit from minimum levels of access and use, while eventually being able to exploit the full potential of ICT. This will require subsidies in order to compensate, at least partially, for income inequalities between individuals and between locations. This in turn will call for careful analysis to determine proper subsidy levels and to decide how such subsidies are to be managed —and whether direct or cross-subsidies are most appropriate. While each option has its benefits and costs in terms of economic efficiency and political effectiveness, the two alternatives are not equally viable. Given the reality of convergent technologies and a highly competitive sector, reductions in telecommunications providers' revenue per user limit the amount of cross-subsidies that can be granted.

Public access to digital information optimizes the use of scarce resources, while providing ways to share the costs involved in ongoing modernization of the technology. The challenge of moving from multiple isolated initiatives aimed at providing the public with access to the digital information available in the region, to a State policy with a stable institutional framework, remains a difficult one. Moreover, as in any complex social system, the problem of rapid obsolescence of equipment, along with that of providing adequate training for users, has no simple, intuitive solution.

Given the horizontal nature of the technologies, policies to support ICT as a means of exploiting the collective intelligence must secure the participation of the highest national authorities, as well as of computing and telecommunications experts and professionals from sectors that use ICT (businesspeople, educators, physicians and health officials, public administrators, etc.). Because of the speed at which technology changes —based largely on forces exogenous to the region— those making decisions on behalf of the region's authorities face an extremely high degree of uncertainty. ICT themselves can be used to provide mechanisms for collaboration and virtual consultation and have already proven useful in gaining the full and effective participation of different sectors.

In conclusion, ECLAC believes that the countries of Latin America and the Caribbean must redouble their efforts to narrow the digital divide, in terms of both breadth and quality of access, while at the same time intensifying use of ICT to foster efforts to evolve into information societies. Accordingly —as promised in the introduction to this book— several fundamental recommendations can be proposed, based on the analysis set forth in the various chapters. First capacities and complementarities must be developed to fully realize the effects of ICT on economic performance and social integration (see chapter IV.B). Second, software capacity and related services must be developed to meet the needs of the region's countries as they attempt to computerize their economic and social structures (see chapter VI). Third, there must be an alignment of the mandates for efficiency and universal service that have been assigned to different regulatory agencies, while strengthening agencies' independence and technical capacities. Fourth, efforts must be made to develop or, depending on the particular country, strengthen any existing initiatives for coordinating resources, in order to create synergies and avoid duplications, and asynchronies —and even incompatibility— of objectives (chapter XII). Fifth, differences in ICT access and use among countries is not a threat but can be seen as an opportunity to benefit from new intra-regional cooperation initiatives that exploit the benefits of international exchange (chapter XII.E). Sixth, those responsible for sectors that use ICT, such as in education, health and business, must be given incentives to assume increasing leadership in overseeing policy issues assigned to them (chapters VIII-XI). Last, but not least, far beyond the reach of a book, attention needs to be focused on strengthening the instruments and institutions responsible for implementing regional initiatives and national and sectoral ICT policies, so as to reduce the gap between words and plans, and real action.

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