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Why National Strategies are Needed for ICT-Enabled Development

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Senior Advisor, ISG

No. 3 September 2003

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The world is in the midst of a general-purpose technological revolution. Although this revolution has taken many names, there is little doubt that it is a *technological revolution*, or a new techno-economic paradigm, brought about by a set of new information and communication technologies (ICT).

The ongoing ICT revolution, combined with the forces of globalization, has provoked the hopes and fears of countries at all levels of development to either leapfrog to the new economy or be left out of the loop. A growing number of developing countries has been inspired by the success stories of fast growing exports of ICT services from a diverse group of countries such as Singapore, India, Taiwan, China, Korea, Malaysia, Ireland, Israel, and Finland. As a result, the response of many governments is to formulate national ICT policies and strategies, where ICT is treated mainly as a sector or industry. Donors and aid agencies have responded by piloting a variety of ICT applications for specific sectors or target groups, including ICT components in development projects, dealing with telecommunications infrastructure as a free-standing sector, and recently by carrying-out e-readiness assessments.

ICT offers substantial opportunities for development effectiveness. ICT has a pervasive impact on competitiveness and all aspects of life in advanced economies as well as potential impact on social and economic development. Therefore, the strategic significance of ICT for enabling national development and poverty reduction strategies must be operationalized by countries striving to gain a competitive edge. In fact, economic history, the cumulative learning and transformation process involved in using ICT, and the pace of this wave of technological change suggest that, with timely action, many developing countries could participate in a technological revolution no less profound than the last industrial revolution.

This paper explores the need for national strategies for ICT-enabled development, including:

- The challenges and opportunities created by the information and communication technology revolution and their implications for development policy and strategies.
- The many ways ICT is likely to impact social and economic development, illustrating the strategic significance of ICT for enabling national development and poverty reduction strategies.
- An examination of why developing countries should look ahead and try to adapt and harness ICT in support of economic and social development.
- The importance of mastering the use of ICT has become a core competency for competition and sustained development.

- A broad view of the promises and risks of the ICT revolution and its potential impact on, among others, productivity, markets, organizations, and education.
- A rationale for designing national strategies for e-development (or e-enhanced development) and the options, objectives, and major thrusts for such strategies in support of economic growth, poverty reduction, and the Millennium Development Goals.

About the ISG Staff Working Paper Series

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About this Paper

This paper is intended to provide a broad perspective on ICT work and we hope it will be of particular interest to readers who are engaged in such work.

About the Author

Nagy Hanna is currently a senior advisor on e-development at the World Bank, focusing on ICT-enabled development strategies and integrated e-development projects. Previously he was a lead economist, corporate strategist, evaluator, and private sector development specialist.

Table of Contents

1. INTRODUCTION *1*
2. OVERVIEW *1*
3. TECHNOLOGICAL CHANGE AND OPPORTUNITIES FOR DEVELOPMENT *3*
4. PROMISES OF A TECHNOLOGICAL REVOLUTION *4*
4.1. Attributes of the ICT Revolution 4
4.2. Impacts of ICT 5
4.3. Three Fundamental Roles 6
5. PERVASIVE AND INCREASING IMPACT *7*
5.1. Impact on Markets 7
5.2. Impact on Organizations 8
5.3. Impact on Competitive Strategies 9
5.4. Impact on Innovation 10
5.5. Implications for Financial and Other Services. 10
5.6. Implications for Employment 11
5.7. Implications for Education 11
5.8. Implications for Regional and Spatial Development 12
5.9. Implications for Poverty Reduction 12
6. RISKS AND BENEFITS *13*
7. OPTIONS FOR DEVELOPMENT *15*
7.1. Promoting the ICT industries 15
7.2. Deploying ICT 16
7.3. Investing in ICT 16
8. IS A NATIONAL E-DEVELOPMENT STRATEGY NEEDED? *17*
8.1. Raising Awareness 18
8.2. Building Coalitions 18
8.3. Clarifying Roles and Responsibilities 18
8.4. Focusing and Prioritizing 18
8.5. Mobilizing and Complementing Market Forces 18
8.6. Scaling Up 19
8.7. Leveraging ICT 19
8.8. Reforming the National Innovation System 20

9. OBJECTIVES & THRUSTS OF ICT-ENABLED DEVELOPMENT STRATEGIES..... 20
9.1. Sustainable Growth..... 21
9.2. Reducing Poverty..... 22
9.3. Millennium Development Goals..... 23
9.4. Integration into Overall Country Development Strategy..... 23
10. ISSUES FOR AID AGENCIES..... 24
11. CONCLUSION..... 25
12. REFERENCES..... 26
13. ABBREVIATIONS..... 31

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Why National Strategies are Needed for ICT-Enabled Development

1. Introduction

This paper aims to improve understanding of the challenges and opportunities of the information and communication technology (ICT) revolution and their implications for development policy and strategies.[1] It examines why developing countries should look ahead and try to adapt and harness ICT in support of economic and social development. It also provides a broad view of the promises and risks of the ICT revolution, as well as its potential impact on productivity, markets, organizations, and education, among others. Finally, it outlines the rationale for designing national strategies for e-development (or e-enhanced development), and the options, objectives and major thrusts for such strategies in support of economic growth, poverty reduction and the Millennium Development Goals (MDGs).

2. Overview

A growing number of developing countries have been inspired by the success stories of fast growing exports of ICT services from a diverse group of countries such as Singapore, India, Taiwan, China, Korea, Malaysia, Ireland, Israel, and Finland. Similarly, the EU countries have been inspired by the dynamism and productivity increases of the US economy in the 1990s, and the emergence of the so-called new economy or knowledge economy. The ongoing ICT revolution, combined with the forces of globalization, has provoked the hopes and fears of countries at all levels of development to either leapfrog to the new economy or be left out of the loop.

The response of a growing number of governments is to formulate national ICT policies and strategies, where ICT is treated mainly as a sector or industry. Donors and aid agencies responded by piloting a variety of ICT applications for specific sectors or target groups, by including ICT components in development projects, by dealing with telecommunications infrastructure as a free-standing sector, and most recently, by carrying out assessments of e-readiness.

ICT offers substantial opportunities for development effectiveness. The complexity and expense of some ICTs, and the urgent needs of the poor, have led some to doubt the relevance and priority of

[1] ICTs are defined as technologies that facilitate communication and the capture, processing and, transmission of information by electronic means. This definition encompasses the full range of ICTs from radio, television, and telephones to computers and the Internet.

ICT for development, while others have hailed the promises of these technologies as the great hope for developing countries.

Perhaps the ongoing technological revolution is so profound and pervasive that it challenges many traditional economic concepts that are rooted in incrementalist thinking. The transformative role of ICT may be difficult to capture in national statistics, due to several kinds of measurement problems (IMF, 2001; David, 2001). However, the evidence in terms of economy-wide productivity is most clear in the case of the USA, as a range of studies suggests a contribution of about one percent in labor productivity in the 1990s (Gordon, 2000; Oliner and Sichel, 2000, Jorgenson and Stiroh, 2000; Council of Economic Advisor, 2001). Other studies suggest a significant increase (0.8 percent) in total factor productivity (TFP) growth, particularly driven by both ICT-producing and intensive ICT-using sectors (Kenny and Motta, 2002; Gordon, 2000; David, 2001). Some recent research suggests that ICT has driven the post-1995 revival of the productivity of the US economy, almost doubling TFP (Brynjolfsson, 2003). The evidence of impact on productivity is even more pervasive and persuasive across countries at the microeconomic, firm, and industry sector levels.

The relatively recent and low usage of ICT in developing countries suggests that this revolution has not yet had a significant impact on economy-wide productivity, except for the Asian tigers (Dewan and Kraemer, 2000). In order to have significant impact on growth, a country needs to have a significant stock of ICT or users in place and perhaps be more advanced in using that stock for economic transformation. But even in the context of a number of middle income developing countries, studies indicate a significant ICT contribution to firm productivity (for example, Fay and Lall, 2002; Gauasch and Sanchez, 2000). In Korea, a comprehensive ICT strategy has been a key driver in the miracle rebound of its economy from the financial crisis: the ICT industry's contribution to GDP growth rose from a mere 4.5% in 1990 to an astounding 50.5% in 2000 (www.mic.go.kr).

But economic history, the cumulative learning and transformation process involved in using ICT, and the speed of this wave of technological change suggest that a "wait and see attitude" would keep many developing countries out of a technological revolution no less profound than the last industrial revolution (David, 2001; Perez, 2001; Freeman, 1994). Countries must adopt an adaptive and proactive posture to take advantage of windows of opportunities to leapfrog, or to exploit a structural change to gain or maintain competitive advantage in many of their industries and services. Otherwise, these countries may be simply locked out and marginalized. The Millennium Development Goals of halving global poverty, among others, are also unlikely to be met without the aid and harnessing of these technologies.

This paper suggests the many ways ICT is likely to impact social and economic development, pointing to the strategic significance of ICT for enabling national development and poverty reduction strategies. ICT offers many promises and opportunities, even while posing serious threats and uncertainties. Its impact is likely to be pervasive, and countries must fashion their own responses. Harnessing ICT for development requires a strategic framework that takes advantage of the various roles of ICT and helps integrate the options made possible by this technological revolution into the design and implementation of country and sector development strategies. As such, ICT is not just a sector or pillar of the knowledge economy, but a lens through which new possibilities and modalities of comprehensive development can be realized. Thus, ICT should be viewed not only as a sector in competition with others for scarce resources, but also as a cost-effective tool to enable all sectors to meet human needs better than through traditional means alone.

Mastering the use of ICT has become a core competency for competition and sustained development. It is also likely to become a core competency in delivering public services, education and training, and even micro credit and poverty reduction programs. To realize this potential, the

current focus on investment in physical infrastructure, hardware, and isolated experimentation must be broadened and scaled-up to address the enabling policies, institutions, infrastructures, and skills, as well as to devise national strategies that are capable of agile adaptation and participatory social learning.

This paper argues for the role of national e-development strategies. Countries that have pursued an explicit strategy and systematically integrated ICT into their overall vision and strategy for development were able to advance the most in terms of realizing the benefits of the ongoing ICT-enabled productivity revolution. Enhanced productivity through ICT use is essentially a developmental task that requires cumulative learning and selective and orchestrated investments in a combination of technological and social capabilities. Applying ICT to increase employment opportunities for the poor and empower them with information and learning also requires strategic intent, substantial experimentation, grassroots participation, social learning and strategies for scaling up and sustainability. Aid agencies must capture this opportunity and challenge by mainstreaming ICT into development thinking and practice.

3. Technological Change and Opportunities for Development

Development is increasingly viewed as a process of change and learning (N. Stern, 2002; Rodrik, 2000; Stiglitz, 1998, 2000). It is a nonlinear, discontinuous and uncertain process (Adelman, 2000). Technological and institutional change or capabilities are at the heart of this process (G. Dosi et al eds, 1988; C. Freeman, 1994). Accordingly, technology is much more than an ingredient in development strategies; it is a conditioning element of their viability (Perez, 1988, 2001). As technology changes, following an "s" shape towards maturity, it sets conditions that generate development opportunities. While learning to benefit from such changing opportunities is gradual within a single technological revolution, a new technological revolution would constitute major discontinuities and shifts in the direction of change, providing new opportunities for learning and catching up.

Each technological revolution provides general-purpose, pervasive technologies and new organizational practices for a significant increase in productivity in existing sectors, and this combined best practice is referred to as a techno-economic paradigm (Perez, 2001). This was the case with the deployment of the mass production paradigm in the 20th century, and currently, the early phases of the ICT and flexible production paradigm. A techno-economic paradigm articulates the technical and organizational model for taking the best advantage of the technological revolution and results in the rejuvenation of the whole productive structure. The transition to the new practices is not easy and may take decades. It is best described by Schumpeter (1975) as a process of "creative destruction" where the established leaders are unlearning much of the old and adapting to the new.

Newcomers who understand the process can direct their efforts towards learning the new practices and may find a route to leaping forward and catching up (Perez, 2001). The four tigers took the leap forward with the microelectronics revolution, rejuvenated mature industries and entered new and fast-growing industries. This involved intense learning and substantial investments in human capital and active absorption of technology. Approaching development under the current techno-economic paradigm will require similar proactive efforts. Capacity to handle information, knowledge and innovation will be more central than ever. This paradigm also calls for radical transformation in education and training systems, science and technology policies, and even in conceiving development strategies.

4. Promises of a Technological Revolution

The world is in the midst of a general-purpose technological revolution, so declared the UNDP, World Bank, and the IMF (UNDP's Human Development Report, 2001; IMF's World Economic Outlook, 2001). The revolution has taken many names. It is a technological revolution, or a new techno-economic paradigm, brought about by a set of new information and communication technologies. Past general purpose technological revolutions like steam power, electricity and the railroads have clearly yielded major benefits, although their diffusion took several decades or a century. Information and communication technology has several striking similarities with past revolutions, but also notable differences: the fall in the relative prices of ICT goods has been very sharp and the benefits seem to be coming much faster than those of past revolutions; and the production of goods embodying the new technology is much more globalized.

4.1. Attributes of the ICT Revolution

The ICT revolution has taken many other names:

- It is a productivity revolution, impacting new ICT industries, ICT-using industries and services, and overall total factor productivity. Evidence is derived mainly from advanced economies, particularly from the USA (EIB, 2001; Onliner and Sichel, 2000; Jorgensen and Stirah, 2000; Graham, 2001; Gordon, 2000).
- It is a knowledge revolution that is giving rise to an information society or knowledge economy, whereby knowledge creation, codification, diffusion and effective use are driving growth and competitiveness, and whereby lack of access to connectivity and knowledge tools is giving rise to digital and knowledge divides and pervasive exclusion (OECD, 1996; Marker, McNamara, and Wallace, 2001; Dahlman and Aubert, 2002).
- It is a learning revolution that has given rise to the learning economy, learning organizations, and life-long learning (World Bank, 2002; ILO, 2001; UN, 1998). Accordingly, individuals, firms and countries are able to create wealth and obtain access to wealth in proportion to their capacity to learn (Lundvall, 1996; Drucker 1993). Not only does this technological change create new demands for learning and raises the bar for skills to function in the new workplace, but it also offers novel and powerful new pedagogies for learning and creativity. It empowers the students to become more active and independent learners (Resnick, 2002).
- It is an innovation-driven economy, whereby national innovation systems and regional clusters (bringing together research institutions, business startups, venture capital, and related services) would spark, speed and sustain growth (Nelson et al, 1993; OECD, 1998, 2001; Stern, Porter, and Furman, 2000). The transition from resource-based and investment-driven growth to innovation-based development requires a government role in fostering a high rate of innovation (Kirkman, Cornelius, Sachs, Schwab, 2002).

Other names imply further promises: fast-paced or "now" economy, networked economy, mobile economy, new economy, weightless economy, and smart growth (Fine, 1998; Ranadive, 1999; Castells, 1996). The following attributes highlight different but complementary aspects of the ongoing technological revolution:

- speeding up all types of transactions throughout the economy, reducing all types of leads and lags, tightening supply chains, cutting time to market, and at times, bringing response time close to zero;
- networking organizations, overcoming distance, extending supply chains across cities and regions and increasing economic relations between core and peripheral areas;

- enabling mobility through wireless communication, tele-work, tele-services and e-learning;
- generating substantial new opportunities for economic activity, new products and services such as high tech products, multi-media services and knowledge industries;
- enabling real-time control and remote monitoring of all types of flows and distribution systems; thus optimizing all kinds of distribution activities and reducing the material- and energy-intensities of almost all industrial processes and service activities.

4.2. Impacts of ICT

The impact of ICT on these attributes may be at its infancy, since ICT is still undergoing revolutionary change, and much of these technologies are yet to diffuse to the majority of mankind (Kirkman, 2002). For example, expected advances in Internet technology, called X Internet, are likely to provide the interactivity and real-world awareness needed to support business-to-business transactions, even while demanding limited communication capacity (by optimizing use of bandwidth). It will exploit sensors and smart tagging and tracing technologies to enable manufacturers to track every product they make from inception to phase out, and thus help manufacturers optimize their sensor-enabled supply chain assets countrywide. The promise of X Internet is already being realized by early adopters in developing countries, for logistics by companies such as Cemex in Mexico, and for enhanced customer service by Carrier China (Colony, Radjou, Howard, 2002). This technical advance, and others such as open source software and low cost access devices could level the playing field for developing countries, provided policy and institutional changes are made to capitalize on these advances.

Perhaps more important in assessing the productivity impact of ICT is to take account of the fact that long adjustment periods are needed for an economy to fully benefit from a revolutionary new technology (Bresnahan and Trajtenberg, 1995; David, 2001). New growth theorists and economic historians have characterized general purpose technologies (GPTs) by: (a) wide scope for improvement and elaboration, (b) applicability across a broad range of uses, (c) potential for use in a wide variety of products and processes, and (d) strong complementarities with existing or potential new technologies. GPTs play the role of "enabling technologies," opening up new opportunities rather than offering complete solutions. They act as catalysts, inducing complementary innovations in other sectors. While the steam engine is widely accepted as the GPT of the first industrial revolution, the electric dynamo is viewed as the GPT for the second industrial revolution (David, 2001).

It is instructive to understand the dynamics of the productivity surge of the 1920s arising from electrification. In the case of the electric dynamo, the great productivity gains came not from the fact that electrical engines were faster and stronger than steam engines, but that they facilitated more efficient organization of work. It took decades for factories to be reorganized and for the full gains to be realized, but there was an overall surge in productivity growth once a certain critical mass was reached. David argues that there are parallels between the interconnection of electric motors through grids – and the associated transformation in manufacturing practices – and the interconnection of computers via communication networks. The Internet, diffusing much faster in the USA than electricity did during the 1880s-1920s, is a major step in this interconnection throughout local and global economies. As David put it: "it remains a good bet that economists who continue proclaiming their skepticism about the information revolution's ability to deliver major long-term productivity pay-offs are going to be proved wrong."

ICT is the GPT of our age. As in earlier GPTs, short-term impact to be reflected in economy-wide productivity surge may be exaggerated or uncertain, but the long term impact is likely to be underestimated. The lead time for ICT impact may be shorter than earlier GPTs, and would not be less transformative. And unlike earlier GPTs, ICT impact will not be limited to manufacturing and

transport — this GPT may have at least as much impact on public and business services and educational and learning processes. But the institutional changes and complementary innovations necessary for ICT diffusion and effective use in the public and educational sectors are likely to come at a slower pace than in business.

4.3. Three Fundamental Roles

The names and attributes of the ongoing revolution suggest three fundamental and interdependent roles or impacts of ICT:

- Accessing *information and knowledge*, with dramatic increase in the power and speed to access, process, adapt and organize information. This, in turn, has accelerated learning, innovation, and knowledge creation and dissemination. In this sense, ICT may have the profound impact of the invention of the printing press.
- Speeding up and reducing the costs of *production and transactions* throughout the economy. ICT is increasingly embedded into all types of production, processes and transactions, giving rise to intelligent products, real time control processes, facilitating trade, outsourcing business-support and back-office services, and enabling complementary organizational innovations. In this sense, ICT may have similar implications as the steam engine, electricity and the railways in transforming production and transportation systems.
- Making *connections* among people, NGOs, enterprises and communities. This gives rise to empowerment, participation, coordination, decentralization, social learning, connecting communities of practice, mobilizing social capital, and globalizing civil society concerns. ICTs have been increasingly described as "technologies of freedom" (Ithiel de Sola Pool, 1983). There may not be a historical parallel to the enabling role of ICT (including telecommunication and the Internet) to coordinate and empower.

A national development strategy that attempts to position an economy to take advantage of the ongoing revolution must take a comprehensive view of the enabling roles of ICT. Often, proponents of one framework or another tend to focus on one of the roles of ICT, at the expense of others. For example, the "knowledge economy" framework, developed by OECD, has tended to focus on the role of knowledge in the economy, and thus view the role of ICT mainly in terms of access to knowledge. But there are other equally important roles of ICT: in speeding up and reducing the costs of production and transactions; and in empowering people to connect, mobilize, organize, overcome their isolation, and share their experiences and idiosyncratic information. Yet developing countries are characterized by high transactions and logistics costs, and by the isolation and disempowerment of large parts of the population. An analysis of the correlation of ICT and knowledge with development (GDP per capita) suggests a positive and nonlinear relationship, but the fit of regression is much higher for the ICT index ($R2 = 0.8$) than for the knowledge index ($R2 = 0.6$), perhaps indicating a broader role of ICT than access to knowledge (de Ferranti et al, 2001).

ICT should be used as a lens to rethink development strategies, as a tool to enable all sectors, and as a new and powerful means to empower the poor. This does not mean that I believe in ICT as a technology fix, but that an understanding of the full potential and implications of the ongoing technological revolution is necessary to realize its potential for development — far beyond its contribution as a sector. It is also essential to understand what makes ICT different from other technologies or from earlier technological revolutions in order to marshal the specific policies, institutions and capabilities (and their complementarities) that must accompany the effective use of ICT as an enabler for development.

On the demand side, it is critical to understand how information and communication are vital to the lives and livelihoods of the poor, and how ICT could enhance their access to markets, institutions,

services, education and skills. Lack of efficient information and communication processes makes public institutions slow and unresponsive, and shifts much of the burden of transactions onto citizens, particularly the poor. Poverty has multiple and mutually reinforcing causes, and lack of access to information and communication exacerbates all of them. The poor lack access to information about income-earning opportunities, market prices for goods they produce, about health, about their rights, and about public and welfare services. They lack access to knowledge, education and skills to improve their livelihood. They lack voice in the political and development processes that shape their lives. If they can have access to relevant information and the tools to communicate with others, the poor can make their choices, articulate their interests, engage in social learning, and have more power over their lives. Understanding the information and communication aspects of poverty is therefore critical to exploit the three fundamental roles of ICT for poverty reduction.

5. Pervasive and Increasing Impact

Early evidence from advanced economies and some newly industrialized countries suggest a pervasive impact of ICT on:

- Markets
- Organizations
- Competitive strategies
- Innovation
- Financial and other services
- Employment
- Education
- Regional and spatial development
- Poverty reduction

5.1. Impact on Markets

ICT is transforming global and local markets. Electronically-mediated markets are profoundly affecting the cost, speed and transparency of market-based transactions. For example, available evidence shows that electronic markets are more transparent and efficient. Through lower transaction cost and increased reach, they result in up to 15% lower costs to consumers, and up to 20% lower costs in business procurement (ILO, 2001). But the potential gains from e-commerce are likely to differ by industry and country. Countries that are more fully integrated into the global market or have high shares of trade in sectors where e-commerce is used intensively, such as apparel in Sri Lanka, must position themselves to adopt e-commerce practices, or otherwise risk losing their position in the value chain. Taiwan, with 80% of exports in sectors such as electronics that are intensive users of e-commerce, is very exposed to e-commerce (Mann, 2002).

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

- by altering the process by which transactions takes place (e.g., putting the supply chain online to improve inventory control and quality management);
- by creating new products and services (e.g., personally tailored products such as garments); and

- by creating new markets in time, space, and information that did not previously exist (e.g., global auction markets, sales of artisanship from the Andes).

Business-to-business (B2B) net-based transactions are transforming supply chains across the globe, leading to the rise of new channels or net-based intermediaries, and enabling SMEs to pool resources and auction or collectively supply large multinationals. In the US, some estimates suggest that by 2005, some 80 percent of transactions will be e-commerce transactions (Jupiter, 2001). The trade net of Singapore helped to link and process transactions among many players including customs, banks, ports, shipping agents, freight forwarders, cargo handlers, and various authorities. The savings in transaction costs and time were dramatic: 1% of Singapore's GDP; clearance time reduction from 3 days to 15 minutes.

Net-based business-to-consumer (B2C) transactions, and point-of-sale scanners are providing producers, particularly multinationals, with detailed and instant information on local and distant buyers and markets. For consumers, C2B transactions are cutting consumer search costs, reducing lead time wait, and broadening choices. Increased information on both sides helps align supply and demand ever more tightly. Recent evidence (IMF, 2001) also suggests that inventory-to-sales ratios have declined in countries and industries that have adopted ICT more quickly. In turn, better timing of inventory changes is helping to reduce economy-wide output volatility.

At a more basic level, information and communication are the lifeblood of efficient markets, and ICT could develop markets and alleviate poverty, even without advanced ICT applications like e-commerce. Market prices act as coordinating signals for producers and consumers. But in isolated villages in developing countries there are virtually no sources of information regarding market prices and other production-related information. Studies suggest the pervasiveness of poor and late information on prices, work, and income opportunities in rural areas, with heavy toll on the rural poor in developing countries (Eggleston, et al, 2002; Geertz, 1978). Under these conditions, even basic communications technologies could play a major role in creating efficient markets, improving producer practices, and speeding innovation. The Grameen's program to lease mobile phones to low income women in Bangladesh indicates that close to half of all calls involved economic purposes such as discussing market prices, employment opportunities, and land transactions, among others. Rather than creating a digital divide, ICT could be used to create "digital provide" (Eggleston, 2002).

5.2. Impact on Organizations

The reorganization of production and distribution around ICT has enabled the adoption of new processes, procedures, and organizational structures, which in turn, have led to sustainable gains in productivity, quality, and responsiveness (Brynjolfsson and Hitt, 2000; Litan and Rivlin, 2000). The forces of globalization and increased competition, combined with the ICT revolution, have spurred organizations to focus on their core competencies while outsourcing increasing amounts of activities and services. These organizations are also designing their supply chains ever more tightly and strategically (Fine, 1998). Multinational corporations have become dense communication networks, with vast extended boundaries. For example, the supply network for Chrysler corporation covers about 100, 0000 organizations or suppliers, with increasingly dense and fast information flows. New forms of organizations have become possible or even necessary to leverage ICT: flat, agile, lean, extended, and client focused. ICT has made it possible to have very large scale organizations that are at the same time flexible, agile, and focused.

Information technology is changing the workplace in fundamental ways, with important implications for human resources. Firms in industrial countries are restructuring from tailoristic organizations to holistic organizations, characterized by job rotation, integration of tasks, and learning across tasks (Lindbeck and Snower, 2000). Studies suggest increasing returns to worker characteristics such as

people skills, capacity to work in teams, multi-task, work without supervision, take initiative, and be entrepreneurial (Levy and Murnane, 1996). A variety of managerial innovations like Total Quality Management (TQM) are designed to exploit these changes. Simple tasks are automated, while the premium on complex tasks increases dramatically. The demand is for both human capital deepening and widening, and for workers able to adapt to rapidly changing environments.

Together, ICT and complementary organizational innovations are enhancing access and management of information resources, accelerating product innovation, empowering project-based teams, and enriching learning and knowledge sharing at all levels of the extended enterprise. A new breed of event-driven organizations is emerging to exploit and tailor real-time information for decision making and service delivery (Ranadive, 1999). Consequently, companies are giving increasing attention to their information infrastructure, knowledge management, and communication competencies. Investment in such intangibles in advanced economies now exceeds 35% of total corporate investment.

The information revolution is changing the institutions of governance by enabling more access to information, and thus transparency, accountability and citizen empowerment. This potential presents many promises and daunting challenges for governance. Power over information is being decentralized, fostering new types of community and different roles for government (Kamarck and Nye, 2002). Moreover, governments are the largest collectors, users and disseminators of information resources on individuals and the economy, and their information-sharing infrastructures and knowledge management practices have major consequences for citizens, businesses and the functioning of government institutions. Thus, information and communication technologies, and the Internet in particular, can be harnessed to transform public agencies, public service delivery and even the basic function of governance. ICT is also being applied to the legislative and judiciary branches of government, to enhance citizen participation in policy formulation and monitoring, and to promote democracy and the rule of law. Creating information-rich environments means not only assuring transparency, but also assuring that multiple voices (including those of the disadvantaged) are heard.

5.3. Impact on Competitive Strategies

These ICT-induced changes are transforming the rules of competition and giving rise to new types of competitive strategies: innovation-driven competition, time-based competition; mass customization; lean manufacturing, and demand-driven, built-to-order products (Fine, 1998). ICT has drastically cut long-standing obstacles to communication: time and distance. New communication technologies allow companies to source inputs independent of location. With costs of transport and information diminishing, countries are forced into the same competitive arena. The "new competition" entails flexible response, customization, networking, and new forms of inter-firm organization (clustering), rather than classic price competition dominated by vertically-integrated firms (Best, 1990).

The lifecycles of products, processes and supply chains are becoming significantly shorter. In particular, the ICT and information-content industries' products, processes, and supply chains are becoming outdated in a few months, not years. To cope with such clock speeds, leading firms are developing the ultimate core capability: the ability to anticipate, invest in, assemble and manage global chains of capabilities (Fine, 1998). Dell company takes orders for customized computers over the internet, build the machines to the orders, and ships the completed products often within 24 hours. This is the product of an ICT-enabled competitive strategy that relies on tight and lean links between the corporation, customers, suppliers, distributors, and alliance networks. Build-to-order, demand-driven supply chains have become a key competitive advantage in such fast-moving industries. Similarly, in fashion industries like garments, time required from producing fiber to cloth has been cut to 10% of what it was a few years ago. The car industry is currently aiming to deliver customized cars in 3 days from order.

5.4. Impact on Innovation

Information and communication are at the heart of the innovation process, and ICT has become a tool for amplifying brainpower and for innovation. ICT is transforming the way researchers conduct their research, communicate with other researchers and potential users, and instantaneously access relevant knowledge from a vast and growing global knowledge. For example, bio-informatics has emerged as a field arising from the essential role of ICT in enabling biomedical research. ICT is further accelerating the codification of knowledge and thus knowledge sharing. A new cyber infrastructure is emerging in OECD countries that combine vast content, processing and interactivity to build "grid communities" and conduct e-science and engineering. Through databases, networks, and computing, ICT is increasing the scope and scale of R&D. More recently, ICT is also changing the way scientists, including social scientists, do research through the use of massive simulations, "adaptive agents," and "artificial" societies (U.S. Department of Commerce, 2003).

ICT is bringing about changes within and among institutions that are accelerating the rate of innovation and tightening the links between universities, research institutions, industry, and users or consumers. In addition to accelerating managerial and organizational innovations, ICT is contributing to accelerated scientific and technological innovation. Enabled by electronic networks, linkages between universities and industries, as well as among firms are allowing firms to access local and global knowledge, to improve their technological capabilities, and to facilitate their joint learning and innovation. ICT is reducing coordination and learning costs, enriching relationships with clients, enabling a shift in responsibility for adaptation and customization to users, harnessing knowledge from multiple experiments, and creating user communities and new forms of user-led innovations or user-producer co-invention. Thus, ICT is enabling the creation and evolution of innovation clusters, knowledge networks, and learning communities.

5.5. Implications for Financial and Other Services.

Electronic financial services have spread quickly in recent years. By the year 2005, the share of online banking could rise from 8.5 percent to 50 percent in industrial countries and from 1 to 10 percent in emerging markets (Claessens, Glaessner and Klingebiel, 2001). E-finance allows for establishing financial systems without first building a fully functioning financial infrastructure. It lowers processing costs for providers and search and switching costs for consumers. Most affected are brokerage markets where online trading is becoming the norm. Increased connectivity has accelerated the migration of securities trading and capital raising from emerging markets to a few global financial centers, with capital raised offshore by emerging markets increasing almost tenfold in the past ten years (Claessens, et al, 2001). The change has also led to deeper consolidations in key middle and back office functions. It will lead to much lower costs and greater competition in financial services, as providing e-finance is much cheaper than providing financial services with existing technologies.

E-finance reduces the need for government intervention, as now the private sector can provide financial services even when a country's financial sector is weak. New technology makes better information more easily available. For countries with underdeveloped financial systems, e-finance offers an opportunity to leapfrog. The financial systems of these countries are unsophisticated, reaching very targeted groups: urban customers with high net worth, state enterprises and large agribusinesses rather than small and medium size firms, farmers or micro enterprises (Claessens, 2001). Such systems have high intermediation costs and are plagued with problems of supervision and re-capitalization. In Africa, electronic cash and multipurpose cards offer services to customers who do not even have formal bank accounts.

5.6. Implications for Employment

The ILO report (2001) is guardedly optimistic on employment growth, as evidence shows that countries where ICT was used most widely were also where total factor productivity and employment have grown the most (ILO, 2001; IMF, 2001). Use of ICT is also associated with new patterns of job creation, destruction and switching. Despite the hopeful signs of job creation, jobs are also lost through several channels: obsolescence, automation, and disintermediation. In labor markets at the forefront of the knowledge economy, diversity of employment is increasing, and the share of self-employed and temporary workers is higher than the national average. Labor markets have become more demanding and turbulent. Most of this instability is being internalized within the enterprise, where jobs are continuously changing (ILO, 2001). With accelerated obsolescence of skills and jobs, attention is now shifting to mobility, employability, life-long learning, and learning to learn. Beyond such foundation skills as the ability to learn and exchange knowledge, the need for ICT-related technical skills is increasing throughout the economy.

ICT impact on jobs is likely to have profound implications for quality of work and life, for income distribution, and for international division of labor. ICT-induced changes in jobs and employment opportunities are leading to labor migration and global competition for knowledge workers, particularly in the ICT industries. A new international division of labor is emerging. As the informational and ICT-related content of jobs is growing, the possibility of polarization in the demand and rewards between the unskilled and the knowledge workers is also increasing. These changes and potential risks are challenging the arrangements and institutions of an earlier industrial era, including trade unions and employers' organizations. Labor market policies as well as the right to life-long learning have become central to ICT and knowledge diffusion.

5.7. Implications for Education

Technology and skills play critical and complementary roles in increasing productivity, and thus in economic growth theory. Goldin and Katz (1998) show that during the industrial revolution of the 18th century, mechanization of industrial process was profoundly deskilling. During the first half of the 20th century, by contrast, technical change slowed and became skill-intensive. The ongoing technological change has increased both in pace and skill-bias. It may be the first year during which technical change has been simultaneously rapid and skill-intensive (De Ferranti, Perry, Gill, Schardy, 2002). Globalization and the ICT revolution combined are raising the level and changing the nature of demand for education and skills, at a fast pace. Understanding this interplay at a relatively detailed level is critical to enable firms to adopt and adapt this general-purpose technology in developing countries and to focus reforms and content in education and training to those critical to participating in this technical revolution.

But unlike earlier technological changes, this one is impacting both the demand as well as the supply of education and training. The expectations are high that this technological revolution is central to learning, and will change how education services are delivered. Current research and pilots suggest that ICT has the potential to fundamentally transform how and what people learn throughout their lives (www.techknowlogia.org; Resnick, 2002). Learning is an active process in which people construct new understandings of the world around them through exploration, experimentation, and discussion. ICT is more than a tool to access and transmit information, but more broadly, a new medium through which people can simulate, create, express and interact. Computers can be seen as a universal construction material, greatly expanding what children and adults can create and what they can learn in the process (Resnick, 1998). For example, children can now use computer simulations to explore the workings of systems of the world, from ecosystems to economic systems to immune systems. The Internet and distance learning are expanding the learning ecosystem beyond schools, enabling new types of "knowledge building communities" in which children and adults around the world collaborate on projects and learn from each other (Resnick, 2002).

The impact of ICT is increasingly evident in higher education. New competition, modes of operation, and forms of delivery are emerging in higher education and corporate training, including distance education, open online universities, mega and virtual universities, corporate universities, and various forms of private sector participation and borderless educational services. Connectivity, knowledge management, education technology, and partnership are key to these new forms of higher education. In turn, these forms raise new demands for governance and management of educational systems including flexibility, quality assurance, industry linkages, and intellectual property rights.

5.8. Implications for Regional and Spatial Development

The spatial implications of the communication revolution are profound but uncertain. Lower transaction and communication costs, combined by goods production that is increasingly based on flexible specialization, tend to favor the dispersion of economic activities (IMF, 2001). Yet, real-time information about consumers, easier outsourcing and the proliferation of producer-support services tend to favor locating production near to large markets and urban centers. Concerning services, the ICT revolution is likely to promote dispersal of services that can be delivered remotely and effectively, even while inducing further concentration of others, such as activities that are driven by innovation, tacit knowledge and face-to-face interactions. Location-independent work or tele-work is growing in industrial countries. One estimate suggests that about 5% of all service-sector jobs in industrial countries will be contestable by developing countries (ILO, 2001). Beyond enabling global trade in services, advanced information infrastructures are increasingly important to attracting foreign direct investment, facilitating technology diffusion, and developing innovation clusters.

Cities are emerging as gateways to services, learning and innovation, more than ever in history. Cities and regions are also differentiating and competing on a global scale, giving rise to global urban networks. Singapore envisioned its future role as an intelligent island or a regional hub for information-intensive services. The "walled" cities of China are opening up to all kinds of information flows. Shanghai drew a "smart" growth strategy that would attract knowledge-based and information services industries, enhance access to information infrastructure, and enrich learning opportunities.

5.9. Implications for Poverty Reduction

The impact of ICT on the poor is at an early stage, even in developed countries, but the potential is being demonstrated at the micro, intermediate and macro levels. The impact of earlier information and communication technologies, particularly radio and television are better known, although their use as tools for informing and educating the poor is still not fully exploited. The new ICTs do not replace the older technologies but can blend with them and extend their reach, enrich and tailor their content, and add new forms of "many-to-many" communication and action that bypass traditional power relations. For example, in Kothmale, Sri Lanka, a live radio program uses a panel of resource persons to browse the Internet at the request of listeners and thus add value by interpreting Internet information into a local context, in local languages, and by providing a platform for feedback and local discussion (http://www.kirana.lk).

ICT can open up new opportunities for the poor and small enterprises, even in remote areas. In Kenya, for example, Naushad Trading Company, which sells local wood carvings, baskets and pottery, grew from US $10, 000 to over US $2 million in the two years since it went online (Africa Internet Forum, 1999). In Brazil's urban slums, the Committee to Democratize Information Technology (CDI) has created 110 self-managed community-based "Computer Science and Citizenship Schools" using recycled ICT and volunteer assistance. CDI schools train 25, 000 students per year, giving them better opportunities for jobs, education, and life changes. These and many other examples are available at www.Infodev.org.

ICT also offer the opportunity to provide investment resources to groups previously denied them. In South Africa, for example, "AutoBank E" has developed an automated savings system using ATMs and aimed at the poorest depositors. The system proved to be highly popular, with 2.6 million depositors and 50, 000 added each month (Economist, 3/25/00, p.81). ICT can also help intermediary institutions and local agents to work more efficiently and responsively and to target interventions to the needs of the poor: intermediaries such as health workers, agricultural extension agents, teachers, local planners, and local NGOs. Various applications of ICT are also used to reduce vulnerability to natural disasters, where the poor are the most vulnerable — especially in cyclone warning, communication and response, awareness raising, and community involvement in hazardous reduction activities. ICT can also allow monitoring and enforcement of environmental quality. In Indonesia, for example, with weak enforcement of water pollution standards, government developed a public access information database rating firm compliance, and within the first 15 months of the program, about a third of the unsatisfactory performers came into compliance (World Development Report, 1998-99).

6. Risks and Benefits

This is not purely a world of opportunity, but one of intense competition and uncertainty. The rapid advance of ICT is leading to pervasive and irreversible changes in information and communication among people. As the uses of information in daily life and work are unpredictable, so is the likely course of this revolution. There is a legitimate worry that ICT may be promoted as a development fad, not dissimilar to earlier ones, disregarding the risks (Wade, 2002). The main risks are:

- Uncontrolled costs
- Unrealized benefits
- Increasing technological dependency
- Exacerbating inequalities within and across countries
- The threat of exclusion

Experience even among industrial countries and among sophisticated organizations suggests that ICT-enabled restructuring is fraught with difficulties and risks, including outright failure to deliver the promised benefits. A growing literature has documented these difficulties, particularly concerning the introduction of complex and integrated software infrastructures that require extensive process reengineering and behavioral changes in large organizations. A recent study of several multinationals found that rather than realizing major gains in control and productivity, the ICT restructuring programs caused "drift" or loss of control (Claudio Ciborra and Associates, 2000).

In essence, the benefits from ICT investments are not automatic. To be realized, they require complementary investments in human capital and much organizational and social learning (Abramowitz, 1986). Widespread adoption and effective use of new technologies require organizational flexibility and the willingness to take risks and adapt. Even when success is demonstrated at the pilot level, attention must be given to scaling up and sustainability challenges. These risks are real and do argue for coherent and realistic policies to integrate ICT into development and corporate strategies, not for abandoning technological change. ICT investments must also be subjected to cost-benefit analysis and placed in the context of other priorities or possibilities for development. New tools and motivating visions can help development if they are used to channel energy and commitment into action and institutional transformation. Enthusiasm about the possibilities being opened by the ICT revolution should not detract from the need to

introduce the new set of tools and possibilities in sequential and learning-oriented ways, and in complementary ways with investments in human and organizational capital.

Another risk is that efforts to bridge the digital divide may have the effect of locking developing countries into "a new form of dependency"(Wade, 2002). Developing countries may be trapped by a software-hardware "arms race," which is driven by wealthier and better-educated consumers and big companies in industrial countries, leading to ever growing complexity. Developing country producers could adopt "open source" software development and make "volks" computers that would give people the necessary basic capabilities, as Indian and Brazilian producers have started with the introduction of $200 "simputers." There is also the challenge of creating relevant content and ensuring that the gatekeepers of international development portals truly represent the interests of developing countries. A related risk is the weak representation of developing countries on global ICT standards-setting bodies such as the ITU and ICANN. The recommended response is not to ignore this ongoing revolution, but to become a sophisticated user of these powerful tools and an informed player in influencing the rules of the game.

Technological change always favors the prepared, and in this case, ICT has been the fastest technological change in history, thus exacerbating adjustment problems. While as far reaching as the agricultural and industrial revolutions of the past, the current technology revolution is unique in its pace of change and diffusion: it took a century for the printing press to reach 50 million people, 40 years for the radio, and 4 years for the Internet. It is also divisive as individuals and countries are in different positions to adapt. For example, the ICT revolution has propelled some Indians to become billionaires and a few software engineers to be more handsomely rewarded, but hardly touched the life of the 99% who are not on the Internet, 95% who do not speak English or find any relevant local content on the Net, 40% who are illiterate, and hundreds of millions who go to bed hungry.

In breaking barriers to communications, ICT is accelerating globalization at a time of increasing world inequality. Differences in speed of ICT diffusion, and in access to complementary skills and institutions, are likely to widen the digital and knowledge divide among countries and enterprises. Despite the many examples of dramatic impact of specific ICT applications in developing countries, the aggregate impact has thus far been limited (IMF, 2001). The diffusion of ICT has been less extensive among SMEs than larger ones, and this digital divide is even more significant within developing countries. As ICT induces product innovation and shorter life cycles, the speed of change is disrupting established supply relationships. The emergence of net-enabled global supply chains could further empower the multinationals to squeeze out more from their SME suppliers in developing countries.

A number of factors point to the threat of exclusion of the poor (Kenny, Sabater, and Qiang, 2001). The gap in the provision of new ICTs is much larger within and among countries than income disparities. A broadly defined index of access suggests that the gap is widening (Wilson, 2003). Benefiting from ICT requires complementary investments and skills, including literacy. Threshold effects are also at work: network externalities, scale economies, lack of local content in local languages, fragmented markets for software applications, and high cost of access for remote areas — factors that lead to or reinforce poverty traps and economic isolation for poor communities. Poor and disadvantaged groups, particularly women, often face special constraints in accessing ICT and using them for their specific needs. Unequal access can worsen existing inequities. The risks of economic exclusion suggest that countries should be concerned with the level of connectivity and ICT provision — and with enabling access and deploying ICT and content in ways that expand relevant information for the poor, increase their voice in decision making, and address bottlenecks to their trade.

The benefits and risks associated with this revolution are not predetermined. They are a product of social and political choices. A passive public policy stance that leaves to market alone the direction of change will reinforce divides (ILO, 2001; UNDP, 2001). Passivity will also lead to economic marginalization and increasing social stress. The unprecedented advances in ICT and decline in prices implies a faster rate of diffusion than in previous technological revolutions. The constraints and risks to realizing the full benefits are real, but a vigorous and coherent effort to harness the potential of ICT is likely to be critical to future growth and poverty reduction.

7. Options for Development

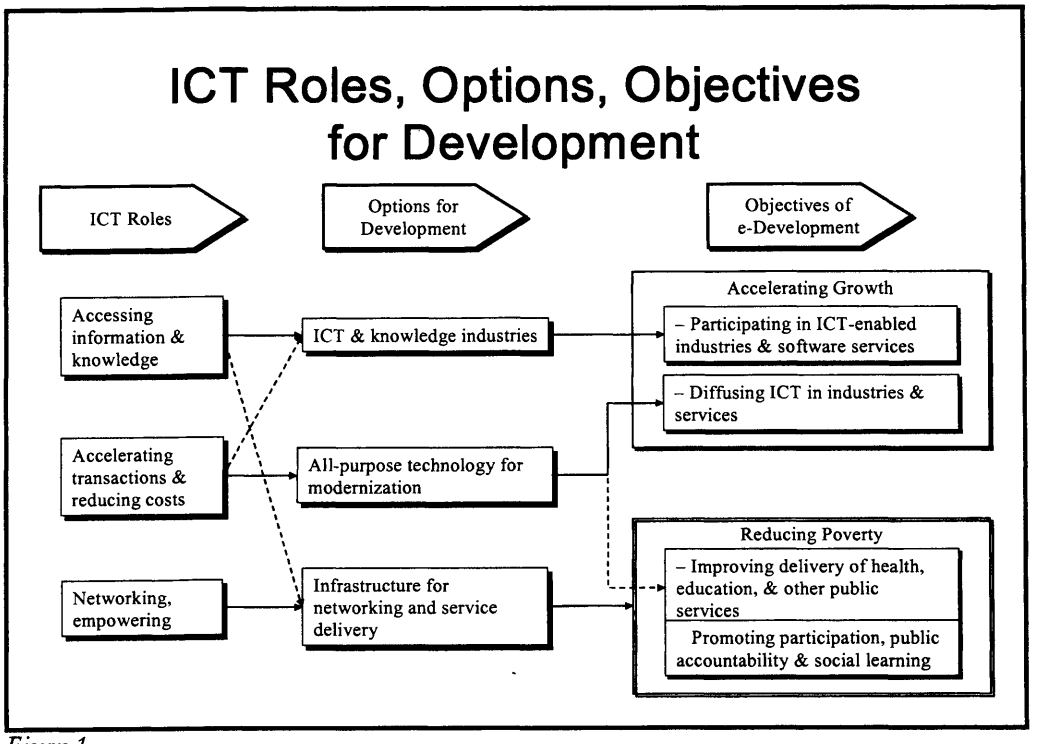

Figure 1

Countries at different levels of development have tried to harness the ongoing ICT revolution in three fundamental ways that correspond to the various roles of ICT (Figure 1):

- Promoting the ICT industries.
- Deploying ICT across sectors, as a general purpose technology.
- Investing in ICT as an enabling and networking infrastructure.

7.1. Promoting the ICT industries

First, many countries have promoted *the ICT (both hardware and software) industry* as the fastest growing, most dynamic, and highest value-added global industry. For many, this industry and related capabilities have been associated with new wealth, new economy, hi-tech, and innovation-driven competitiveness. The global market for ICT, including telecommunications, is about $2.5 trillion, and for software and IT services alone is estimated at US $620 billion (2001). The decline in the cost of telecommunications and access to the Internet have given rise to the globalization of business-

support services and the outsourcing of back-office work to developing countries like India and the Philippines. Over 50 nations currently export software and ICT-enabled services.

Early national drives were not always successful, particularly when focused on the local protection of a highly global and dynamic industry such as computer hardware production. Brazil and India tried to build their computer industries under protection, with mixed results. Similarly, several European countries had selected national champions in the ICT sector, but later abandoned these efforts. However, the drive to export software and ICT-enabled services segments has produced promising results for some developing countries. As a result, more countries are now aspiring to participate in this wealth-creating industry and to leapfrog into information- and skill-intensive services.

What about leapfrogging? Can ICT present a new route for economic development? Malaysia presents an example of ICT-driven development strategy, with a view to leapfrog into innovation or knowledge-based economy (ILO, 2001). A national ICT framework has been developed which comprises targeted investments in human resources, hard and soft infrastructure, and demand-driven applications and content development. Among key measures to achieve this transformation is the setting up of a Multimedia Super Corridor (MSC) to attract world-class companies with cutting-edge technologies to test flagship technologies such as smart cards. The MSC is linked by high speed network to regional and global centers. Another key measure is the Demonstrator's Application Grant Scheme which aims to develop, among others, entrepreneurial communities enabled by electronic networks. It is premature to judge from Malaysia's experience so far whether its large investment will reap the promised benefits. Each country needs to weigh the risks and rewards in view of its comparative advantage and resources. Other approaches may be less risky, as suggested by Costa Rica's inducement to Intel to make the investment for leapfrogging.

7.2. Deploying ICT

A second perspective or option for development, is to exploit *ICT as a General Purpose Technology* that can increase the productivity and competitiveness of the local economy, and particularly among the potentially ICT-intensive industries and services. As ICT impacts organizations, competitive strategies, and all kinds of transactions, ICT adoption and integration by all types of industries are fast becoming a requisite for survival and adaptation. The payoffs of applying these new technologies to all types of processes are often dramatic, and are fundamentally derived from associated organizational and business process changes. A unique aspect of ICT is that its impact also spans beyond industries to all types of information-based and business-support services. ICT-enabled productivity improvement in such services is often dramatic and these services are now key to the competitiveness of any knowledge economy. This perspective is less common among developing countries, although there is growing awareness among advanced and poor countries alike that this is where most of the economy-wide benefits are likely to be.

7.3. Investing in ICT

The third perspective is to view *ICT as an enabling or networking infrastructure* that would connect government agencies, NGOs, SMEs, and even the poor to participate in development. Many NGOs in Latin America are assisting micro enterprises such as artisans to integrate into the global economy by using Web sites for retail and wholesale buyers in industrialized countries, providing timely information on markets and buyers, and delivering a variety of training and business-support services (Susana Sanchez, 2001). Access to information and communication is also central to empowerment and to building human capabilities. Accordingly, this new infrastructure would enable local economic and social agents to network, mobilize and share local information, access global knowledge and markets, coordinate local action, share local experiences and innovations, and accelerate social learning. It enables real time information sharing among change agents, communities of practice, and otherwise isolated communities. No wonder that Internet communications have powered global civil

society movements for causes such as debt relief, banning land mines, and providing HIV drugs in poor countries. The Internet was just as powerful in mobilizing people locally in campaigns against corruption (Korea), for democracy (The Philippines), and to protect the environment (Brazil).

ICT use in government could also facilitate effective decentralization, more transparent and accountable governance, delivery of responsive public services, making public information resources available to all, and improving the quality and reach of health, education and other basic services. This role is still in its infancy, but results of various pilots in many developing countries, particularly in Latin America, are encouraging. It is fast taking a central stage with e-government, e-commerce, e-learning and other internet-enabled activities.

These perspectives on ICT present different options for development that may complement or conflict with each other. In many countries, the vocal and relatively well-placed ICT producers and their associations, like the National Association of Software Companies (NASSCOM) of India, or the computer and telecommunications industries in Brazil and Mexico in the 1980s and early 90s, have played a major role in focusing national policy debates and strategies on the option of promoting and protecting ICT as an industry, often at the expense of local diffusion or broader application to development. But these local actors can be allies to support the other options, and to build synergies between them. For example, the development of local software capabilities can serve all three options. Moreover, the balance between these perspectives in formulating national ICT strategies should be timed and tailored to the level of economic development, local skills and technological capabilities (ICT supply), the size and structure of the domestic market (ICT demand), and social demand for reforms, participation and learning (Hanna, 1999).

8. Is a National e-Development Strategy Needed?

Given the profound promises and pervasive impacts of ICT on national economies and global competition, countries need to embed ICT into their overall development strategies, as much as businesses have learned to integrate ICT into their core business strategies. Managing the benefits, risks, and impacts of ICT is a challenging task in view of the complexity and uncertainty of the interaction between ICT, economic growth, and poverty reduction.

Designing a national strategy for e-development would serve several roles:

- Raise awareness, resources and commitment to action.
- Build coalitions for policy and institutional reforms.
- Clarify roles, build public-private partnerships, and facilitate participation by all stakeholders, including NGOs.
- Focus scarce resources on exploiting ICT for national priorities and help sequence and phase complementary investments.
- Complement market forces, promote societal applications, enable bottom up efforts, and ensure shared learning and scaling up.
- Address the special needs and dynamics of promising segments of the ICT industry for export and economy-wide competitiveness.
- Re-orient the national innovation system to meet the substantial and cumulative technological learning requirements of ICT (as a general purpose technology).

- Address coordination failures, exploit network effects, and secure complementary investments to use ICT as empowerment and service delivery infrastructure.

8.1. Raising Awareness

National e-Development strategies aim at raising awareness, promoting national dialogue, generating consensus, and inspiring commitment to action. This was a key function of Singapore's successive IT plans. National strategies should help mobilize public and private resources and rally the energies of all stakeholders. Through incentives and motivating visions, such strategies could also signal to local and foreign investors and civil society agents to participate in identifying options and realizing opportunities made possible by the ICT revolution. They should harness such hopes and inspirations. They should clarify the ICT options available for development, and those that should be taken. They should set nationally-owned priorities for donors and international organizations to support. This is particularly important for small and low income countries where donors are often the major financiers of *ad hoc* applications.

8.2. Building Coalitions

E-Development strategies can be critical to building coalitions for reforms. For example, NASSCOM in India has worked with reform-minded leaders in government and business to introduce reforms in many public policy spheres that hindered software exports, data communications, venture capital, etc. A motivating vision could help overcome monopolies of telecommunications, bureaucratic inertia, and resistance to change. The threat of being left out of the loop, unable to participate in the knowledge-based global economy could help initiate overdue educational reforms. Providing success models and early demonstration effects — through well-timed pilot projects that are conceived within national strategies — could also allay fears and build a broader base for reform.

8.3. Clarifying Roles and Responsibilities

A national strategy should help clarify roles and responsibilities and facilitate broad-based participation in the design and implementation of priority programs. It should not be viewed as a government-only strategy. In particular, it should define the role of government in setting the policy and institutional environment, in promoting ICT industry development, in targeting business segments or SMEs for ICT diffusion, and in supporting private and civil society initiatives. It should clarify the roles of government, private sector, and civil society, and who leads when and where.

8.4. Focusing and Prioritizing

A national e-Development strategy process can help policy makers and other stakeholders focus, prioritize, sequence, and phase investments and complementary efforts. It should stimulate partnerships for investments and complementary actions. This is particularly critical for e-government, strategic or nationally-shared systems, and other public sector applications that require major investments, institutional reforms, public-private partnerships, and long-term commitments. Similarly, choices will have to be made about the priorities for promoting access to information infrastructures for businesses, citizens, schools, government agencies, civil society, and the scientific community.

8.5. Mobilizing and Complementing Market Forces

National strategies are needed to mobilize and complement market forces, promote societal applications, enable bottom-up efforts, and ensure shared learning and scaling up. National planners face two fallacies: the complacent view that "the private sector will take care of it" and the false dichotomy that top-down macro-scale initiatives are doomed and only bottom-up approaches can work for the poor. Evidence suggests that the private sector does not invest in rural communication

and societal applications to optimal levels without significant support and partnership from the government, in terms of subsidies, R&D, and other incentives. Countries with proactive programs and effective partnerships with the private sector and NGOs have been able to significantly reduce the digital divide as well as promote economy-wide competitiveness.

8.6. Scaling Up

Similarly, most pilots and bottom-up efforts do not scale up without sustained support from national institutions with the requisite resources, scope, and scale. Bottom-up efforts and pilots play an essential role in reducing uncertainties about the applicability of ICT to the problems of the poor and contribute to the knowledge required to apply ICT most effectively to these problems. However, propagation of these efforts involves more than replication on a larger scale. While focused efforts and intensive support can make it easy to adapt ICT to local opportunities, application on a large scale requires broad policy and institutional reforms and changes in management practices — all likely to encounter resistance and to require national commitment and knowledge about processes to diffuse and scale up best practices.

8.7. Leveraging ICT

The role of e-development strategy may be also clarified in terms of the three options for leveraging ICT: as an industry or sector in its own right, as a general purpose technology to be applied across sectors, and as an enabling infrastructure for empowerment and service delivery. The ICT industry, particularly the most promising segment, the software industry, is characterized by fast growth and technological change, low entry barriers, high global outsourcing, dominance of small enterprises particularly in developing countries, intensive producer-user interaction, importance of local user-base or domestic market, strong network or cluster effects, and high intensity of R&D. These features call for national strategies that focus attention and target resources, stimulate the development of enabling polices and infrastructures, provide shared facilities for small software houses and incubators for innovative start ups, set standards and procurement practices to develop the domestic market, support export promotion programs to build country image and ICT brand, and provide incentives for foreign direct investment, finance, entrepreneurship and innovation (Tessler, Barr and Hanna, 2003). Governments also play an important role through outsourcing their ICT requirements through competitive bidding, and bootstrapping ICT use in the private sector.

Would this mean that the government would be "picking winners"? Not in terms of picking single companies or national champions. But, yes in terms of targeting this sector for its special characteristics and promises, and where there is a presumption of comparative advantage. Countries can no longer rely on selling generic skills such as low cost labor as a source of comparative advantage (Porter, 1990). East Asian countries have taken the lead in implementing national ICT strategy processes and actively targeted segments of the ICT industry for systematic technological deepening, diffusion, and exports (Hanna, 1996). These countries with active targeting strategies in this sector had the most outstanding economic performance (Lall 2003). To reduce the risks and improve the impact of targeting the ICT industry for promotion and focused efforts, governments should work with the private sector to identify target market opportunities, match specific niches to comparative advantage, systematically assess current constraints and jointly devise the policies and programs to develop the industry and exploit market niches.

What is the role of a national strategy in leveraging ICT as a general purpose technology? E-development strategies may target ICT as a core technological competency, in view of its requirements and its potential as a tool for competitiveness. Technologies differ in their learning requirements. Targeting technologies with substantial potential and spillover effects is shown to have greater dynamic benefits on economies (Lall, 2003). ICT is distinguished by the need for substantial and cumulative technological learning to realize its potential. It involves, among other aspects,

localization and adaptation, linkages among suppliers and customers, joint learning and standard setting, innovation intensity, and co-investment in complementary institutional resources. Organizations go through several phases to leverage ICT — phases that ultimately lead to organizational and business transformations. E-development strategies must also address the learning requirements for governments to use this technology for managing the public sector. Unfortunately, national innovation systems in developing countries are slowly adapted and poorly equipped to deal with the technological learning requirements of this fast and pervasive technological revolution.

8.8. Reforming the National Innovation System

A special focus of a national ICT strategy should be to reform the national innovation system to promote the diffusion of this GPT among SMEs. Industries and services in developing countries are predominantly SMEs. But ICT diffusion to SMEs is typically constrained by lack of common infrastructures, low awareness, and weak adoption capabilities, among other aspects. These SMEs also suffer from isolation, low productivity and limited access to markets, finance and information. So, the paradox is that these enterprises have the least access to ICT, yet can benefit the most from ICT deployment and diffusion. Experience from national ICT diffusion programs suggests that such programs can be effective in accelerating the diffusion process and in linking SMEs to the national and global supply chains (Hanna, 1995). Coordination among private sector users is necessary to set cooperative standards for doing business and thus to establish common networks, databases and value-added services. Similarly, governments may work with private sector associations and NGOs to identify priority business segments for promoting ICT diffusion and for partnering to modernize public services.

What is the role of a national strategy in leveraging ICT as a service delivery and empowerment infrastructure? Information and communications technologies are characterized by interdependencies and network externalities, and national ICT strategies should address coordination failures, help exploit scale and network effects, secure complementary investments in human capital, and create synergies among programs (Hanna, 1995, 1996, 1999). Coordinated public decision making is necessary for effective public investment in common databases and networks and for setting ICT policies and standards to promote government-wide information sharing and one-stop access to public information and services. As governments are typically the largest information providers and ICT users, coordinated actions reduce duplication in data collection and ICT investments and training by various agencies, and at the same time focus resources on improving the relevance, quality, and use of information. Coordinated action could also help countries to access global public goods in this area, including standards, free source software, and the Global Development Gateway.

The risks of unrealized benefits from ICT investments are particularly high in the context of poverty due to the mutually reinforcing causes of poverty and the need for complementary assets. The role of ICT in poverty reduction is through their catalytic and leveraging effects on income opportunities, educational and health services, and welfare provision. ICT benefits can be realized mainly through a holistic approach. A pro-poor ICT agenda should be pursued in line with a pro-poor agenda in other sectors like education, health, and rural development.

9. Objectives and Thrusts of ICT-enabled Development Strategies

Given the opportunities and risks presented by the ICT revolution, the challenge for developing countries is to harness this revolution for their own priorities and embed ICT strategies in their overall development. This may be conceived in terms of two overarching development objectives:

- sustainable growth, driven by participating in a highly dynamic global industry and by diffusing ICT to enhance economy-wide competitiveness; and
- poverty reduction, facilitated by broad-based growth, accelerated human development, and empowerment.

9.1. Sustainable Growth

Competitiveness is served in two ways: first, by participating in the fastest growing global *industry*, ICT, which is also where the highest productivity gains have been possible; and second, by diffusing and effectively *using ICT*, particularly among the large pool of SMEs.

The ICT Industry

First, the *ICT industry*, and particularly, the newly enabled services, presents major opportunities for participation by many developing countries. Since the 1980s the ICT industry has witnessed a fundamental restructuring, from the vertically integrated IBM and DEC, to horizontal industrial structures, with many segments in computer hardware, software, consumer and industrial electronics, telecommunication services, information and media services, etc. Many of these segments, especially software and ICT-enabled services, are not capital intensive and have relatively low entry barriers. The Internet of the 90s further expanded these segments, diversified points of entry, and encouraged globalization and outsourcing in the industry.

Many East Asian countries have first targeted the ICT industry, particularly the hardware and electronics segments, for policy and institutional support (Hanna, 1996; Wade, 1990; Amsden, 1989, 1994). In a decade or two, countries such as Korea, Taiwan, Singapore, and Malaysia have managed to increase ICT exports to constitute over 50% of their total export. China's ICT exports have reached over $40 billion annually. Similarly, Israel and Ireland were transformed into innovation-driven economies and their exports have shifted from agriculture, to ICT, and mainly to software innovation and services. In the last decade, India managed to increase the share of software services in its exports from 0.5% to 14%, reaching $7 billion (2001).

Earlier experience suggests the need to balance country aspirations for participating in the ICT industry, as innovator and producer, with the need to become an effective user of this all-purpose technology for the benefit of the rest of the economy. One pitfall is the excessive emphasis put on protecting and promoting the hardware segments of the ICT industry, at the expense of developing the software and ICT-enabled services, as was the case until recently in Japan, Korea, Brazil, Mexico, and India. Another pitfall is the exclusive focus on exports, to the neglect of local applications, local content and language, and local transformation for the majority of the population, as in the case of India. China seems to have combined promotion of the domestic market with moves into selected segments of the export market for the development of its electronics and information industry (ILO, 2001).

East Asia successes point to some common lessons concerning innovation and technological learning, particularly in the electronics and computer industries. They have given priority to technology policy, R&D incentives and infrastructure. They committed themselves to high levels of investments in technical education, and financed, or induced the private sector to invest in advanced telecommunications infrastructure. They targeted the most dynamic segments of this industry for promotion and export, and sequenced their entry and systematically upgraded their capabilities towards higher value segments of the global supply chain. Governments acted in partnership with the private sector, promoting incubators, hi-tech cluster development, and local knowledge networks. Such networks were linked globally through various means, including trade and FDI. These countries also mobilized their large diasporas for capital, technology, entrepreneurship, and market intelligence.

Using ICT

A second major thrust for competitiveness and broad growth is to *use ICT* in the most critical industries and services of the country, promote ICT diffusion among SMEs, and deploy ICT for modernizing government-to-business transactions. Although it is up to the private sector to take the lead in such use, governments can influence and accelerate this process through various means, including establishing the necessary laws and regulations for e-commerce, and providing incentives for investments that would alter managerial practices and strengthen supply chains. But SMEs face major constraints to ICT use: awareness, expertise, access and bandwidth, technical support to adoption, relevant content, finance for such intangible investments, and complementary logistics to benefit from e-commerce. Such constraints have been recognized, even among industrial countries (ILO, 2001). Advanced OECD countries have since developed and financed substantial programs to promote ICT or new technology diffusion, particularly among SMEs. Many evaluations have been carried out of these programs, and relevant lessons can be drawn for developing countries (Hanna, 1995).

Perhaps most promising for competitiveness is the use of ICT in government in support of business-to-government transactions. By one estimate, SMEs spend about 20% of their revenues on transactions with governments, including accessing information and forms, applying for permits, submitting taxes. An effective and transparent government is also a critical ingredient in a competitive business climate and an attractive investment environment. A recent pilot to modernize tax administration in Russia (assisted with World Bank financing) has introduced ICT-enabled transformation in the administration's interactions with businesses and citizens, eliminated the long lines for tax submissions, drastically cut all kinds of transaction costs, closed opportunities for corruption, and at the same time, raised the badly needed tax revenues.

9.2. Reducing Poverty

The second overarching objective is *reducing poverty and accelerating human development.* ICT could support poverty reduction strategies by informing policy making, delivering effective health and education services, facilitating citizen to government transactions and public sector reforms, and promoting participation and accountability. Recent emphasis on poverty analysis and on mainstreaming results-oriented development programs have reinforced the need for relevant, reliable and timely information for policy formulation and program implementation and adaptation. Week feedback and communication on implementation often lead to rigid designs, uniform top-down solutions, limited participation, slow learning and disappointing results (Hanna, 2002). As suggested earlier, ICT can be also deployed to extend access and improve quality of education, health and other social services.

The promise of improving citizen-to-government transactions (C2G) has inspired many governments to innovate one-stop services, such as Singapore's eCitizen, and to integrate electronic government into their broader public sector reforms. Even less integrated and more modest bottom-up initiatives such as land record computerization in Karnataka, India, have delivered land certificates in 15 minutes, instead of 20-30 days, and in the process, reduced transaction costs and corruption, created a viable land market, enhanced the creditworthiness of farmers, and improved the life of the common man.

A major opportunity for using ICT in poverty reduction is to provide information and knowledge to rural populations and to empower local development agents to serve the poor. A variety of informational and connectivity advantages can accrue to the poor through improved operational capacities of the specialized local agencies. One example is Chile's electronic rural information system which connected farmers organizations, rural municipalities, NGOs, and local government extension agencies to the Internet. It was estimated that transmitting information on prices, markets, inputs, weather, social services, and credit facilities cost 40% less than using traditional methods (S.

Balit, 1998). Similar pilots and programs have been applied in Mexico. In Maharashtra, India, a cluster of 70 villages is covered by the "wired village" project, which is modernizing the local cooperatives, and aiming to provide agricultural, medical, and educational information to the facilitation booths in the villages (N. Vijayaditya; Bhatnagar and Schware, 2000).

Perhaps the area of most promise but least evidence of successful large scale application is in the use of ICT to promote broad participation, grassroots innovation, and social learning. Telecenters or community information and communication centers can play several roles: provide affordable public access to ICT tools including the Internet; extend and customize public services, including those offered through e-government; provide access to information in support of local economic activities and learning opportunities; and connect and network people. The last function proved to be the highest priority for many communities who would otherwise have remained isolated. These centers have enabled them to carry out local dialogue, share practical and locally relevant information, and support community problem solving. Given the limited relevance of the vast amount of global Internet content to these communities, the role of these centers in networking and creating local content becomes all the more important. Community centers could also provide women with a medium to participate as producers, consumers-providers-users, counselors-clients. In South Africa, women's organizations are linked to various resource web sites which aim to mobilize women around common concerns. Digital literacy centers in Benin and Ghana have become an important instrument of empowerment of low-income communities, enhancing employability, increasing capabilities, and extending learning opportunities beyond those available in educational institutions (M. Fontaine, 2000).

9.3. Millennium Development Goals

E-development should aim at harnessing the ongoing technological revolution to achieve the ambitious Millennium Development Goals. The massive backlog of educational, health, extension, and social needs of developing countries, including those of the rural and isolated communities, are unlikely to be met in a timely and effective manner without the innovative and strategic use of these new technologies. For example, the target of reducing poverty by half by 2015 in the context of a globalizing economy is unlikely to be met without addressing the implications of ICT for the competitiveness of developing economies, revitalizing threatened industries such as textiles, and diversifying into new ones such as call centers and business process outsourcing. E-development would systematically address the opportunities to use ICT to expand employment and earning opportunities, to access market information and lower transaction costs for the poor, women, marginalized communities, small farmers, traders, and artisans. Again, ICT may be used to achieve MDGs in health and education for example by enhancing the delivery of basic training for health workers and teachers, by increasing information sharing about diseases and famine, by increasing access to family planning and AIDs prevention information and services, and by increasing access of extension workers and care givers to specialist knowledge. Sustainable development goals would be promoted by applying ICT for clean technologies, economizing on the use of energy and materials in production, remote sensing for resource and environmental risk management, and local monitoring by NGOs of environmental abuses.

9.4. Integration into Overall Country Development Strategy

A national ICT strategy must be integrated into the overall development strategy of the country. It should assess the prospects and options for promoting the ICT industry, for using ICT in key sectors of the economy, and for empowering and networking all stakeholders in development. It should also systematically address how to use ICT as an enabling tool, in combination with other instruments, to address the two overarching goals of development: sustainable growth and poverty reduction.

10. Issues for Aid Agencies

The ICT and knowledge revolution present many challenges and opportunities for aid agencies (Hanna, 1999, 1991; World Bank, 1998; Mansell & When, editors, 1998; UNDP, 2001). Aid agencies should view this fundamental technological change as an opportunity for developing countries to address development problems and innovate new means to achieve basic development goals in the context of new global realities. This change also presents opportunities to leapfrog and participate in dynamic and fast growing industries and services.

Many aid agencies have begun to address the challenges arising from the ICT revolution for the way they do business and for building client capacity to exploit the potential of ICT for development. For example, the World Bank has appointed a senior manager for all knowledge initiatives, approved a sector strategy for information and communications technologies, and combined the public and private sides of Bank Group (Bank and IFC) assistance in the information infrastructure sector. Moreover, the Bank supported a number of global initiatives, in partnerships with other agencies: an innovation fund for ICT (Information Technology for Development, InfoDev), a portal on development information (the Global Development Gateway), and a program to connect schools to the Internet (World Links), among others.

An independent evaluation of Bank Group assistance to information infrastructure shows better than average performance for stand-alone Bank and IFC projects, but suggests growing gaps in connectivity among and within countries, and a fragmented response to rapid technological change (OED, 2001). A recent Bank strategy addressed issues of assistance to the information infrastructure (Information and Communications Technologies Sector, 2002). Several reviews of World Bank lending suggest that ICT applications are growing in coverage, complexity and pervasiveness, but these could be better integrated and evaluated (Hanna, 1993; IAD reports, 1996, 98; OED, 2001). The World Bank and other aid agencies need to take a broader and strategic view of the sector, to encompass ICT applications across sectors, to integrate e-development more holistically into sector and country assistance strategies and to link e-strategies to the Millennium Development Goals.

Information technology needs to be mainstreamed into the core business of aid: at the country, sector and project levels. A key issue facing such integration is whether to build a critical mass of core competencies in ICT application across sectors in a central location, or to build and integrate such competencies in each sector. A related issue is whether to develop hybrid experts who would have substantive knowledge of both a specific sector and of the potential or generic applications of ICT. Aid agencies may develop new modalities for ICT experts to work with substantive sector experts in key fields like education, public sector reform, and private sector development. Similar issues of integration arise at the country and regional levels, where ICT may provide a new lens for re-thinking development options and country assistance strategies.

Aid agencies could help governments set appropriate public policies and programs for using ICT to reform the public sector, to reach out to the poor, and to act as catalysts for ICT diffusion among SMEs and throughout the economy. They could take a strategic and holistic view of ICT, beyond ad-hoc assistance to ICT components in investment projects and stand-alone telecommunications operations. Accordingly, aid agencies could scan the global environment and draw on emerging best practices, then work with governments and local stakeholders to build local capabilities and develop home grown strategic responses that take account of global trends and practices. They could alert policy makers to the opportunities to mainstream ICT in the fight against poverty and to the need to get the enabling environment right. Aid agencies could also alert them to the pitfalls of viewing ICT as a magic bullet, in isolation of complementary investments and reforms, and of adopting rigid e-development strategies not adapted to local realities and capabilities. In doing so, aid agencies must

engage in partnerships and learning experiments to mobilize global and local know-how and resources, and facilitate local innovation and learning (Hanna, 2002).

It is time for aid agencies to integrate this technological revolution into their core businesses, develop the core competencies, and build the external partnerships necessary to help their clients meet the challenges and dilemmas arising from the ongoing revolution.

11. Conclusion

By ensuring the development of a solid national ICT strategy, many countries can position their economies for competitive advantage in a global knowledge-driven technology. Those who understand the process can direct their efforts towards learning the new practices and may find a route to leaping forward and catching up. This will involve a great degree of learning and understanding the impacts of ICT on markets, organizations, competitive strategies, innovation as well as the implications for services, employment, education, regional and spatial development and poverty reduction.

Furthermore, a successful ICT strategy requires a country's substantial investment in human capital, active absorption of technology, ability to raise awareness, build coalitions, clarify roles and responsibilities, mobilize and complement market forces, as well as scale up and leverage ICT. A special focus of a national ICT strategy should be to reform the national innovation system to promote the diffusion of ICT as a General Purpose Technology.

However, enabling the use of ICT as a strategic tool provides many challenges. For most countries, the capacity to handle information remains a dilemma, especially since knowledge and innovation are becoming more central than ever. This paradigm calls for radical transformation in education and training systems, science and technology policies, and even in conceiving development strategies.

The massive backlog of educational, health, extension, and social needs of developing countries, will pose great difficulties in catching up, much less "leapfrogging." However, an innovative and strategic use of new technologies could be crucial to meeting the Millennium Development Goals in a timely and effective fashion.

Evidence supports the school of thought that developing a national ICT strategy is vital to a country's economic development.

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13. Abbreviations

B2B – Business-to-business

B2C – Business-to-consumer

C2B – Citizen-to-Business

C2G – Citizen-to-Government

DEC – Development Economics

GDP – Gross Domestic Product

GPT – General Purpose Technologies

IBM – International Business Machine

ICANN – The Internet Corporation for Assigned Names and Numbers

ICT – Information and Communications Technologies

IFC – The International Finance Corporation

ILO – International Labor Organization

IMF – International Monetary Fund

InfoDev – Information Technology for Development

ITU – International Telecommunication Union

MDG – Millennium Development Goals

MSC – Multimedia Super Corridor

NASSCOM – National Association of Software Companies

NGO – Non-governmental organization

OECD – Organization for Economic Cooperation and Development

R&D – Research and Development

SME – Small and Medium Enterprise

TFP – Total Factor Productivity

TQM – Total Quality Management

UNDP – United Nations Development Program

WSIS – World Summit on Information Society