Government ICT Policy Primer

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Executive Summary

Information and communication technology (ICT) plays an important role in national economic performance. Investments in ICT spur job creation, create new sources of innovation, and enhance the competitiveness and capabilities of other industries, leading to improved economic performance and increased rates of employment. ICT can improve the Gross Domestic Product (GDP) and productivity performance. As an input technology, ICT can have tremendous impact on downstream industries, enhancing the pace of innovation and providing competitive advantage. As an industry, ICT offers opportunities for sustainable, economic development-enhancing employment.

Government policies have a substantial affect on the rate of adoption and diffusion of ICT. Numerous policy prescriptions can be used to deepen ICT assets within a national economy and proliferate the benefits throughout the nation's citizens, businesses and government organizations. These policy prescriptions include regulatory polices, tax incentives, procurement policies, laws governing public/private partnerships, R&D grants, standards, education and skills initiatives, and public awareness campaigns.

To be successful, policy prescriptions must be matched to a nation's economic and political system and level of maturity. Mature countries need to invest in ICT to accelerate their pace of innovation in a more competitive global economy. Less developed countries (LDCs) can use ICT investments to bring about rapid improvements, but they may also need to make structural changes to attract foreign investment and expertise. All involve a shift toward a stakeholder-centric model (rather than an inwardly-focused bureaucratic model) and require broad support. Technology trends offer new opportunities for governments, businesses and citizens to benefit, and for LDCs to leapfrog ahead.

Introduction: ICT Benefits, Government Actions

Information and communication technology underlies the world as we know it. ITC infrastructure supports logistics, communication, capital flows, and government transactions, and handles tens of trillions of dollars in commerce and trade annually around the world. ICT infrastructure enables multinational corporations and mom-and-pop operations alike to do business across the globe. It allows citizens to shop or access government services from the comfort of their own home, saving time and money for both the individuals and the company or agency with which they're doing business. It enables grandparents to view photos of their grandchild from thousands of miles away, just moments after the child's birth, and people with common interests to create a community that spans the globe. Studies show that ICT has a positive impact on the performance of companies and national economies. Indeed, higher levels of ICT investment are associated with higher GDP[1] , productivity[2] , and jobs creation.[3]

ICT infrastructure is a powerful networking technology. Already, an estimated billion people are connected by the Internet, and the modernization of economies like China, Russia, India, and Brazil will add a billion new people over the next decade. That growth will accelerate the network's economic usefulness and impact, and bring the global world community closer together. New and emerging ICT technologies – from wireless networks that enable affordable broadband networking in remote geographies to optical technologies that remove distance limitations on data storage – promise to deliver even more value and opportunity.

But the benefits of technology progress are not automatic. Government policy plays a critical role in determining the rate of ICT diffusion and the corresponding economic impact – and whether the benefits accrue to broad population segments or are confined to narrow elites and specific nations.

[1] Positive contribution to country specific GDP for 1990-1999 rangrd form .08 up to 7 percent. Andrea Bassani and Stefano Scarpetta, "Growth, Technological Change, and ICT Diffusion: Recent Evidenve from QECD Countries." Oxford Review of Economic Policy, Autumn 2002

[2] Productivity output due to ICT investments showed an increase from 3.8 percent in the US to .04 percent across Europe. Francesco Daveri, "the Economy in Europe, 1991-2001," Oxford Review of Economic Policy, Autumn 2002

[3] Employment in the ICT industry increased 21 percent in New Zealand over 1991-1996. Stephen B. Blumfield and Glen Thicket, "Surfing the Knowledge Wave: The Impact of Information and Communication Technology on Decent Work in New Zealand." New Zealand Journal of Industrial Relations, Feb 2003.

Government Policy and ICT Overview

Many governments recognize the correlation between ICT investment and economic results, and are crafting policies favorable to ICT proliferation. For instance, Sweden has invested heavily in government and commercial infrastructure, as well as deep residential penetration of PCs through aggressive tax policies. The country spends on average five percent of GDP on ICT (1995-2000) and has the largest R&D budget as a percentage of GDP in the world. Sweden started an employee PC purchase program (EPP) in 1997, well ahead of other countries, and today more than 80 percent of Swedish households have a PC – the highest PC penetration of any country.

In 2002 Sweden ranked as the number one country in Europe for e-government infrastructure and sophistication.[4] It has the lowest cost for broadband access in Europe. Sweden has one of the highest rates of college graduates in scientific disciplines (computer science and mathematics). Its small to medium enterprise (SME) businesses have one of the highest ICT take-up and usage rates in the world, which results in positive export sales. Sweden's employment rate in ICT increased over seven percent (1999-2000). And Sweden continually ranks as one of wealthiest GDP per capita countries in the world. There is a direct correlation between GDP, per capita income, citizen skills, and employment rates on the one hand, and the investments Sweden has made in its ICT infrastructure on the other.

The methods governments can use to influence ICT usage and penetration range from tax incentives and changes in the legal and regulatory environment to development grants, public/private partnerships, education and awareness campaigns, and government procurement policies. The goals include:

- Producing a more efficient economic system suited to a more competitive environment.
- Transforming economies from low-skilled manufacturing to knowledge- and innovation-intense industries.
- Decreasing social and geographic disparities.
- Spurring sustainable economic development in less developed countries.
- Increasing the transparency of interaction between government, business, and citizens.
- Managing the post 9/11 security environment.

The issues that arise in formulating ICT policy can be complex, connecting policy, ICT technology, commercial, and public interests. Consider a US-focused example. The worldwide supply chain moves six million cargo containers into and out of the US every year. In an atmosphere of heightened security concerns, US policymakers need to balance the government's mission to protect national security against the profit and productivity goals of commercial enterprises. Efforts to establish policy concerning the security of the worldwide supply chain span a broad range of questions:

- Should the supply chain be regulated?
- If so, what should be regulated?
- What technologies can be deployed?
- What is the trade-off of expenditure to safety?
- Where does government responsibility stop and commercial responsibility start?

Answers to these questions can have a broad economic and social impact. Failing to enact regulatory edicts to protect the global supply chain through technology (track and trace, physical inspections, or targeting at risk shipments) could result in a cataclysmic global stoppage of trade. The economic impact of a cataclysmic (nuclear or biological) event would be measured in hundreds of billions of dollars and could push the world into a global recession. Waiting for private industry to invest in the necessary technology to protect the supply chain creates a great social risk to the public interest.

Private industry should do its share, but how do you convince or encourage large retailers to incur costs that would secure their shipments, but put them at competitive disadvantage in the marketplace? They won't do it unless assured that the field is regulated by government and everyone is playing by the same cost structure.[5]

To date policymakers have cautiously implemented a system allowing US customs officials to electronically review the manifest of shipments and screen out high risk shipments. That decision results in less than five percent of all cargo entering the US being inspected.[6] Who should determine if that is sufficient – and how? Legislation is pending on several fronts: research and development efforts to create new technologies, regulatory regimes to screen a higher percentage of shipments, and incentives to encourage private enterprise to invest more deeply in security.

This is a classic example where government policy, industry interests, and ICT intersect (Figure 1). Yet, there is no clear

[4] Booz Allen Hamilton, International e-Economy Benchmarking, The World's Most Effective Policies for the Economy, Nov 2002.
[5] Holman Jenkins, "How to Keep Osama from Coming Down The Chimney," Wall Street Journal. Dec 1 2004
[6] Stephen Flynn, America the Vulnerable, New York: Harper Collins, 2004

answer on where private interests should stop and government responsibility should start. Much work is needed on this topic moving forward. This will require deep cooperation between ICT innovators and suppliers, commercial businesses, government, and citizens.

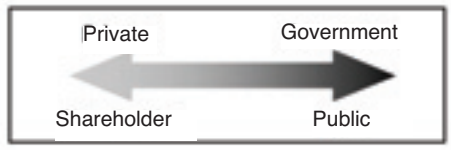

Figure 1: Successful policy prescriptions balance the interests, and require the cooperation after of public and private sectors.

ICT Impacts

ICT is used in three sectors of the economy, each of which services a set of constituents and interests:

- **Governments** serve businesses, citizens, other governments, and employees.
- The **commercial or business** sector serve consumers, employees, and shareholders, and conduct transactions electronically with government.
- The **residential sector** spans a broad range of functions including continuous education, entertainment, and increased personal productivity (paying bills on line as one example).

ICT investments produce impacts that can be measured in three quantitative ways: contribution to GDP, productivity, and employment. Qualitative impact, often more difficult to measure, include improved transparency, improved information access, and strengthening community bonds (Table 1).

Table 1: Measures of ICT Impact

Economic	Social	Spillover
Contribution to GDP	Information access	Downstream industry impact
Productivity statistics	Community bonds	Spawns new innovation
Increased employment	Educational opportunity	Improved pace of innovation
Cost reductions	Sustained economic development	
Competitiveness	Increased transparency and improved trust	
Labor skills	Increased citizen participation	
	Improved work/life balance	

Economists from the Organization for Economic Cooperation and Development (OECD) have studied and analyzed their thirty member countries using growth accounting models, surveys, regression analysis, and Total Factor Productivity (TFP analysis). They report that from 1995 to 2001, ICT capital investments contributed one half of one percent to annual GDP growth in OECD countries. Wide disparities often exist between the results at a country level, caused by variations in the level of investments (for example, the US invested approximately ten percent more in ICT than the OECD's European countries), the rate of diffusion (often a result of policy frameworks), the lag time between impact and analysis (the US started investing much earlier), and the effectiveness of implementation.

Empirical evidence from the OECD countries finds that manufacturing plants that adopted advanced technologies, in particular ICT, experienced faster growth in productivity and market share than plants that had not incorporated advanced technologies. Over the periods 1993-1994 and 1998-1999, it is estimated that ICT investments accounted for one-third of the labor productivity growth of 3.2 percent in Australia. This is consistent with studies performed in other countries. Productivity is often cited as the reason the US economy performed well during the 1990s and the jobless recovery of 2001-2004.

As mature economies have migrated towards service-based economies (finance, health care, insurance, retail) and away from light and heavy manufacturing, ICT has become a much higher percentage of overall employment in mature economies. In addition, manufacturing in these nations has become more capital intensive and less labor intensive, with capital deepening substituting for low-skilled labor. Increased rates of employment in the ICT sector is a factor impacting economic performance at the national level. The US semiconductor industry - the foundation of the ICT industry - employs over 250,000 skilled workers and contributes 6.5 percent to the economy.[10]

[7] Amhad, Schreyer, and Wolf, in The Economic Impact of ICT: Measurement, Evidence and Implications, OECD, 2004.
[8] Baldwin, Sabrouin, Smith in OECD, 2004.
[9] Gretton, Gali, Parham in OECD, 2004.
[10] Wesner, 2004

ICT development can result in sustained economic development and can be a major factor for proactive, market-enhancing government policy. ICT is a strategic input (upstream) product which benefits many downstream industries. Investments in ICT can spur job creation, create new sources of innovation, and enhance the competitiveness and capabilities of other industries, leading to improved economic performance and increased employment.[11]

Policy and the Government Sector

Governments are direct consumers of ICT as well as agents whose policies determine the pace of ICT proliferation throughout a nation.

Economies perform better when they operate with an efficient government infrastructure. Efficient structures provide transparency and support services to citizens and business constituents. For instance, consider opening a business in an OECD country and a less developed country. In most OECD countries, an entrepreneur can get needed information online without ever visiting a government building. In a less developed country (LDC), an entrepreneur may have to physically deal with fifty different agencies, often with little transparency, creating conditions for corruption. There are obvious economic implications in time, energy, and entrepreneurial spirit as a result of these infrastructure limitations.

ICT usage is pervasive across national, regional, and local governments and is a key instrument of a proper functioning government. Government ICT infrastructure handles critical functions such as defense and intelligence, tax collection, health services, education, and public safety. Governments worldwide spend more than US$40 billion annually on ICT hardware (not including services and software) and US$68 billion on telecommunications hardware equipment.

Defining Success

Government agencies and policymakers often define their objectives in terms of mission, while private enterprises define success in term of shareholder return. Government missions include increased transparency and access, increased workforce productivity, ICT literacy, education and health, public safety, constituent (business and citizen) satisfaction, and economic development. Measures of success include mission achievement, the number of government services moved online, reduction of operational or personnel costs, and social impact.

A particularly acute problem given the mission framework is measuring economic impact, return on assets, and social return. Governments lack the analytical tools to properly assess and forecast impact and measure results. This is a big challenge, since governments must make tradeoffs against other national or local priorities. Policymakers must balance and evaluate the expenditure of public funds on ICT against a range of other pressing societal needs (health, education, security). To gain better insight and make better decisions, policymakers need better analytical tools.

The Need to Lead

As Figure 2 shows, there is a unique intersection in the government sector between policymakers, purveyors of ICT solutions, and government stakeholders (the commercial and residential sectors and other governments).

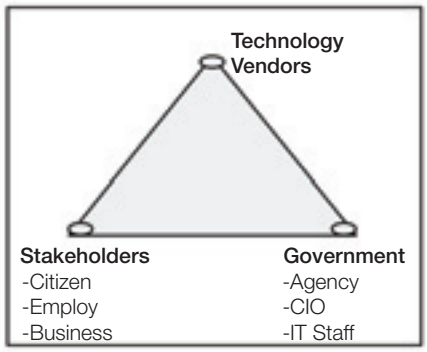

Figure 2: The intersection of vendors, policymakers and government stakeholders.

Government can act through public/private partnerships to stimulate R&D and pilot new innovations. Research arms of agencies like the Department of Homeland Security in the US, the Korean Institute of Science and Technology, or Taipei's RDEC (research development and evaluation commission) have been on the forefront of ICT innovation in government. More often, however, government lags rather than leads.

This is especially true where security, privacy, and confidentiality-related issues are involved. This lag is often the result of poor or late government policies.

For an example, look at the ubiquitous diffusion of wireless technology in the consumer and commercial sectors over the last three years, while many government agencies around the world struggle with policy issues in deploying the technology. Technology advances will continue to bring new capabilities such as Voice over IP (VoIP), WiMAX*, and virtualization - the ability to operate a dual operating system environment on a single platform.

[11] IDC, 2003.
[12] Gibbs and Tanner, 1997 and Silva and Figueroa, 2002.

In a globally competitive environment, government policymakers must be out in front of these technology advances if they are to have an effective framework of operations.

Large-Scale Innovation

Because of the magnitude of their organizations and the challenges they are trying to solve, governments are often unique in the scope and impact of the ICT projects they take on. Consolidating silos of government functions such as human resources or ensuring interoperability between first responders (fire, police, and health care workers) are unique problems in scope and scale to government and provide a fertile ground for innovation.

E-government implementations have been a place where governments have demonstrated innovation and leadership. E-government is providing routine government information and transactions using electronic means, often using the Internet. These services may be delivered to citizens at home, to businesses at work, or to both through public kiosks. Throughout the world, governments are investing billions in e-government initiatives to move counter- and paper-based processes toward electronic transactions. The objective of these programs is to increase worker and stakeholder productivity (i.e., citizens and businesses) while reducing costs. E-government initiatives follow a ladder of innovation and value, beginning with simple information transmittal and progressing to transaction-based services and interactive services.

Government plays the unique role of customer, policymaker, and innovator. The government sector can dramatically impact the rate of ICT diffusion and adoption and thereby make a significant impact on national economic performance.

Policy and the Commercial Sector

Commercial enterprises have invested heavily in ICT over the last fifteen years. Extensive ICT capital deepening (raising the ratio of capital to labor) has occurred in the service (insurance, finance, and retail) and manufacturing sectors. This is a result of a continuous decline in ICT prices, coupled with a dramatic increase in capabilities. (See Figure 3.)

ICT benefits to commercial enterprises include savings on capital and labor, efficiency gains, reduced transaction costs, higher flexibility, and improved product quality.[13]

Figure 3: Declining prices and increasing performance and capabilities bring new opportunities for ICT to deliver dramatic business value.

The literature of ICT success stories in the commercial sector is deep. To cite just a handful of US-oriented successes:

- Google implemented the world's largest cluster system, helping make it the preeminent search engine and a market leader.
- Wal-Mart, E-Bay, and Amazon have created advanced supply chain management systems that propelled them to market leadership in their respective sectors.
- The Pringles* potato chip brand managers used high performance computers to simulate how potato chips move through the production line, enabling them to increase efficiencies where none were thought to exist.
- Boeing has implemented a paperless design of its 777 aircraft, contributing to dramatic savings in operations costs for the company and its key design and manufacturing collaborators.

ICT investments have been a fundamental asset in the successes of these companies. As the OECD points out, companies that invest in ICT are more productive, gain market share faster, and innovate more quickly.

Government policies can impact the rate of adoption by commercial enterprises. Laws imposed by government on telecommunication policies impact costs, labor laws impact a company's flexibility to hire ICT-literate workers, tax treatments of ICT and e-commerce can have significant consequences on return on asset measurements. Anecdotal evidence comparing high performing economies and firms in the US, Netherlands, and Australia to slow mover economies like France and Germany lead one to conclude that governing ICT policy frameworks can have a significant impact on national performance and productivity measures (GDP, productivity, and employment).

[13] Hollenstein, OECD, 2004.

Policy and the Residential Sector: Bridging the Digital Divide

Governments have implemented a variety of purchase plans to increase ICT penetration in the home – and for good reason. Promoting network access and helping citizens purchase PCs are important ways governments can proliferate the benefits of ICT and raise the ICT skill base throughout their populace. In addition, government initiatives for citizens are worth little unless citizens have a way of accessing those services. And, of course, fundamental issues of fairness and equity are also at play.

Broadband infrastructure is evolving toward a basic utility service model in many countries and potentially toward a universal access model similar to phone service. The importance of ICT literacy is captured by Digby Jones, Director General of the British Confederation of Industry, who says, "It is essential for every single person to succeed in the 21st century that you have got to understand how to operate a PC." [14]

Residential ownership is a measure of the penetration of consumer products such as personal computers, broadband, and services in the home. An analysis of PC penetration, teledensity, and broadband penetration (Appendix 1) shows a wide disparity between OECD, emerging, and less developed countries. This disparity is often referred to as the digital divide, as it results from macroeconomic factors (country size, population, and GDP), policies (tariffs and incentive plans), telecommunication infrastructure, citizen capabilities, and affordable products.

Many governments have initiated programs to bridge this divide. Among these are employee purchase programs (EPP), low cost PC programs, student purchase programs, and shared access models.

Employee Purchase Programs

Employee purchase programs enable citizens to purchase home PCs through their companies at a discounted rate or tax free. EPPs are viewed as an employee benefit similar to the way a 401K or health insurance benefits are seen in the US. EPP programs are now sponsored by governments including Sweden, the UK, Denmark, France, Spain, and Italy.

To support these programs, governments have:

- Reformed tax laws to provide relief on purchases.
- Pushed PC providers, ISPs, telecommunication providers, content providers and other companies to bundle services together and provide discounts.
- Offered low cost loans through banks.
- Structured salary sacrifice schemes to simplify the process with automatic payroll deductions.

The net result of these efforts is to decrease acquisition costs and accelerate penetration rates.

For these programs to work successfully, the industry partners and sponsoring companies must cooperate closely with each other and with the government. Thus, a unique aspect of these programs is the public/private partnerships that result – partnerships that often lead to further collaboration and deliver further value to the nation's government, citizens and businesses.

The anecdotal result of these programs on PC penetration and economic performance is evident in different countries. In a UK survey[15] of employees with home computers purchased through a government support program:

- 61 percent had improved IT skills.
- 65 percent were more familiar with the Internet.
- 51 percent learned additional work skills.
- 77 percent said they balanced work and family demands better.

As of this writing, more than 25 countries have employee purchase programs in place.

Budget PC Programs

Government budget PC programs began in 1999 when Korea initiated its Internet PC program to provide low cost PCs to low income citizens. The objective was to increase PC literacy and usage of e-government services. In budget PC programs, as with employee purchase programs, governments initiate public/private partnerships to manufacture and deliver a low cost PC, create compelling financial mechanisms, and bundle Internet services.[16]

The Korean program was followed by similar efforts in Malaysia, Thailand, Indonesia, the Philippines, and Vietnam. These programs all had ambitious goals set by policymakers and politicians. Combined, these programs hoped to deliver over two million PCs with Internet connectivity to citizens. While some programs fell short of their goals due to execution issues, fraud, and lack of awareness, others have been quite successful, and in all cases, the government was the catalyst

[14] Interview with the author, 2004.
[15] Booz Allen Hamilton, 2004.
[16] IDC, 2004.

in getting the private sector to acknowledge the market opportunity in lower income segments. This has resulted in changes by vendors and service providers in how they approach those markets.

Student Purchase Programs

The laptop Student Purchase Program in France is an example of another category of program where government is the innovation driver in an effort to deepen ICT assets. The program was launched in the fall of 2004 with up to US$6.1 million in funding and the involvement of nine PC manufacturers, six banks, and ten content providers. The program's objective is to increase the eight percent laptop penetration rate in France's population of two million students, as well as to provide free Internet access on French universities and a richer learning environment for students. Again, government policymakers were the catalyst that brought together private and public stakeholders: PC providers, Internet service providers, content providers, and banks offering low cost loans.

The empirical evidence of economic impact from these programs has not yet been assessed, but the anecdotal evidence is clear. Citizens benefiting from employee purchase programs demonstrate increased learning and increased job satisfaction, yielding improved job performance and productivity. Citizens benefiting from low cost PC programs in Asia gain increased access to government services and educational services and develop much needed skills for a modern economy. Lastly, students are able to enrich their learning experience, ultimately leading to a better informed and better educated workforce.

Policy Impacts

It is clear from these programs that governments can have a positive impact on residential ICT penetration. Equally important is the linkage between these programs and the expenditures made by governments to modernize and transform their own ICT infrastructure. The complementary investments make for a powerful contribution to economic development and citizen skill set enhancement, and ultimately pay dividends economically for countries.

Bridging the Divide in Less Developed Countries and Rural Areas

In less developed countries, the importance of an ICT-literate society is clear to policymakers. Also clear is the need for government to step in and act as a catalyst, because market forces alone are not getting the job done.

Less developed countries have unique challenges when it comes to ICT implementation and policies:

- Frequent power outages
- Low income (GDP capita) levels
- Poor fixed-line assets for communication (i.e., poor phone line and network quality)
- Limited ICT literacy or experience
- Insufficient and/or low-quality content
- Limited local industry capability

These obstacles afford an environment of experimentation throughout the world.

Solution: Shared Access Models

Most of the efforts in less developed countries or low income areas are based on a shared access model. A shared access model consists of centralized locations within proximity of a rural or low income area where citizens can come to access personal computers and the Internet. The shared access points may include community learning centers, Internet cafes, government-sponsored kiosks, tele-centers, and tele-cottages.

Shared access models enable governments to amortize the cost of equipment and access across a community. Results are often measured in social returns as opposed to return on investment or contribution to GDP. Government goals may include:

- Eliminating the lack of access to information in rural and low income areas.
- Strengthening community bonds and interaction.
- Increasing social networking within and outside a community.
- Complementing and improving formal education for children and adults.

- Creating new and sustainable business opportunities for entrepreneurs.
- Reducing transaction and opportunity costs for citizens and governments.
- Improving government transparency and increasing citizen participation in government.

Example: Korea

In South Korea, the government is sponsoring the Korean Information Network Village (Kinvil) program to reach rural agricultural areas. This program consists of a community learning center, home PCs for citizens, broadband access, and e-commerce training. The Korean network village is a public/private program that includes sponsorship by the government and ICT vendors.

The Korean Network Village program is connecting remote rural farmers to the global economy, allowing them to sell goods to global markets through e-commerce transactions. This successful model has increased the revenue for the village and individuals, which in turn has increased the quality of housing, infrastructure, healthcare, and life in the village.

The networked village also provides a location for citizens to conduct transactions such as land registration, license renewal, and tax payment through secure government kiosks. By avoiding the long commute to government offices, the Kinvil saves villagers valuable time that can be spent working. It also reduces the government's paper and transaction costs. The Kinvil Community Learning Center serves as a base to train children on ICT usage, as well as a community center ensuring a long term ICT literate society.

This innovative program has become a reference community – a model for other rural areas in Korea. The Korean government has funded several early pilots and solicited participation from industry to support the early proof-of-concept village. It is expected that the successes in these early villages will lead other villages to make similar investments on their own. Korea's objective is to have over 2000, such networked villages.[17]

Examples: Latin America

In Latin America, the governments of Peru, Argentina, and Chile have sponsored the formation of private tele-centers. ICT tele-centers come from the idea of a shared service center that provides phone services in rural or low income areas. Argentina aims to implement 10,000 tele-centers, while Peru is attempting to implement over 2,000 such centers.[18] The tele-center model is set up to develop a self-sustaining enterprise that will be owned and operated privately, stimulating local entrepreneurship.

Examples: Africa, India

In Tanzania over 2000, private Internet cafes using refurbished PCs have become a major source for connecting to the world. This momentum has been spurred by increased liberalization of telecommunication policies.

In rural India, government-sponsored kiosks have become a primary source of healthcare information. Government-sponsored networks have linked farmers into a powerful community to share information on farming techniques, weather forecasts, and bringing products to global markets.

Public/Private Partnerships

As we've seen, it is often up to governments to act as a catalyzing force to create the momentum and means in the early stages of these efforts. Many of these initiatives are spawned by early investments made by the government or international organizations such as US aid or the World Bank. These efforts include public/private cooperation with the objective of finding the right model or recipe to effectively scale an effort. A report by the World Resource Institute Digital Dividend Project shows that over 60 percent of the efforts in less developed and low income rural areas are spawned by international institutions and nongovernmental organizations (NGOs), 20 percent by the private sector, 12 percent by government, and 8 percent donor organizations.

In the United States a good example of the role an NGO can play to increase access is One Economy, an organization chartered to bring access to low income US households by working with urban housing developers to pre-wire low income housing developments. One Economy works with state officials, housing developers, industry providers (ICT equipment, Internet services providers, and content developers), and local financial institutions to bring a complete solution to citizens in lower economic areas. One Economy is reaching out to over nine million US citizens who would otherwise not have the opportunity to connect to the modern economy. As One Economy personnel would tell you, providing access is just the first step. Successful programs must also include relevant content,[19] a program to drive awareness and education of the users.

[17] Interviews with the author, 2004.
[18] United Nations Task Force, Connected for Development, Department of Economic and Social Affairs, 2004.
[19] See the One Economy Beehive Web Site for content, www.thebeehive.org

Broad Impacts

Many of the policies to stimulate these early proof points have also set in motion a powerful innovation cycle. In India low cost wireless loop solutions have brought inexpensive access to remote regions. Across Southeast Asia the drive for budget PCs has stimulated the search for ways to cut the cost of back-end computers and spurred the adoption of open source solutions. Health care solutions providers have begun creating healthcare kiosks to provide preventive medical services and information to patients in rural areas, thereby reducing overall health care costs and increasing the quality of life. In the US, programs such as One Economy have stimulated the development of the BeeHive web site to bring relevant content and services to low income households.

The opportunity to move toward digital inclusion has never been richer. Innovative recipes for sustained ICT penetration exist throughout the world. Creative solutions are being spawned as governments and NGOs realize that tremendous social benefits can be accrued through the widespread deployment of ICT solutions. Standing at the center of this discourse are government policymakers. From liberalizing access to acting as a catalyst for early proof points, government has never played a more critical role in bridging the digital divide and preparing its citizens for a more connected world.

Policy Frameworks for ICT Investments

Governments have a wide range of policy frameworks through which they can deepen the national impact of ICT and proliferate ICT's benefits throughout their economies and their citizens. At the broadest level, governments may choose to pursue market correcting, market enhancing, or laissez faire approaches to the ICT sector:

- Mature and newly industrialized countries should adopt policy prescriptions that enhance the market and make it more efficient and competitive. Market-enhancing policies would stimulate innovation through R&D grants, favorable tax treatments for ICT investment, and incentives for public/private cooperation to drive new innovation.

- In less developed countries, market correcting actions are needed. LDCs often need to liberalize the telecommunication infrastructure, invest directly to catalyze the market, open the path for development investment, improve laws to stimulate cross-border collaborations, and continue to experiment with sustainable economic development models.

Policy frameworks must reflect the unique economic systems, philosophies and tax structures upon which the country is organized. These comparative economic structures – based on long-embedded national philosophies, current policy tactics, responses to globalization, and political biases – impact a country's rate of ICT diffusion and must be taken into consideration as governments consider how best to implement policies to drive ICT deepening within their economies. Here are a few simplified examples:

- US policy is built on the framework of competition, low taxes, laisse-faire, and limited market intervention. Because of US economy's size, scope, and diversity, limited market intervention by government is needed.

- Sweden is built on a model of high taxes and significant social services. With a small market economy of five million people, Sweden's economic structure allows it to effectively target specific areas of investment, as it does in ICT.

- France is a guided by quasi-public/private partnerships and tends to have high tax rates, strict labor laws, and technocratic biases on how markets evolve. Policies pick winners and losers, as well as what critical industries should be targeted for investments. These actions may distort the pace of innovation in the marketplace, but when the right areas are chosen, they can yield superior results.

- Newly industrialized countries (NICs) struggle with the structure of national industries in key areas such as energy, telecommunications, and healthcare. Governments often maintain controlling stakes in these important national areas and as a result play an active role in the how markets are shaped and work.

Table 2 lists the core areas for policy consideration, and the following pages discuss various tools for implementing policy.

Table 2: Policy Frames

Policy Prescription	Description	Impact
Regulatory changes	Policy directives from government agencies that enforce standards for conducting transactions with government. Changes could include mandates for electronic medical records, enforcement of RFID tags or electronic tracing of packages for shipment across borders.	Forces market sectors to accelerate technology deployment. Regulatory policies should be utilized when the social benefits (health and security) require government to appropriate resources.
Tax incentives	Front-end tax policies stimulate procurement behavior, creating a procurement that would not have happened or accelerating purchasing behavior. Back-end tax policies accelerate depreciation of ICT equipment, which accelerates refreshing of equipment.	Lowers the cost of procuring and owning ICT equipment. Increases the rate of diffusion and refresh within a country, which in turn enhances productivity and economic welfare.
Procurement policies	Policies to accelerate the adoption of leading edge technologies. Spending can be 1-5 percent of GDP budgets.	Stimulates solutions development within the private sector. The result is advanced ICT infrastructure which expands the business base and accelerates technology diffusion.
Collaboration incentives, public/private partnerships	Policies to encourage public/private partnerships through legal reform and financial incentives.	Stimulates the interaction between government agencies, non-government agencies, and the private sector. Accelerates solving ICT problems, improving a country's infrastructure and utilization of resources.
R&D grants and investment	R&D grants targeting ICT innovation and development. Past areas include semiconductor, browser, and data mining technology.	Stimulates indigenous capability and development. Increases the flow of future product development through long-term R&D.
Standards	Industry standards set by working groups and certified by government agencies.	Enables interoperability and scale of investment in ICT.
Education and awareness	Advertising campaigns by government to create awareness for businesses and citizens. In advanced countries this could include making citizens and small businesses aware of government efforts to modernize infrastructure.	Increases the social and financial returns on government ICT investments.
E-government transformation and incentives	Policy incentives can increase electronic commerce between businesses (B2B) and between businesses and employees (B2E), business and government (B2G), and government and citizens (G2C). Incentives can include tax holiday, monetary incentives or deductions for electronic filing, and awareness campaigns.	Reduces operation costs, increases government transparency, speeds the diffusion of ICT technology into the economy, increases citizen satisfaction.

Regulatory Policies

Changing the regulatory environment can force ICT deepening when sectors are not moving quickly enough of their own accord. For example, governments might mandate that medical records be storable and transferable electronically, a move that is under consideration in the US and already being implemented in other countries. Such a mandate would require health providers to invest in the infrastructure and create momentum for greater innovation in the healthcare segment. The long-term result would be increased efficiency, reduced costs, and improved quality of patient care. Another example would be in customs inspection and logistics. Government could mandate that all commerce transactions include an e-certification to eliminate paper transactions and require shipments be traceable from the point of origin on the factory floor. Some of this is being implemented by US customs, but must be standardized across the globe.

Changing regulatory rules can impact the level of ICT investment in a country. Governments can justify these actions when innovation is not occurring at a sufficient pace to meet the nation's social and economic good; increased public health and public safety, in the examples above, are the payoff to justify the action. Businesses may resist such changes since they will incur short term expenses, but as long as the regulations are applied and enforced equally, no one will be given an unfair advantage in the market and ultimately all are likely benefit from their technology deployments.

Tax Incentives

Favorable tax frameworks through faster depreciation schedules or tax moratorium policies can accelerate diffusion and implementation. Stimulating the infrastructure by deepening the ICT resource pool has an amplifying effect across multiple sectors of the economy. The deeper the pool of ICT investment, the more labor is required to service those resources, the more innovative products that come to market, and the more rapid the pace of innovation across the nation's economy.

The US has provided a tax-free environment for e-commerce, which has had a stimulating effect on e-commerce. Specifically, it has:

- Led entrepreneurs and service providers to deepen ICT assets and reduce fixed-store costs.
- Caused multinationals to invest more deeply and lowered transaction costs.
- Stimulated innovation in software development as the market opportunity promises rents can be earned by entrepreneurs.
- Reduced product costs to consumers, stimulating buying.

The lessons learned in e-commerce need to be applied to new technology advances like voice over IP (VoIP). Recently, the state of Minnesota attempted to increase regulatory oversight on VoIP services by Vonage. The US Federal Communications Commission stepped in and classified the services as interstate and therefore not subject to local regulation. This is an example of aggressive states seeking new sources of revenue that would place revenue collection over technology diffusion.

Procurement Policies

Countries can use procurement policies to stimulate investments. Far-reaching government-sponsored projects, such as electronic patient records in the health care system or sensor technologies through military procurements, can create and stimulate innovation. Most governments have a local supplier preference to stimulate local business development, skill up local resources, and create sustainable development models.

Governments can use centralized procurement to establish standards and increase purchasing economies of scale. A trend towards centralized procurement within governments has occurred over the past two years. These policies increase the government's ability to influence suppliers' product direction (and thus better ensure that the government's program needs are met). They can also shift the balance of power between seller and buyer.

Collaboration and Partnership Incentives

Favorable frameworks for public/private partnerships are an important element of stimulating and deepening ICT assets, whether in mature countries trying to reduce the digital divide or in less developed countries trying to accelerate ICT adoption. Policymakers can provide legal structures, tax incentives, and intellectual property regimes that attract deeper investments and willingness by multinational corporations and small to medium enterprise businesses. Governments can also provide a formula to attract investments in training, education, and establishing centers of excellence in developing ICT literacy.

Collaboration incentives to form R&D programs between universities, labs, and private enterprise can stimulate innovation,

which in turn can stimulate demand. Ensuring good legal frameworks that encourage collaboration is an effective policy instrument.

R&D Grants and Investments

Government grants to conduct research into leading-edge technologies are needed to continue the pace of ICT innovation. Government policies play a significant role in catalyzing early research. These grants should be peer reviewed and devoid of political bias. This is a particularly important policy for advanced countries seeking to increase or maintain their industry leadership position in the face of increased global competition.

Education, Access and Awareness

Sometimes, governments invest large amounts of money to transform and modernize their infrastructure, but then do little to provide access and awareness to citizens. Governments must take a balanced approach to ensure that attention is given to both sides of the equation. Governments can do a great deal to promote education and skill development through training centers and tax relief for education. Governments can sponsor reference communities as best practices which other communities can then follow. Governments do not have to make massive investments to completely revamp systems, but they are in a unique position to promote early successes as reference communities and then let market forces move things in the right direction.

Governments can do more to increase access to their citizens. Government-assisted purchase programs can help stimulate the market. The networking power of ICT often means that governments need to jump start the market initially. Once the market reaches a certain threshold, market forces and the connectivity power of ICT assets create an accelerating rate of adoption across the country. These programs can be complemented by financial incentives such as making license renewal a free transaction or reducing a citizen's property taxes if they file electronically.

Many citizens may not be aware of the modernization efforts or programs that governments have put into place to improve their lives. The Beehive (One Economy) program cited earlier is a good example that combined increased capability and increased awareness to create a successful program. In 2004 over 13,000 low income families were able to take advantage of the US earned income tax credit. Without access to and awareness of the beehive, this would not have occurred.

Ensuring that labor keeps pace with ICT developments should be a priority for policymakers. Advanced countries need to ensure that incentives exist for continuous education and advancements. Scholarships and educational tax incentives can help create a favorable framework. Less develop countries need to invest in developing the infrastructure and expertise by importing capability and personnel from advanced countries. Less developed countries have the opportunity to leapfrog and catch up with mature countries and markets by importing expertise while they build indigenous infrastructure.

Planning for Next-Generation ICT Policies

ICT capabilities are advancing rapidly. Understanding key technology trends can help policymakers adjust their policy frameworks to take advantage of emerging capabilities. Today's technology trends will also change market dynamics and create new ways to work. The following technology trends will change the shape of tomorrow's ICT infrastructure and impact tomorrow's policy formulation.

Convergence

Communication and computing devices once represented different spheres of innovation and product development. Now they are morphing into a single converged ICT solution. Convergence is a significantly disruptive force that will create new market leaders, drive new partnerships, and reshape the ICT industry.

Convergence is taking shape in media, communication, and health care:

- Convergence of media platforms with computer platforms; e.g., your PC becomes your stereo and entertainment system.
- Convergence of communication devices; e.g., your cell phone doubles as a personal digital assistant (PDA).
- Convergence of medical devices; e.g., first responders use devices that merge mobile capability with diagnostics capability.
- Convergence of the IT enterprise infrastructure servicing data with the communication infrastructure servicing voice. Voice over IP is an early application example of how these technologies will merge to provide new capabilities at lower costs. Figure 4 shows that VoIP is projected to grow rapidly.

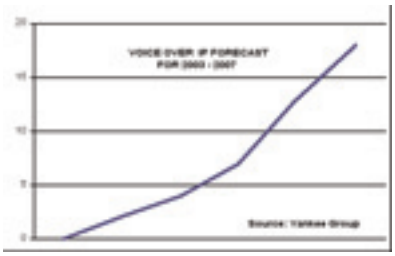

Figure 4: VoIP Growth Projection.[20]

Convergence is being driven by higher levels of transistor integration. It produces convergence at the platform level, with innovations such as the merger of PBX voice infrastructure with an Internet protocol-based computer server infrastructure.

Every sector will be impacted by convergence:

- Governments will have the opportunity to reduce communication costs and standardize on platforms that bring down overall operations costs. They will be able to run one network to handle voice, data and wireless communications, instead of three.
- Commercial entities will enjoy similar cost reductions and will also be able to capitalize on new services that enhance productivity.
- In the residential sector, consumers and citizens will experience lower communication costs.
- Emerging economies will be able adopt a leapfrog strategy to catch up with developed nations, while developed nations will try to accelerate the pace of innovation in order to stay ahead.

Policymakers have the opportunity to accelerate the diffusion of new technologies or to slow their advance. The time when innovative technologies begin to move from early adoption to mainstream is particularly crucial. In the case of VoIP, governments today receive substantial tax revenue from the phone system. This enables universal access, which is important since phone service is a basic utility service to which every person expects to have access. US states could lose substantial revenue if consumers move towards VOIP rapidly, as the previously cited Minnesota case highlights.

Policymakers must determine if the current tax regime should be extended to the emerging technology. Consumers will adopt the new technology more quickly if tax policies do not get in the way. Taxes could slow adoption, but they could also be implemented to ensure universal access equivalent to the existing phone system. These are difficult choices and have consequences on diffusion, economies, and the pace of innovation, as well as on citizens.

Wireless Technologies

Wireless is a mainstream technology. The 802.11 standard has helped make Wi-Fi* access points and laptops basic fare for consumers and business. The trend towards wireless will continue as integrators incorporate mesh networking, a methodology to bring together access points into a seamless single network. The introduction of the 802.16 specification and WiMAX technology will close the last mile gap, which has been a major source of the digital divide for mature nations. It will also usher new opportunities for emerging countries, which will no longer have to incur the cost of fixed-line investments (digging and laying wire to remote regions or through new urban areas) in order to provide broadband connectivity.

Semiconductor and Optical Advances

The rapid advance in computing capability and accompanying drop in prices is a product of Moore's Law - the ability to double the number of transistors onto a silicon die every 18 months. Moore's Law (named after a prediction made nearly forty years ago by Intel co-founder Gordon Moore) is predicted to continue for at least for another decade. Today's PC desktop microprocessors utilize about 125 million transistors, while a complex server processor utilizes close to one billion transistors.

Substantial challenges in the form of power consumption, heat production, and electromagnetic interference are facing semiconductor vendors as they attempt to continue fulfilling Moore's Law. No challenge is more significant than managing heat production and the thermal envelope. Today's processors are pushing the thermal envelope for air-cooled systems, approximately 100-120 watts. Systems vendors may move toward more complex liquid-cooled solutions, but this would increase system costs and reduce the appeal of ICT equipment to consumers and businesses.

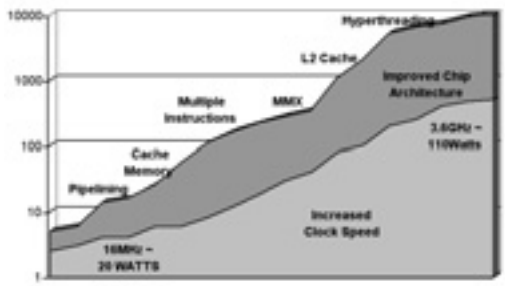

Figure 5: Moore's Law has brought steady increases in computer capability, but significant innovation is needed to maintain the rate of advancement.[21]

The solution appears to be to slow the pace of clock speed (frequency) improvements, improve the packaging and utilize parallelism. Instead of a single CPU running at an ever faster

[20] Source: Millions of Subscribers 2003-2007, Economist Special Supplement, Yankee Group.
[21] Illustration: W. Wayt Gibbs, "A Split at the Core," Scientific American, 2004.
[22] W. Wayt Gibbs, "Computing at the Speed of Light," Scientific American, 2004.

clock speed, the approach will be to utilize two, three, four or more CPUs in a single package. This is akin to having several engines powering your car instead of just one. This is a significant change in processor architecture, the most significant in the last 20 years.

While significant challenges face semiconductor manufacturers, significant technology advances will keep the pace of innovation moving forward. One important technology on the horizon is photonics - the ability to exchange data via laser light.

Today's telecommunication exchange networks are fiber-optic based. These networks can absorb significant costs due to the large amount of data that passes through them. In today's computer systems, however, most of the connections within a computer are still based on copper wires. As material science advances, technologists will be able to integrate the traditional semiconductor materials with new ones such as optical technologies. The result could be a dramatic change in performance and capability over the next decade. For example, an optically equipped platform could communicate at one gigabit per second (Gbps) – one thousand times faster than the ten megabit per second (Mbps) networks that are commonly used today. Optical technology also removes distance limitations, allowing components to be spread out over vast differences. This could dramatically change how and where businesses and individuals store data and access applications and services.

The fusion of technical disciplines will also impact future ICT implementations. Material science, genetics, physics, and software advances will all play a role in how the ICT sector emerges over the next two decades. Experiments are now underway with micro-fluidics, using silicon to analyze blood. So not only will technical disciplines see fusion, but also market sectors.

Changing Market Dynamics

Markets are changing dramatically, and this will have an impact on how policymakers should view the ICT sector. Mature markets are injecting ICT to increase the levels and pace of innovation. Less developed countries are investing in ICT to catch up with advanced nations and stimulate sustainable economic development. ICT is enabling further physical separation between worker and companies, enabling both off-shoring and working from home. Three billion new consumers are entering the market with very different economic conditions than the mature countries which ICT vendors have become accustomed to serving.

Emerging Markets

Newly industrialized countries are rapidly advancing. ICT is seen as key economic pillar by policymakers. Economic programs are being implemented to deepen ICT capital pools through regulatory regimes, tax incentives for consumers and business, modernizing government infrastructure, educational initiatives, and awareness campaigns.

Government efforts to stimulate investments and deepen ICT assets will reshape the ICT industry. In the past, ICT vendors have viewed newly industrialized countries as a market for refurbished equipment. However, moving forward, vendors will look at the governments, consumers, and businesses in newly industrialized countries as their primary growth markets.

Today, most ICT vendor business models are built on high margin, high revenue product mixes. In emerging countries such as India, where GDP per capita is less than US$3,000 annually, bringing many of these new potential consumers online will require a much different product mix than a US$2,500 PC and US$40/month broadband subscription. Innovative products and solutions will have to emerge to move price points to less than US$250 for a personal computer and a US$4/month subscription fee (a tenfold decrease in pricing) without reducing functionality. This could have a substantial impact on the vendor business models that have been built over the past twenty years.

Innovation and Market Disruptions

If current R&D efforts and the past are appropriate indicators of the future, the pace of innovation in the ICT sector will not be slowed because of technical limitations. The greatest risk to the ICT sector is slowing market demand or market saturation. Stable or rising market demand will ensure continued innovation from the ICT industry. Market demand disruptions because of increased trade friction or geo-political events are a greater threat to the pace of innovation than current scientific challenges. This is an important consideration for policymakers given the unique ability of governments to stimulate markets during critical junctures.

Tele-working

Tele-working is a significant trend. As networking power grows and technology advances increase the available bandwidth dramatically during the next ten years, the potential to free workers from the constraints of physical space is increasing. A good example is not just the case of off-shoring various business activities to low cost labor markets, but also the

ability to create new jobs where manufacturing dislocation is occurring. Missouri is an example of this, where dislocated manufacturing workers now transcribe court records from home. This is a result of government efforts to provide ICT assets and training in the community. Instead of off-shoring jobs, new jobs are created locally. The driver is not labor, but infrastructure investment and productivity.[23]

In the US Congress, policy is in motion to require that government employees work from home two or three days a week. The objective is to decrease traffic congestion and pollution, and increase workers' quality of life. These early pilots are proving quite successful. Interestingly enough, productivity increases while costs decrease. Such policies and practices have the potential to reshape labor laws, the structure of the labor force, and the innovation system.

Promoting Success: Best Practices for Implementing ICT Policy

Gartner, a leading ICT research firm, estimates that over 60 percent of e-government initiatives fail to meet the visions laid out by policymakers and politicians. The problems are not rooted in technology capabilities, but rather in implementation. Governments have struggled with numerous issues: organizational, political, resources, and personnel skills. A review of these issues highlights the wide range of factors which impact the success and failure of e-government investments, and shows that successful implementations of e-government initiatives and other ICT-deepening programs share a number of common traits:[24]

- **Good governance practices.** Effective government policymakers consider opportunity costs, stakeholder management, and specific measures of success when evaluating ICT sector-specific policy. Disciplined governments follow a process of assessing program costs and benefits before spending public funds and embarking on new deployments. Good governance requires a feasibility study or cost/benefit analysis, an opportunity cost assessment to gauge trade-offs against other priorities, and a closed loop process for measuring success. Effective policymakers also ensure a thorough assessment of stakeholder needs (citizens, legislators, IT practitioners) and a thorough technology viability assessment before deployment (looking for best practices from vendor sources).

- **Stakeholder-centric.** Successful governments shift toward a citizen- or stakeholder-centric model instead of remaining fixed to an inward-looking, bureaucratic view.[25] For example, one-stop portals such as the US firstgov.gov provide a single point of contact for citizens, employees and businesses to start their information search. Users of such portals are not concerned with what agency or department they are dealing with, or with the inner workings and structure of government. They value information that is organized according to stakeholder interests and requirements. From this important paradigm shift flow changes in government organizational structures, governance, operations, and policy decisions.

- **Top-down support.** Successful implementations have broad support. They are not bottom-up efforts driven solely by those with ICT responsibility in government. There is agreement between e-government implementers and e-governance decision-makers (policymakers, politicians, and budget personnel) before projects are started. Some governments have elevated ICT to a minister or agency level position to coordinate procurements, formulate policies, and fund long term R&D. Through these agencies, governments have the power to address market failures, move markets faster, or slow market adoption.

- **Process redesign.** Whether in government or business, the full value of technology is not realized by simply placing information or services online. With successful implementations, "deployment" goes well beyond putting the new technologies in place. Processes are redesigned to make effective use of the technology.

- **Access and education.** Access is a core component of any strategy. In successful programs, there is explicit recognition of the futility of implementing e-government infrastructure when access is constrained by telecommunication policies that limit citizen and business access, or a lack of policies to drive PC penetration and literacy. Programs are put in place to ensure that citizens, employees and businesses are aware of the new services, understand why they're important, and have the means to access them.

- **Future oriented.** Implementation must be designed with headroom. This means that policymakers, politicians, and IT implementers must keep focused on the end solution and continually move up a chain of innovation from information access, to transaction based activities (renewing licenses, filing taxes, performing a registration search), and eventually toward interactive services.

[23] Dobbs Journal, November, 2004.
[24] Frank Tipton, Bridging the Digital Divide in Southeast Asia," ASEAN Economic Bulletin, April 2002, and interviews with the author, 2004.
[25] Ho, 2002.

Conclusion

Governments are leading consumers of ICT and play a unique role in the diffusion of ICT. Government-led investments in ICT can promote job creation and improve economic performance. As an input technology, ICT can have deep impacts on "downstream" industries, enhancing the pace of innovation and providing competitive advantage.

Advances in ICT will continue unabated for the foreseeable future. Given the networking power, the economic benefits, and sustainable development capabilities of ICT – and the economic risks of inaction – governments must embrace policies to accelerate faster diffusion of ICT throughout their population base and their economies.

About the Author

As Global Manager of Government Programs for Intel Corporation, Rick Herrmann frequently speaks with industry leaders and government policymakers. He visited more than 20 countries during 2004, gaining first-hand insights into the challenges facing government policymakers and the factors that drive policy successes.

Rick joined Intel in 1989 and has served the company in senior management positions responsible for Intel's North American Distribution and Channel Organization and the strategic High Performance Computing Initiative. He holds a BS in Business from Northeastern University, an MS in Technology Management from Pepperdine University, and is pursuing an MA in Government Science and Technology Policy at George Washington University.

Appendix

Raw Data on ICT Penetration, Usage, and Expenditures

Income Designation	Country	2004 Estimate PC per 1000	2004 PC % of Population	2004 Internet Per 1000	Internet Growth 00-03	Current Incom TV per 1000	2003 GNI CAP at PPP dol ls	GDP AVG 2000-2003	2003 Literacy (15-64 adults)	2002 ICT as % of GDP	ICT Spend Change 00-02
low	Afghanistan	0	0%			14					
low	Albania	14	1%	4	41%	318	4,700	6.40%	98.7		
low	Algeria	8	1%	16	42%	114	5,940	3.98%	68.9		
low	Angola	2	0%	3	36%	62	1,890	6.50%			
middle/OECD	Argentina	86	9%	112	19%	326	10,920	-1.84%	97	3.9	-2
low	Armenia	24	2%	16	18%	229	3,770	10.58%	99.4		
high/OECD	Australia	605	60%	482	15%	731	28,290	2.71%		6.37	-11
high/OECD	Austria	410	41%	409	10%	637	29,610	1.49%		5.53	-10
low	Bahrain	163	16%	247	43%	428	2,450	2.60%	88.5		
low	Bangladesh	4	0%	2	26%	59	1,870	5.24%	41.1		
middle	Barbados	113	11%	112	42%	328	15,060	-0.05%	98		
low	Belarus			82	52%	362	6,010	5.50%	99.7		
high/OECD	Belgium	248	25%	328	6%	541	28,930	1.57%			
low	Belize		0%	119	26%	182	1,110	5.31%	76.9		
low	Benin	2	0%	7	43%	12		5.59%	39.8		
middle	Bermuda	544	54%			1,084	4,000		97		
low	Bhutan	18	2%	14	51%	27		7.10%			
low	Bolivia	26	3%	32	33%	121	2,460	2.25%	86.7		
low	Bosnia/Herz	37	4%	26	33%	116	6,320	4.37%	94.6		
middle	Botswana	43	4%			44	7,960	5.35%	78.9		
middle	Brazil	87	9%	82	40%	349	7,480	1.77%	88.2	8.32	0
high	Brunei	80	8%			629	10,500		98.5		
low	Bulgaria	55	6%	81	18%	453	7,610	4.67%	98.6	6.9	23
low	Burkina	2	0%	2	37%	79	1,100	4.60%	12.8		
low	Burundi	1	0%	1	21%	31	620	1.20%	60.4		
low	Cambodia	2	0%	2	52%	8	2,060	6.46%	69.4		
low	Cameroon	7	1%	4	16%	75	1,980	4.48%	67.9		
high/OECD	Canada	511	51%	513	9%	691	29,740	2.77%	99	5.86	-10
middle	Cape Verde	90	9%	36	29%	101	5,440	5.25%	98		
low	C. Africa Rep	2	0%	1	34%	6	1,000	-1.07%	48.6		
low	Chad	2	0%	2	48%	2	1,100	7.17%	45.8		
middle	Chile	130	13%	238	16%	523	9,810	3.18%	95.7	5.74	-9
low	China	35	4%	46	38%	360	4,990	8.15%	90.9	5.81	3
low	Colombia	55	6%	46	32%	303	6,520	2.42%	92.1	6.65	-15
low	Congo, Dem Rep		0%	1	69%	2	640	-0.03%	82.8		
low	Congo, rep	4	0%				710	4.07%			
middle	Costa Rica	219	22%	193	45%	231	9,040	2.88%	95.8		
low	Côte d'Ivoire	11	1%	6	29%	61	1,390	-1.93%	NA		
middle	Croatia	207	21%	180	39%	293	10,710	4.20%	98.1	7.51	
middle	Cuba	50	5%			251	10,500	2.43%	96.9		
high	Cyprus	289	29%	294	22%	386	19,530	3.78%	98		
middle/OECD	Czech	204	20%	256	38%	538	15,660	2.80%	99	7.22	-7
high/OECD	Denmark	606	61%	513	12%	869	31,210	1.70%	98.5	5.75	-13
low	Djibouti	17	2%	7	41%	78	2,200	2.17%	95		
middle	Dominican Rep		0%	160	30%	236	6,210	-2.24%	84.4		
low	Ecuador	35	4%	42	41%	237	3,440	3.48%	91		
low	Egypt,	19	2%	28	46%	229	3,940	3.75%	55.6	3.28	12
low	El Salvador	55	6%	46	51%	233	4,890	1.98%	79.7		
low	Eritrea	2	0%	2	22%	50	1,100	0.98%	60		
middle	Estonia	237	24%	328	9%	602	12,480	6.12%	99.8		
low	Ethiopia	1	0%	1	54%	6	710	3.20%	41.5		
low	Fiji	50	5%	61	46%	117	5,410	2.24%	92.9		
high/OECD	Finland	460	46%	509	14%	670	27,100	2.43%	99	5.79	-9
high/OECD	France	364	36%	314	31%	632	27,460	1.98%	99	5.19	-13
middle	Gabon	13	1%	19	20%	308	5,700	2.72%	97		
low	Gambia	12	1%	18	29%	15	1,820	4.27%	65		
low	Georgia	36	4%	15	44%	357	2,540	5.15%	85		
high/OECD	Germany	470	47%	412	14%	661	27,460	0.90%	85	5.18	-11
low	Ghana	4	0%	8	49%	53	2,190	4.40%	73.8		
OECD	Greece	86	9%	155	21%	519	19,920	4.23%	85	4.83	-7
middle	Grenada	130	13%	142	40%	370	6,710	1.47%	85		
low	Guatemala	15	2%	33	54%	145	4,060	2.58%	69.9		
low	Guinea	6	1%	5	51%	47	2,100	3.00%	85		
low	Guinea-Bissau	5	1%	4	21%	36	660	-0.18%	85		
low	Guyana	28	3%	142	34%	98	3,950	0.08%	85		
low	Haiti	9	1%	10	47%	6	1,630	-0.26%	51.9		
low	Honduras	15	1%	25	41%	119	2,580	3.38%	80		
high	Hong Kong	447	45%	430	19%	604	28,810	4.06%	90	4.63	-16
middle/OECD	Hungary	117	12%	150	29%	475	13,780	3.58%	98		
high/OECD	Iceland	474	47%	648	4%	509	30,140	2.46%	99	7	
low	India	8	1%	16	39%	83	2,880	5.42%	61.3	2.78	-9
low	Indonesia	13	1%	38	49%	153	3,210	4.04%	87.9	1.46	-11
low	Iran	80	8%	48	52%	172	7,190	6.10%	98		
low	Iraq	8	1%	1		83	5,100		98		
high/OECD	Ireland	446	45%	271	19%	694	30,460	6.09%	99	3.99	-13
high	Israel	241	24%	301	17%	330	19,200	1.72%	96.3	6.89	
high/OECD	Italy	262	26%	362	19%	494	26,760	1.40%		4.38	-8
middle	Jamaica	57	6%	229	51%	374	3,790	1.39%	87.6		
OECD	Japan	409	41%	449	18%	786	28,820	1.56%	99	5.33	-12
low	Jordan	41	4%	58	33%	177	4,290	4.16%	90		
low	Kazakhstan	66	7%	16	37%	338	6,170	10.58%	99.4		
low	Kenya	7	1%	13	49%	26	1,020	0.82%	84.3		
low	Korea, (North)	6	1%			162	1,020		85		
OECD	Korea (South)	623	62%	552	13%	363	17,930	5.59%	99	6.49	-1
high	Kuwait	123	12%	106	19%	418	30,000	45.00%	82.9		
low	Kyrgyz	19	2%	30	32%	49	1,660	3.91%	98		
low	Lao	3	0%	3	35%	62	1,730	5.37%	68.4		
middle	Latvia	189	19%	133	30%	660	10,130	7.07%	99.7		
middle	Lebanon	95	9%	117	8%	357	4,840	1.60%	98.5		

Income Designation	Country	2004 Estimate PC per 1000	2004 PC % of Population	2004 Internet P ex 1000	Internet Growth (00-03)	Current known TV p ex 1000	2003 GNI CAP at PPP dat $)	GDP AVG 2000-2003	2003 Literacy (15-64 adults)	2002 ICT as % of GDP	ICT Speed Change 00-02
low	Lesotho	11	1%	10	40%	35	3,120	3.06%	81.4		
low	Liberia	12	1%			26	1,020	7.16%	55.9		
middle	Libya	23	2%	23	67%	137	12,000		81.7		
middle	Lithuania	135	14%	144	32%	467	11,090	6.89%	99.6		
high/OECD	Luxemburg	663	66%	370	19%	671	54,430	3.11%	99.7		
low	Macedonia,	4	0%	48	29%	282	6,720	0.99%	98		
low	Madagascar	5	1%	3	23%	25	800	1.93%	64.8		
low	Malawi	1	0%	3	25%	4	600	1.16%	64.8		
middle	Malaysia	173	17%	320	18%	210	8,940	4.55%	88.7	7.25	2
low	Maldives	93	9%	53	35%	131	1,800	5.42%	88		
low	Mali	1	0%	2	21%	33	960	6.42%	19		
low	Malta	275	28%	209	14%	566	1,800	1.68%	88		
low	Mauritania	11	1%	4	27%	99	2,010	4.48%	41.2		
middle	Mauritius	122	12%	99	600%	299	11,260	4.59%	84.3		
middle/OECD	Mexico	93	9%	98	44%	282	8,960	2.12%	90.6	4.43	13
low	Moldova	19	2%	34	36%	296	1,750	5.57%	99		
low	Mongolia	38	4%	21	22%	79	1,800	2.80%	97.8		
low	Monocco	31	3%	24	46%	167	3,960	3.99%	50.7		
low	Mozambique	4	0%			14	1,070	7.30%	46.5		
low	Myanmar	7	1%	1	44%	8	1,800	5.86%	85.3		
low	Namibia	87	9%	27	20%	269	6,620	3.05%	83.3		
low	Nepal	4	0%	3	19%	8	1,420	3.50%	44		
high/OECD	Netherlands	495	50%	606	7%	648	28,600	1.09%	96.7	5.76	-13
high/OECD	New Zealand	431	43%	484	9%	557	21,120	3.30%			
low	Nicaragua	30	3%	17	23%	123	2,400	4.76%	76.7		
low	Niger	1	0%	1	41%	10	820	3.17%	17.1		
low	Nigeria	7	1%	3	50%	103	900	4.81%	66.8		
high/OECD	Norway	644	64%	603	7%	884	37,300	1.50%	99	4.05	-14
middle	Oman	36	4%	66	27%	553	14,000	3.68%	74.4		
low	Pakistan	4	0%	10	52%	150	2,060	3.87%	41.5		
middle	Panama	38	4%			191	6,310	2.07%	92.3		
low	Papua New Guin	4	0%	14	19%	21	2,240	-0.41%	65		
low	Paraguay	55	5%	17	35%	218	4,740	0.54%	91.6		
low	Peru	42	4%	93	38%	172	5,090	2.97%	85		
low	Philippines	32	3%	44	32%	182	4,640	4.47%	92.6	4.24	4
middle/OECD	Poland	125	13%	230	42%	422	11,460	3.20%	98	5.22	-4
middle/OECD	Portugal	149	15%	194	-17%	413	17,990	1.42%	98	5.76	-6
high	Puerto Rico	88	9%			339	15,000	2.00%	94.1		
low	Qatar	193	19%	115	33%	869	15,000		84.2		
low	Romania	96	10%	83	33%	697	7,140	4.44%	97.3	4.28	29
low	Russian	101	10%	41	31%	538	8,920	6.78%	99.6	3.69	0
low	Rwanda	2	0%	3	46%		1,290	6.32%	96.2		
low	Samoa	7	1%	22	45%	146	5,700	4.50%	65		
middle	Saudi Arabia	181	18%	62	46%	266	15,000	1.80%	77.9	4.6	
low	Senegal	21	2%	10	30%	78	1,660	4.69%	39.3		
low	Sierra Leone	2	0%	2	20%	13	530	5.50%	40		
high	Singapore	684	68%	624	20%	303	24,160	2.85%	92.5	6.49	-11
middle/OECD	Slovak	200	20%	160	23%	409	13,420	3.61%	99.7	5.75	-8
high	Slovenia	310	31%	376	35%	366	19,240	3.15%	99.7	4.89	-2
low	Somalia	2	0%	9	74%	14	1,060	0.00%	65		
middle	South Africa	75	8%	68	10%	177	10,270	2.90%	86	9.2	2
OECD	Spain	220	22%	166	4%	564	22,020	2.82%		4.5	-4
low	Sri Lanka	17	2%	11	21%	117	3,730	3.48%	92.1		
low	Sudan	8	1%	3	39%	386	1,880	6.15%	59.9		
low	Swaziland	32	3%	19	28%	34	4,860	2.40%	80.9		
high/OECD	Sweden	671	67%	573	11%	966	26,820	2.24%	99	6.52	-12
high/OECD	Switzerland	730	73%	351	9%	552	32,030	0.91%	99	6.15	-13
low	Syrian Arab	21	2%	13	60%	182	3,430	2.42%	82.9		
low	Tajikistan	2	0%	1	6%	357	1,040	9.55%	99.5		
low	Tanzania	45	4%	2	27%	45	610	5.91%	77.1		
low	Thailand	46	5%	78	30%	300	7,450	4.76%	92.6	4.74	11
low	Togo	35	4%	41	27%	123	6,890	1.39%	59.6		
middle	Trinidad	88	9%	106	15%	345	9,450	3.90%	98.5		
low	Tunisia	34	3%	52	28%	207	6,840	4.18%	73.2		
middle/OECD	Turkey	47	5%	73	33%	423	6,690	3.40%	86.5	4.69	-1
middle	Turkmenistan	4	0%			182	5,840	18.90%	98.8		
low	Uganda	3	0%	4	34%	18	1,140	5.54%	68.9		
OECD	UK	434	43%	423	21%	950	27,660	2.30%		6.12	11
low	Ukraine	20	2%	18	38%	456	5,410	7.43%	99.6		
high	United Arab E	126	13%	337	12%	252	18,000	4.40%	77.3		
high	Uruguay	107	11%			530	7,980	-0.34%	97.7		
high/OECD	USA	692	69%	551	11%	938	50,000	2.34%	98	6.49	-7
low	Uzbekistan	2	0%	11	32%	260	1,720	4.15%	99.3		
middle	Venezuela,	68	7%	51	18%	186	4,740	-0.32%	93.1	4.36	4
low	Vietnam	11	1%	18	56%	197	2,490	6.99%	90.3	2.41	-21
low	West Bank Gaza	39	4%	30	40%	148	2,400	-0.94%	90		
low	Yemen,	14	1%	5	46%	308	820	4.66%	49		
low	Zambia	7	1%	5	35%	51	820	4.22%	79.9		
low	Zimbabwe	28	3%	43	65%	96		-0.47%	90		

SOURCES:

PC Rates: ITU (2002) World Report - -Sourced From World Bank On Line Data (WDI)
PC 3 Year Growth Rate Sourced From World Bank On Line Data (WDI) -- Years 2000, 2001, 2002, and 2003
2003: Urban and Rural Population Data: Sources from World Bank on Line Data (WDI)
2004 Population Rates: Sourced from finfacts.ie ~ ww.finfacts.com/biz10/globalworldincomepercapita.htm
2004 GNI per Capita: finfacts.ie ~ ww.finfacts.com/biz10/globalworldincomepercapita.htm
2003 GNI (PPP - purchase price parity): Sourced from World Bank On Line Data (WDI)

** Note: some estimates where made where actual data was not available. Estimates were based on average of characteristics for similar countries (pop, GNI, penetration, literacy). Estimates were made on the following countries: Bahrain, Benin, Bermuda, Bhutan, Brunei, Cuba, Eritrea Grenada, Guinea-Bissoau, Guyanna, Iraq, Kenya, Korea, Kyrgz, Lebanon, Leshoto, Liberaria, Libya, Luxembourg, Macedonia, Myanmar Oman, Papaua New Guinea, Qatar, Samoa, Saudi, Sierra-Leone, Tajikistan, Uzbekistan, West Bank, Zambia

1.0 Organizations

- 1.1 United Nations
  - 1.1.1 Digital Opportunity Task Force
  - 1.1.2 ICT Task Force
  - 1.1.3 United Nations Development Program
  - 1.1.4 Conference on Trade and Development - Human Development Report
  - 1.1.5 Wireless Internet Institute
  - 1.1.6 UNITAR: Institute for Training and Research
- 1.2 World Resources Institutes Digital Dividend Project
- 1.3 World Summit for Information Society (WSIS)
  - 1.3.1 Action Plan: 2015 villages, schools, hospitals and governments connected
  - 1.3.2 Global Digital Solidarity Fund
- 1.4 World Information Technology and Services Alliance (WITSA)
  - 1.4.1 Digital Planet Reports
- 1.5 World Teleport Association
  - 1.5.1 Awarding / Tracking the most sophisticated Digital Cities
- 1.6 Organization of American States
  - 1.6.1 Inter American Telecommunication Commission (CITEL)
- 1.7 World Bank
  - 1.7.1 African Virtual University (29 campuses, 18 countries in Africa)
- 1.8 CISCO Training Academy (83 countries)
- 1.9 International Telecommunications Union