

The Global Information Technology Report

2002–2003

Readiness for the Networked World

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INSEAD

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The Networked Readiness of Nations

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Overview

INSEAD has long recognized the fundamental role of information and communication technology (ICT) as a catalyst for organizational transformation and change. Therefore, gaining a better understanding of the economic and business impact of ICT has been identified as a key research priority, giving rise to a multitude of research streams. The Networked Readiness Index 2002–2003 discussed in this chapter is the product of one such research effort.

ICT forms the “backbone” of several industries, such as banking, airlines, and publishing, and is an important value-adding component of consumer products, such as television sets, cameras, cars, and mobile telephone sets. ICT is today a dominant force in enabling companies to exploit new distribution channels, create new products, and deliver differentiated value-added services to customers. ICT is also an important catalyst for social transformation and national progress. Disparities in the levels of ICT readiness and usage could translate into disparities in levels of productivity, and hence could influence a country’s rate of economic growth. Understanding and leveraging ICT is critical for nations striving for continued economic progress.

1

Over the past few years, numerous attempts have been made to measure the comparative levels of ICT development of nations. The multitude of these efforts and the diversity of the organizations conducting them only help underline the importance of ICT as a key factor contributing to a nation’s development, and as a cohesive force for integrating a nation into the global economy. The speed with which technological forces affect us and the rapidity of the ensuing changes requires a mechanism for measurement that not only accounts for factors enabling the spread and usage of ICT, but that also explicitly considers the roles played by the major stakeholders—individuals, businesses, and governments.

This chapter presents the Networked Readiness Index (NRI) that has been used to assess the comparative progress of eighty-two countries along different dimensions of progress in ICT. The discussion is divided into five main sections. First, we shall discuss previous attempts to measure the ICT competitiveness of countries and communities. Following this, there is a discussion on the Networked Readiness Framework and the procedure used to arrive at the NRI results. Third, the results of the research and analysis are presented; that is, the relative ranking of nations based on their degrees of networked readiness. Fourth, we take a closer look at the three indexes (and their constituent subindexes) composing the NRI, and at how various countries have fared on each of these dimensions. Finally, the fifth section investigates the relationship between networked readiness and key variables such as gross domestic product (GDP) per capita, ICT expenditure, and Internet usage, in addition to presenting some of the challenges that were faced while conducting the study.

Previous Efforts to Measure ICT Competitiveness

The task of capturing a nation's competitiveness in a single index score remains a significant challenge. Prior measurement approaches varied significantly with the type of organization in which they were developed, and the aims, objectives, methodology and results the measurement produced (see Table 1). Table 2 gives a detailed analysis of leading past efforts at measuring the ICT competitiveness of nations, and presents information about the countries/communities covered in each approach, the strengths and weaknesses of the approach, and a general description of the methodology. The Networked Readiness Index Framework (NRI Framework) proposed in this chapter builds upon these prior frameworks and research.

Table 1. Previous Approaches

Type of organizations	Conducted by different types of organizations such as: <ul style="list-style-type: none"> • Private sector • Government sector • Academic institutions
Objectives	<ul style="list-style-type: none"> • Policymaking and evaluation tool for countries • Measure state of internet acceptance (or e-readiness) in a country or community • Measure the growth of internet in the world
Methodology and data	<ul style="list-style-type: none"> • Questionnaire-based data (based on opinions of decision makers and leaders) • Hard data based on sources such as World Bank Pyramid, ITU....
Results	<ul style="list-style-type: none"> • Comparative analysis of countries • Identification of lacunae and fortes of independent communities • Stage of ICT development of a country

The private sector, governmental organizations (including transnational consortiums) and academic institutions have been the key drivers in developing ICT measurement efforts. Naturally then, one would expect the subject of the analysis to vary, based on the intended application of the agency formulating it. We see that reports like the Global Technology Index and McConnell's Ready? Net. Go! are rooted in the private sector and are meant to be guides for other businesses. The APEC e-Commerce Assessment Guide, developed by the Asia-Pacific Economic Cooperation (APEC) E-commerce Steering Group, has significant representation from both the business community and governmental organizations; the APEC assessment acts as a policy guide for governments, based on input from the business community. This translates into the report having

a significant emphasis on metrics falling within the purview of the government: aspects such as basic infrastructure, current policy indicators, laws and taxation. On the other hand, Mosaic's Global Diffusion of the Internet comes from the academic world and presents a more balanced framework; they include business-related measures like organizational infrastructure, and government-related measures like connectivity infrastructure.

The objectives of the different approaches also vary significantly. There have been two main motivations for assessing networked readiness in the past: first, as a policymaking and evaluation tool for countries, and second, as a measure of the state of Internet acceptance in a country or community. One would add a word of caution here. The different tools have often sought to measure the "readiness" of different communities and the factors that contribute to this readiness. The definition of readiness itself, however, varies from one study to the other. This fact is important, because the measurement and assessment of the factors are consistent with the study's definition. Hence, while APEC's readiness guide and McConnell's Ready? Net. Go! both define readiness as the level of preparation of a community to participate in the increasingly networked world, the Computer Systems Policy Project (CSPP) defines it as the level of development of a community to ensure that e-commerce can thrive and deliver real value to a community. Other agencies, such as the Center for International Development (CID) at Harvard University, have extended the concept of readiness to include the potential of a community to participate in ICT developments.

The methodology used in prior research also varies. Studies such as the APEC e-Commerce Readiness Assessment Guide and Global Diffusion of the Internet rely upon questionnaire-based data. Others, such as the CID study, are a hybrid of survey questionnaires and hard data. Only recently has there been a move to incorporate impact metrics in any of these studies. This is understandable, because ICTs have only recently had widespread impact, moving beyond the initial elite users such as academia and the military. Now, not only has a level of maturity been reached in terms of the technology to enable a networked world, but also, all the key stakeholders have come around to accepting and exploiting productivity advantages enabled by ICTs. Hence, an important indicator of ICT competitiveness in the future will be the impact of ICT on the citizens, businesses, and government of a nation. Some of the older models, such as the CSPP and APEC models, are primarily readiness-based analyses. As a reflection of the development of thought in this direction, agencies such as the Economist Intelligence Unit (EIU) and the CID have incorporated impact metrics into their frameworks.

Table 2. Key Efforts to Measure ICT Competitiveness

Intended Application	Countries Covered	Strengths and Weaknesses	Overall Analysis
APEC e-Commerce Readiness Assessment Guide, 2000 by the Asia-Pacific Economic Cooperation (APEC) Electronic Commerce Steering Group			
<p>To help member governments develop policies to promote the balanced development of e-commerce</p>	<p>The report does not include the study of any one country but provides a guide for analysis. It has been used for evaluating various countries, such as Hong Kong and Malaysia</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Fairly comprehensive readiness assessment 2. Provides a toolkit that is easily reusable by the member states for self-assessment <p>Weaknesses</p> <ol style="list-style-type: none"> 1. There is no hard data-based analysis 2. Assessment is based on soft data or opinions of individuals 3. Impact analysis of ICT has not been done 4. Relative rankings of the different countries is not available 5. There is no overall guide for interpreting the results 	<p>This tool was created with the influence of the industry, in order to help in guiding the policymaking efforts of governments. It is comprehensive in its coverage of the readiness factors, with little analysis of the impact of past initiatives. It examines 6 broad indicators for e-commerce, and these are developed into a series of questions that provide direction to desirable e-commerce policies and for the removal of barriers to electronic trade. The 6 indicators are:</p> <ol style="list-style-type: none"> 1. Basic infrastructure and technology 2. Access to necessary services 3. Current level and type of use of the Internet 4. Promotion and facilitation activities 5. Skills and human resources 6. Positioning for the digital economy <p>The guide does not provide a comparative assessment of nations. It is a questionnaire-based self-assessment guide for the use of member countries on a one-off basis.</p> <p>Its output is a good guide for macro-level policy making but not for businesses looking for guidance on the relative e-competitiveness of nations.</p>
Global Diffusion of the Internet, 2001 by The Mosaic Group			
<p>The framework is designed to assess the state of Internet diffusion in a country. It is useful for business stakeholders wanting to make use of and invest in the Internet, for policymakers debating how to positively (or negatively) influence its use and development, and for researchers studying the large-scale diffusion of complex interrelated technologies.</p>	<p>Mosaic has studied about 25 countries—mainly developing countries in Asia, the Middle East, and central Europe, apart from some NRI leaders such as Finland and Hong Kong</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Provides a good picture of the state of diffusion of Internet in a given community or country 2. Addresses the perspective of all stakeholders, including individuals, businesses, and government. 3. Outputs results in the form of an easy-to-understand Kiviat diagram <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Lacks overall e-competitiveness analysis 2. Focuses only on Internet penetration and not on ICT in general 3. Methodology remains primarily qualitative. 	<p>It has been formulated by Mosaic, a group that has roots in academia. The framework analyzes the diffusion of the Internet in a country along 6 main lines:</p> <ol style="list-style-type: none"> 1. Pervasiveness—level of use by individuals 2. Sectoral absorption—level of use by organizations in the sectors academic, commercial, health, and government. 3. Connectivity infrastructure—quality and robustness of the underlying network infrastructure. 4. Organizational infrastructure—the number and robustness of the organizations (e.g., ISP) providing the infrastructure. 5. Geographic dispersion—how geographically dispersed are the organizations providing infrastructure ? 6. Sophistication of use—how intense has the adoption of the technology been? <p>The framework is more balanced and addresses all stakeholders: individuals, businesses and government. It is particularly useful for the study of a given community. While the framework might be useful for policymaking, it makes comparative analysis of nations complex. The report relies on a questionnaire as its primary source of data.</p>

Table 2 Key Efforts to Measure ICT Competitiveness (continued)

Intended Application	Countries Covered	Strengths and weaknesses	Overall Analysis
Ready? Net. Go! By McConnell International, 2001			
<p>The framework is designed to assess a country's e-readiness, or capacity to participate in the global digital economy. It aims to evaluate who is e-ready which countries are enabling businesses, governments, and citizens to flourish in the networked economy.</p>	<p>The 2001 report covers 53 countries. While the emphasis is on developing countries, no geographic region is predominant.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Provides a qualitative reference guide for the comparative e-competitiveness of nations. 2. Is rich in examples of the way in which ICT has been promoted or used across the world, which can serve as inspiration to policymaking. <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Does not provide an overall assessment of a country in terms of its e-readiness. 	<p>McConnell International is a consulting firm helping clients with technology policy and strategy. Clients include governments, nongovernmental organizations (NGOs), multinational organizations, and private sector firms. It analyzes a country's e-readiness on the following dimensions:</p> <ol style="list-style-type: none"> 1. Connectivity—whether networks are easy and affordable to access and use 2. E-leadership—the role that government and businesses play to promote the use of networked technologies in a country, and whether e-readiness is a national priority 3. Information security—can the processing and storage of networked information be trusted? 4. Human capital—are the right people available to support e-business and to build a knowledge-based society? 5. E-business climate—how easy it is to do e-business today? <p>The report is a good tool for business leaders trying to assess the global state of development of the Internet. However, it is difficult to gain an understanding of the relative level of e-readiness of countries studied.</p>
2002 Global Technology Index (GTI) by Dr. Howard Rubin, Metricnet.com, 2002			
<p>The index is meant to be a measure of the economic dynamism and strength, as well as the technological capabilities and potential, of a country.</p>	<p>This report covers more than 50 countries spread over all the important commercial zones of the world. It has an even mix of developing and developed countries.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Provides a comprehensive and overall score for each country 2. Ranks the various countries using subcriteria to assist those interested in specific areas of competence for a market <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Methodology used is not explicitly explained, such as how the overall index is computed 2. Analysis is largely readiness driven 	<p>Metricnet.com is a data collection and distribution service and is a division of the META group. The 2002 Global Technology Index is one of many such reports available at metricnet.com. The data for this report however are driven by statistics from independent data sources such as the CIA, IMD, and the NUA Internet surveys. The five factors used to measure the GTI are:</p> <ol style="list-style-type: none"> 1. Knowledge jobs 2. Globalization 3. Economic dynamism and competition 4. Transformation to a digital economy 5. Technological innovation capacity <p>This Global Technology Index produces a set of indexes ranking the nations according to their competitiveness. The framework has been kept largely unchanged from the previous report, making it easy to track the movement of countries in the rankings.</p>

Table 2 Key Efforts to Measure ICT Competitiveness (continued)

Intended Application	Countries Covered	Strengths/Weaknesses	Overall Analysis
International Survey of E-Commerce by The World Information Technology and Service Alliance (WITSA), 2000			
<p>This report seeks to determine:</p> <ol style="list-style-type: none"> 1. What factors are most important for the deployment of e-business 2. The degree of business and consumer use of e-commerce. 	<p>Contributions from the 27 member countries are used, and there is a good mix of developing and developed countries.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Addresses the key issues and concerns on the ICT policymaker's agenda 2. Attempts to provide a more detailed analysis of the eight key global issues identified, each of which are applicable to any nation <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Lacks country-based analysis. 2. Lacks comparative overall ranking of nations 3. Survey-based; lacks basis in hard data and related analysis 	<p>WITSA is a consortium of 38 IT-industry associations that are often involved in policy-influencing activities. This cross-national perspective is reflected in this survey; it has no special focus, but highlights 8 global issues in the development of e-business.</p> <ol style="list-style-type: none"> 1. Trust, security and privacy 2. Technology 3. Workforce issues 4. Public policy 5. Taxation 6. Business process 7. Costs 8. Consumer attitudes <p>The report is not meant to provide an understanding of country-specific readiness measures for e-commerce. The results are important for policymakers looking to understand the primary concerns around the development of e-business.</p> <p>Given that WITSA consists of industry associations, most of the factors that have been considered for this survey are policy issues falling under the purview of governments rather than of private businesses.</p>
Negotiating the Digital Divide by Center for International Development and Conflict Management (CIDCM), University of Maryland			
<p>The project focuses on analyzing the development of the Internet in developing countries, particularly in African countries.</p>	<p>Ghana, Senegal, Kenya. Reports for China and Brazil are also underway.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Aim is to augment knowledge of Africa 2. Focuses on the process of Internet diffusion, and pays special attention to the roles and interactions of institutions and individuals <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Focus is only on Internet-related technologies and skills 2. Does not allow for intercountry comparisons 	<p>This framework is the work of CIDCM, an academic institution involved in conflict management and preventive diplomacy. This project, in partnership with the U.S. Agency for International Development, is designed not only to assess the advancement of the Internet, but also to enable it, with a particular focus on the sub-Saharan African region. CIDCM seeks a re-usable model; however, the individual studies are nation specific. The guidelines for employing the framework recommend a combination of questionnaires and statistical data analysis. It identifies the deployment of the Internet as being divided into 4 stages: Pre-commercial, Commercial, Competitive, and Consolidated. It also considers the ease and speed of negotiations of the different actors, such as individuals, businesses, governments, and NGOs. A toolbox has been developed to apply the framework to new studies</p>

Table 2 Key Efforts to Measure ICT Competitiveness (continued)

Intended Application	Countries Covered	Strengths/Weaknesses	Overall Analysis
Readiness for Living in the Networked World by the Computer Systems Policy Project (CSPP)			
<p>The CSPP self-assessment tool is designed to help determine how prepared a community or country is to participate in the networked world.</p>	<p>The report does not examine any given country, but presents a tool that is generally applicable.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Breaks down the analysis for each of the 23 indicators into 4 stages of development according to the indicator's performance 2. Tool is fairly easy to use <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Demarcates stages for each category, but does not advise how to move between stages 2. Focused on readiness with a limited analysis of impact 	<p>The CSPP is a public policy advocacy group, and is comprised of chairpersons and chief executive officers of leading U. S. information technology companies.</p> <p>The report presents a series of 23 questions under 5 distinct groups</p> <ol style="list-style-type: none"> 1. The network (infrastructure) 2. Networked places (access) 3. Networked applications and services 4. Networked economy 5. Network world enablers <p>The report proposes analyzing each of the 23 indicators by classifying a country in 1 of 4 categories, or stages of development. Categories range from the stage 1 community with a minimum of the necessary technology and applications, to the stage 4 community, which has advanced technology and ubiquitous applications. The framework itself does not compare different communities; rather, it presents an assessment based on the given inputs for the various questions.</p>
Readiness for the Networked World by Information Technologies Group, Center for International Development (CID) at Harvard University			
<p>The guide is intended to be a tool for government policymakers to assess the state of networked readiness of a community. It is targeted at communities in developing countries seeking to define a strategy to participate in the networked world.</p>	<p>The 2001–2002 Global Information Technology Report evaluates a mix of 75 developed and developing countries.</p>	<p>Strengths</p> <ol style="list-style-type: none"> 1. Breaks down analysis into 4 stages of development for each of the 19 indicators, according to its performance on the same. 2. Tool is simple and easy to use <p>Weaknesses</p> <ol style="list-style-type: none"> 1. Demarcates stages for each category, does not advise how to move between stages 2. Focused on readiness with a limited analysis of impact 	<p>This framework builds on the earlier CSPP framework, and has been developed in an academic institution. It represents a more balanced approach. The CID has used its framework to develop the 2001–2002 Global Information Technology Report rankings. The report looks at 19 different categories of indicators, which fall into 5 distinct groups:</p> <ol style="list-style-type: none"> 1. Network access 2. Networked learning 3. Networked society 4. Networked economy 5. Network policy <p>The report proposes analyzing each of the 19 indicators by classifying a country in 1 of 4 categories, or stages of development. The framework itself does not compare different communities and just presents an assessment based on the given inputs for the various questions.</p>

The results produced by the different tools fall into three main categories: (1) those that look to provide a comparative analysis amongst the various countries (i.e., the 2002 Global Technology Index); (2) those that are designed to identify lacunae and fortes of independent communities (i.e., McConnell's Ready? Net. Go!); and (3) those that identify the stage of development of a country (the CID and CSPP studies). While all categories are important for different aspects of policymaking, reports such as the 2002 Global Technology Index present a better understanding of the overall and relative development of countries, and reports such as McConnell's Ready? Net. Go! are good representations of the policymakers' view of the state of affairs in a particular community. A report that does not fit either of these categories is the World Information Service and Technology Alliance (WITSA) International Survey of e-Commerce, which provides information about generic challenges in establishing and furthering e-business without a focus on specific markets.

The Networked Readiness Framework 2002–2003

Influences on the NRI Framework

In the Global Information Technology Report 2001–2002, CID defined the Networked Readiness Index as “the potential and degree of preparation of a community to participate in the Networked World.” While we concur with this definition, we would like to extend it to include the potential and preparation of a community within its encompassing environment. By adding this, we separate environmental factors within which stakeholders, such as individuals, businesses, and governments, operate from the potential and preparedness of these same stakeholders.

The CID Networked Readiness Index (Figure 1) is divided into two overall measures: network use and enabling factors. The former “measures the extent of current network connectivity” while the latter “measures a country's capacity

Figure 1. The Networked Readiness Index Framework 2001–2002

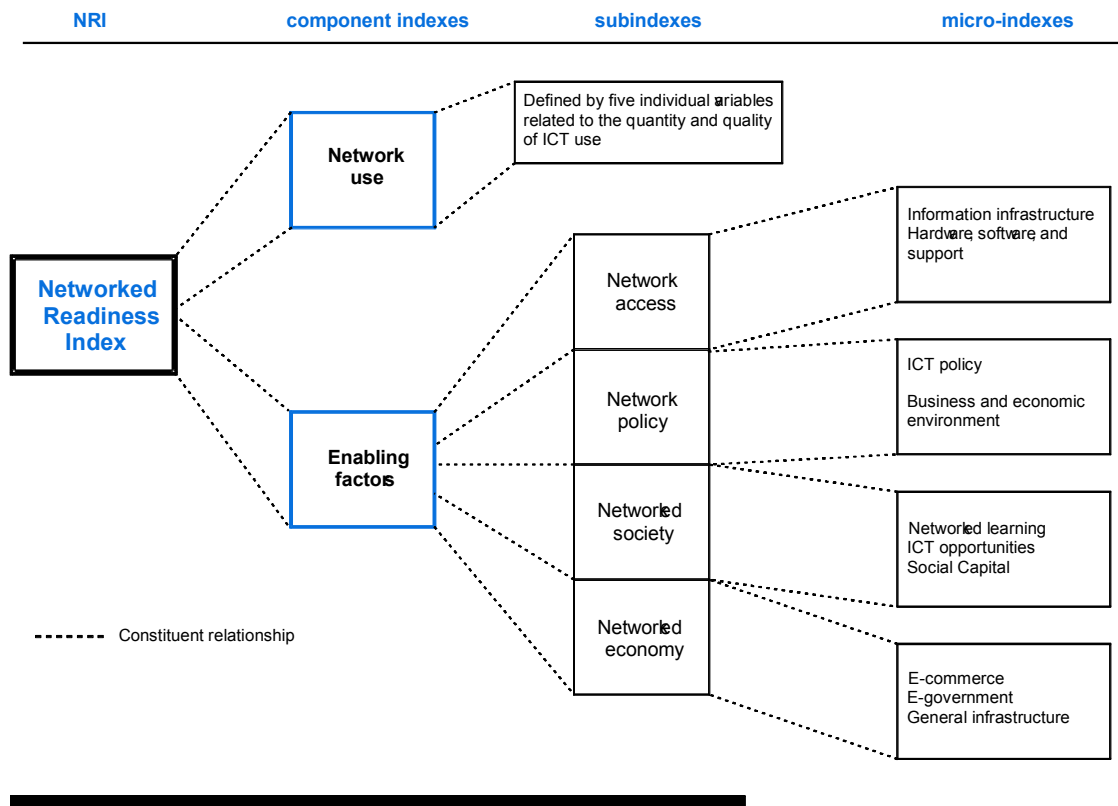
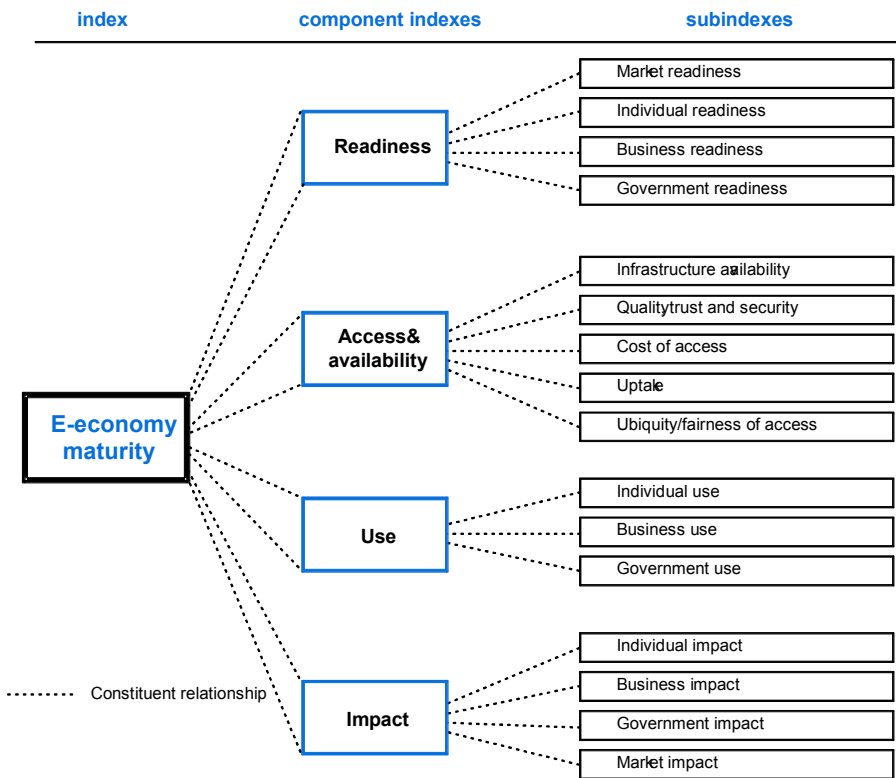


Figure 2. The IAP Framework



Source: Information Age Partnership

The IAP model (Figure 2) introduces an explicit distinction

between the three key players in a nation—individuals, businesses, and government—within the context of the market. We have chosen to retain this distinction in our definition of the NRI Framework. The EFQM's European Quality Model (Figure 3) is structured into two layers—enablers and impact—each of which is further broken into constituent layers focusing on leadership, processes, and results. The NRI Framework (Figure 4) that we have employed in this report has a similar structure and constitution.

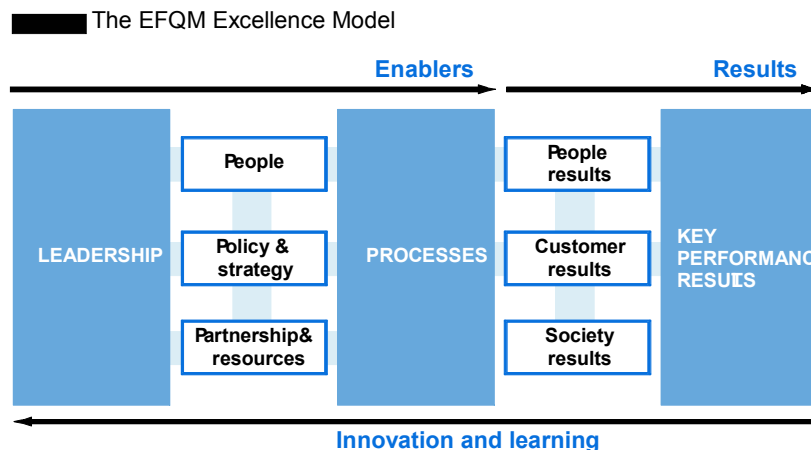
Both the IAP and the EFQM-TQM frameworks are consistent with the CID model in that they also break up the analysis into impact and enabling factors. This structure is important in order to extend the

to exploit existing networks and create new ones" (Kirkman et al 2002). The enabling factors are further broken up into several constituent subindexes such as network access, policy, society and economy. The strength of CID's model lies in the fact that it takes a step forward by defining a fairly comprehensive and well-developed framework, and that it is a simple and well-structured model.

While the CID model serves as a reference point, two other efforts have had an important bearing on the NRI Framework defined in this chapter: The Information Age Partnership (IAP) from the United Kingdom, and the European Foundation for Quality Management (EFQM) version of the Total Quality Management (TQM) model. It is interesting to observe TQM models, as they are widely used by corporations globally to evaluate and benchmark their achievements with respect to TQM. Although measuring ICT readiness is different from measuring TQM achievements, the measurement framework and principles used within TQM provide valuable lessons for our study.

from that of their current participation in the networked world to the potential future impact that the community can make on the networked world. However, the key reinvention of our model is the explicit realization that this analysis of potential needs to be further broken up to study the role of the individual, business, and government operating within an overall environment. These three key dimensions have been recognized explicitly in the past by models such as the IAP, and implicitly by some of the models outlined in the earlier part of this chapter.

basis of a community assessment



Source: European Foundation for Quality Management

The NRI Framework

The Networked Readiness Index Framework 2002–2003 represents an effort to untangle the underlying complexity behind the role of ICT in a nation's development. The Framework and its components not only provide a model for computing the relative development and use of ICT in countries, but also allows for a better understanding of a nation's strengths and weaknesses with respect to ICT.

Figure 4 depicts the structure of the NRI Framework. The NRI Framework is based upon the following premises:

1. There are three important stakeholders to consider in the development and use of ICT: individuals, businesses, and governments
2. There is a general macroeconomic and regulatory environment for ICT in which these stakeholders play out their respective roles
3. The degree of ICT (and hence the impact of ICT) on the three stakeholders is linked to the degree of their readiness (or capability) to use and benefit from ICT.

The NRI is defined as “the degree of preparation of a nation or community to participate in and benefit from ICT developments.” As shown in Figure 4, the Index is a composite of three components: the environment for ICT offered by a given country or community; the readiness of the community's key stakeholders (individuals, businesses, and governments) to use ICT; and finally, the usage of ICT amongst these stakeholders. A discussion in greater detail on the structure of the Framework is presented below in the section titled, Disaggregating the Networked Readiness Index.

NRI Results for 2002–2003

The overall results for the Networked Readiness Index 2002–2003 are presented in Table 3.

- ² Finland comes out with the top rank, followed by the United States. Finland, as shall be seen later, has performed well across all the Component indexes of the NRI Framework. Singapore, Sweden, and Iceland occupy 3rd, 4th, and 5th place, respectively. Canada gets the 6th place, followed by the United Kingdom, Denmark, and Taiwan with almost equal NRI scores. Germany comes in 10th place. Of note also are:
1. Israel, with its rapidly developing e-business sector and large technically-skilled workforce, has a current rank of 12
 2. Korea, with its very high Internet penetration and one of the highest usages of broadband in the world, is ranked 14th
 3. Estonia is the leader amongst the Eastern European countries, with a rank of 24.

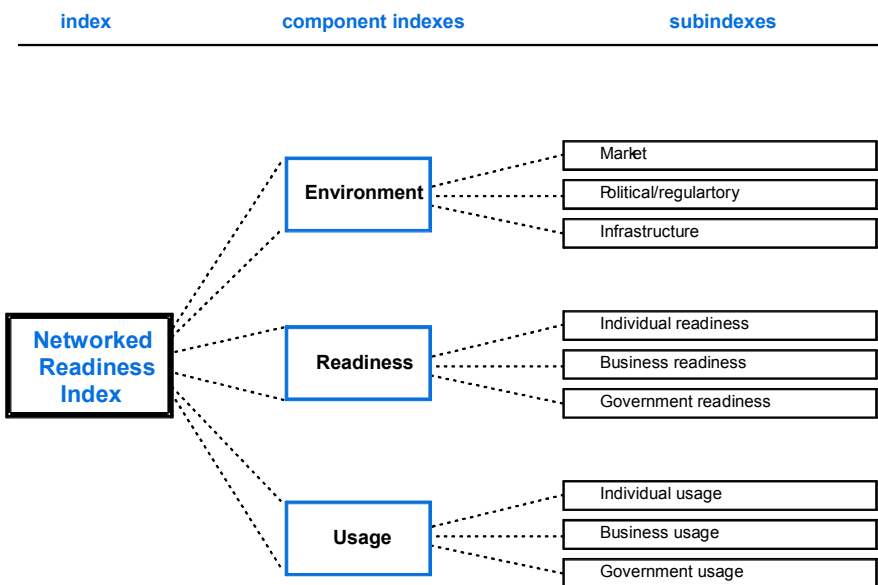
One sees in the top twenty-five rankings the following regional groupings:

1. The Americas. Two countries—the United States and Canada
2. Western Europe. Fourteen countries, led by Scandinavia
3. Asia and Oceania. Seven countries, led by Singapore
4. The Middle East and North Africa. One country—Israel
5. Central and Eastern Europe. One country—Estonia.

Furthermore, one can observe the following:

1. The top-ranked South American countries are Brazil (29th), Chile (35th), and Argentina (45th). As a block, Latin America fares poorly in the NRI rankings. Secondary analysis leads us to believe that this is partially explained by the relatively low levels of governmental e-readiness of these countries.
2. In Asia, India with its immense pool of trained IT manpower is ranked 37th, and Thailand follows at rank 41; China is ranked 43rd.
3. Russia comes in with an overall ranking of 69.
4. There are few countries from Africa and Central Asia that are included in the rankings. This is due to limitations in obtaining reliable data from these nations (see last section for more details on limitations of the research).

Figure 4. The Networked Readiness Index Framework 2002–2003



..... Constituent relationship

Source: INSEAD

Table 3. The Networked Readiness Index

Country	Networked	
	Readiness	NRI Rank
Finland	5.92	1
United States	5.79	2
Singapore	5.74	3
Sweden	5.58	4
Iceland	5.51	5
Canada	5.44	6
United Kingdom	5.35	7
Denmark	5.33	8
Taiwan	5.31	9
Germany	5.29	10
Netherlands	5.26	11
Israel	5.22	12
Switzerland	5.18	13
Korea	5.10	14
Australia	5.04	15
Austria	5.01	16
Norway	5.00	17
Hong Kong SAR	4.99	18
France	4.97	19
Japan	4.95	20
Ireland	4.89	21
Belgium	4.83	22
New Zealand	4.70	23
Estonia	4.69	24
Spain	4.67	25
Italy	4.60	26
Luxembourg	4.55	27
Czech Republic	4.43	28
Brazil	4.40	29
Hungary	4.30	30
Portugal	4.28	31
Malaysia	4.28	32
Slovenia	4.23	33
Tunisia	4.16	34
Chile	4.14	35
South Africa	3.94	36
India	3.89	37
Latvia	3.87	38
Poland	3.85	39
Slovakia	3.85	40
Thailand	3.80	41

Country	Networked	
	Readiness	NRI Rank
Greece	3.77	42
China	3.70	43
Botswana	3.68	44
Argentina	3.67	45
Lithuania	3.65	46
Mexico	3.63	47
Croatia	3.62	48
Costa Rica	3.57	49
Turkey	3.57	50
Jordan	3.51	51
Morocco	3.50	52
Namibia	3.47	53
Sri Lanka	3.45	54
Uruguay	3.45	55
Mauritius	3.44	56
Dominican Republic	3.40	57
Trinidad and Tobago	3.36	58
Colombia	3.33	59
Jamaica	3.31	60
Panama	3.30	61
Philippines	3.25	62
El Salvador	3.17	63
Indonesia	3.16	64
Egypt	3.13	65
Venezuela	3.11	66
Peru	3.10	67
Bulgaria	3.03	68
Russia	2.99	69
Ukraine	2.98	70
Vietnam	2.96	71
Romania	2.66	72
Guatemala	2.63	73
Nigeria	2.62	74
Ecuador	2.60	75
Paraguay	2.54	76
Bangladesh	2.53	77
Bolivia	2.47	78
Nicaragua	2.44	79
Zimbabwe	2.42	80
Honduras	2.37	81
Haiti	2.07	82

We would like to emphasize that while rankings are useful as relative indicators of a nation's ICT excellence, there are several limitations to the analytic process. For one, caution should be exercised while comparing countries that are closely ranked. Countries ranked closely together can show very small variation in index scores. Costa Rica (index = 3.57, rank = 49) and Turkey (index = 3.57, rank = 50) even have the same overall score. In this case, Costa Rica had an overall index score marginally higher than that of Turkey, but it was at the 3rd decimal place. Additionally, small differences in the index may be outside the limits of statistical significance because a number of missing observations were estimated using analytic techniques such as regression and clustering.

Also, only eighty-two countries were considered in our analysis because of limitations in the availability of data from reliable sources. Ranking other countries remains a challenge for the future. Any overall ranking on a global basis needs to account for these missing countries, and any inferences drawn on the current rankings should be done with this taken into consideration.

Interpreting the results

The NRI permits business leaders and public policymakers to investigate the reasons leading to a nation's ranking and relative performance. It captures key factors relating to the environment and the readiness and usage of the three stakeholders in ICT (individuals, businesses, and governments), and can be used to understand the performance of a nation or even a region with regards to ICT development. The component index and subindex rankings serve to identify key areas where a nation is under- or overperforming. For example, relative imbalances in development across the three component indexes of environment, readiness, and usage could be identified.

In order to supplement the NRI analysis, one is strongly encouraged to consult the chapters in this Report addressing in detail the ICT issues across different geographic regions. Additionally, in the country section of the Report, key statistics relating to the eighty-two countries can be found, and towards the end of the Report there are listings of the variables used during the current analysis to compute the ranking results.

Box 1. Comparing the Network Readiness Index

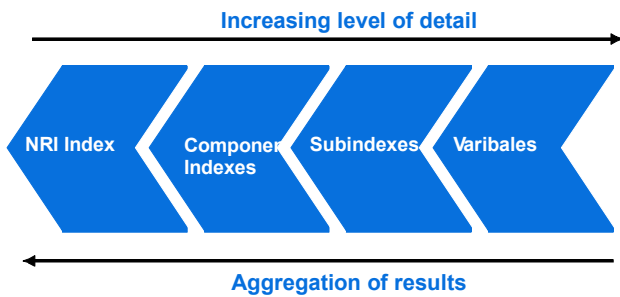
Country	2002–2003	2001–2002
Finland	1	3
United States	2	1
Singapore	3	8
Sweden	4	4
Iceland	5	2
Canada	6	12
United Kingdom	8	10
Denmark	7	7
Taiwan	9	15
Germany	10	17

Comparisons with results 2001–2002

One should exert restraint while comparing the NRI results for 2002–2003 to that of the previous year—2001–2002. The NRI Framework 2002–2003 is an evolution of the model used to compute the Index last year. Further the variables used to compute the NRI vary due to the model differences. For example, variables related to the readiness and adoption of ICT by governments is given a higher importance in the NRI Framework

Finally, the complexity of ICT-related issues in a nation can become obscured by the numerical figure of its NRI. A country such as India, for example, shows enormous geographic and demographic divides in ICT usage. India has one of the largest ICT workforces in the world. One can find intense ICT usage in technology clusters such as Bangalore and Gurgaon (near New Delhi), or amongst the upper middle bracket of incomes. The other side of the story is that

Figure 5 Disaggregating the Networked Readiness Index



Source: INSEAD

large parts of the country lack even telephone connectivity. In Singapore, on the other hand, there is high usage of ICT across all stakeholders—individuals, businesses, and governments.

Disaggregating the Networked Readiness Index

The NRI provides a quick and relative benchmark of the overall success of a country in participating in and benefiting from ICT. While this is useful, one may need to gain further insights into the areas in which a nation over- and underperforms, and to understand the key drivers determining a country's ranking. One can do so by looking at the component indexes: environment, readiness, and usage. (See Table 3 for the overall results of each component index.) Further insight may be gained by looking at the subindexes composing each component index. The final level of detail can be obtained by having a close look at the sixty-four variables comprising the subindexes, which are presented at the end of the report. Figure 5 gives a schematic diagram of the relationships between the various indexes, and how they add up to form the NRI. The technical appendix to the chapter provides details on the computation of the NRI.

Environment

The environment component index is designed to measure the conduciveness of an environment that a country can provide for the development and usage of ICT. As can be seen from Table 4, the top countries with regards to the environment are the United States, Finland, and Iceland,

and the results are consistent with the overall index. An exception is Israel, which has a rank of 12 on the overall NRI and that of 5 for environment. The primary driver for Israel's excellent rank is the country's policy and regulatory environment for ICT, both of which reflect the high priority given to ICT by the government.

Table 5 presents the detailed ranking results and scores of each of the three subindexes comprising the environment:

Market. This entails the assessment of whether or not there are appropriate human resources and ancillary businesses to support a knowledge-based society. The forces that play an important role in determining the market environment for ICT are varied and include fundamental macroeconomic variables such as GDP and import/export, commercial measures such as availability of funding and skilled labor, and the level of development of the corporate environment. The leader for this subindex is the United States, followed by Finland, the United Kingdom, and Sweden. It is noteworthy that Israel is also ranked high (at 5th place).

Political/regulatory. The priorities of a nation are reflected in its policies and laws, and these in turn influence its rate

Box 2. CASE STUDY: e-Business Roundtable in Canada

An e-business roundtable was set up in 1999 as a voluntary co-operation in the private sector with the objective to grow the e-economy in Canada. It had 35 members: mainly leaders from the ICT industry, industry associations and one representative from the government—the deputy minister of industry. The roundtable advised Industry Canada, which lobbied the federal government to enforce selected recommendations.

Action: The roundtable consisted of five groups each working with an objective to improve Canada's performance in a particular area. The five areas in which the members worked were 1) Government on-line service 2) ICT talent pool 3) Capital markets 4) SME access to ICT and 5) Canada as a place for e-commerce. Members from one group interfaced with corresponding members from Industry. The roundtable was dissolved in 2002 since it was originally set with a one-year mandate. But the public and private initiatives continue.

Results: The roundtable became an effective advisor to the government on e-commerce strategy, enabling the government to make meaningful changes in a short period of time. The capital gains tax has been reduced to 50 percent in response to the 30 percent recommended by the roundtable. Provisions have been made for \$600m to implement government online strategy by 2005. Corporate tax rates are to be reduced from 28 percent to 21 percent over the five-year period starting 2002.

Table 4 Networked Readiness Index Component Indexes

Environment		
Country	Score	Rank
United States	5.83	1
Finland	5.58	2
Iceland	5.32	3
Canada	5.30	4
Israel	5.27	5
Sweden	5.26	6
United Kingdom	5.24	7
Singapore	5.22	8
Germany	5.18	9
Netherlands	5.12	10
Denmark	5.05	11
Austria	4.95	12
Switzerland	4.94	13
Australia	4.89	14
Taiwan	4.88	15
Ireland	4.86	16
France	4.85	17
Luxembourg	4.81	18
Japan	4.79	19
Norway	4.78	20
Hong Kong SAR	4.71	21
New Zealand	4.66	22
Belgium	4.64	23
Italy	4.61	24
Spain	4.58	25
Korea	4.50	26
Portugal	4.28	27
Estonia	4.28	28
Malaysia	4.24	29
Hungary	4.24	30
Czech Republic	4.18	31
Brazil	4.17	32
Chile	4.04	33
India	3.98	34
Tunisia	3.98	35
Slovenia	3.89	36
Slovakia	3.86	37
South Africa	3.86	38
Greece	3.79	39
Thailand	3.68	40
Latvia	3.66	41
Botswana	3.66	42
Jordan	3.64	43
Namibia	3.61	44
Lithuania	3.57	45
Dominican Republic	3.56	46
Poland	3.56	47
Croatia	3.52	48
Morocco	3.50	49
Trinidad and Tobago	3.49	50
China	3.49	51
Uruguay	3.48	52
Argentina	3.47	53
Mauritius	3.43	54
Sri Lanka	3.39	55
Turkey	3.38	56
Philippines	3.33	57
Costa Rica	3.30	58
Colombia	3.30	59
Mexico	3.24	60
Panama	3.22	61
Jamaica	3.20	62
Venezuela	3.10	63
Egypt	3.06	64
Indonesia	3.01	65
El Salvador	3.01	66
Peru	2.95	67
Russia	2.88	68
Bulgaria	2.87	69
Ukraine	2.77	70
Romania	2.75	71
Nigeria	2.69	72
Vietnam	2.61	73
Guatemala	2.55	74
Bolivia	2.41	75
Zimbabwe	2.41	76
Bangladesh	2.37	77
Ecuador	2.32	78
Paraguay	2.28	79
Honduras	2.20	80
Nicaragua	2.19	81
Haiti	1.83	82

Readiness		
Country	Score	Rank
Singapore	6.41	1
Finland	6.34	2
United States	6.06	3
Sweden	5.95	4
Canada	5.87	5
Iceland	5.86	6
Taiwan	5.82	7
Israel	5.81	8
Switzerland	5.73	9
United Kingdom	5.72	10
Denmark	5.62	11
Korea	5.60	12
Japan	5.56	13
Germany	5.56	14
Netherlands	5.51	15
France	5.51	16
Hong Kong SAR	5.46	17
Austria	5.44	18
Australia	5.35	19
Ireland	5.31	20
Estonia	5.29	21
Norway	5.29	22
Belgium	5.20	23
New Zealand	5.12	24
Czech Republic	5.04	25
Spain	5.03	26
Tunisia	5.01	27
Hungary	5.00	28
Malaysia	4.95	29
Luxembourg	4.93	30
Italy	4.78	31
Slovenia	4.75	32
Brazil	4.72	33
Chile	4.50	34
China	4.50	35
Thailand	4.49	36
Portugal	4.41	37
Latvia	4.41	38
Slovakia	4.38	39
India	4.35	40
Lithuania	4.33	41
Sri Lanka	4.29	42
Costa Rica	4.23	43
South Africa	4.23	44
Poland	4.20	45
Botswana	4.16	46
Greece	4.13	47
Croatia	4.02	48
Morocco	4.01	49
Jamaica	3.99	50
Namibia	3.98	51
Mexico	3.97	52
Jordan	3.95	53
Mauritius	3.91	54
Vietnam	3.90	55
Dominican Republic	3.88	56
Bulgaria	3.84	57
Trinidad and Tobago	3.80	58
Turkey	3.79	59
Russia	3.78	60
Colombia	3.76	61
Indonesia	3.72	62
Panama	3.71	63
Argentina	3.70	64
Uruguay	3.61	65
Ukraine	3.58	66
Egypt	3.57	67
Peru	3.50	68
El Salvador	3.48	69
Philippines	3.43	70
Romania	3.35	71
Venezuela	3.11	72
Guatemala	2.89	73
Zimbabwe	2.87	74
Ecuador	2.85	75
Paraguay	2.85	76
Bangladesh	2.81	77
Honduras	2.66	78
Bolivia	2.62	79
Nicaragua	2.62	80
Nigeria	2.61	81
Haiti	2.19	82

Usage		
Country	Score	Rank
Finland	5.85	1
Singapore	5.58	2
Sweden	5.53	3
United States	5.49	4
Iceland	5.36	5
Denmark	5.32	6
Taiwan	5.22	7
Korea	5.22	8
Netherlands	5.17	9
Canada	5.17	10
Germany	5.14	11
United Kingdom	5.08	12
Norway	4.94	13
Australia	4.88	14
Switzerland	4.87	15
Hong Kong SAR	4.80	16
Belgium	4.66	17
Austria	4.64	18
Israel	4.60	19
France	4.55	20
Estonia	4.51	21
Japan	4.51	22
Ireland	4.50	23
Italy	4.40	24
Spain	4.38	25
Brazil	4.32	26
New Zealand	4.32	27
Portugal	4.15	28
Czech Republic	4.08	29
Slovenia	4.04	30
Luxembourg	3.90	31
Chile	3.88	32
Argentina	3.84	33
Poland	3.79	34
South Africa	3.73	35
Hungary	3.67	36
Mexico	3.67	37
Malaysia	3.64	38
Latvia	3.54	39
Turkey	3.53	40
Tunisia	3.50	41
Greece	3.39	42
India	3.33	43
Croatia	3.33	44
Slovakia	3.30	45
Uruguay	3.25	46
Thailand	3.24	47
Botswana	3.22	48
Costa Rica	3.18	49
Venezuela	3.13	50
China	3.12	51
Lithuania	3.05	52
El Salvador	3.01	53
Philippines	2.99	54
Mauritius	2.99	55
Panama	2.98	56
Morocco	2.98	57
Colombia	2.94	58
Jordan	2.93	59
Peru	2.85	60
Namibia	2.83	61
Trinidad and Tobago	2.79	62
Dominican Republic	2.76	63
Indonesia	2.76	64
Egypt	2.76	65
Jamaica	2.75	66
Sri Lanka	2.68	67
Ecuador	2.62	68
Ukraine	2.58	69
Nigeria	2.56	70
Nicaragua	2.50	71
Paraguay	2.50	72
Guatemala	2.45	73
Bangladesh	2.40	74
Bulgaria	2.38	75
Bolivia	2.38	76
Vietnam	2.37	77
Russia	2.30	78
Honduras	2.25	79
Haiti	2.19	80
Zimbabwe	1.97	81
Romania	1.88	82

Table 5 Environment Subindexes
 Environment Subindex = 1/3 Market + 1/3 Policy & Regulatory + 1/3 Infrastructure

Country	Market	Rank
United States	6.08	1
Finland	5.92	2
United Kingdom	5.56	3
Sweden	5.56	4
Israel	5.36	5
Germany	5.16	6
Taiwan	5.12	7
Netherlands	5.11	8
Canada	5.08	9
Singapore	4.93	10
France	4.93	11
Ireland	4.91	12
Switzerland	4.88	13
Norway	4.86	14
Denmark	4.84	15
Austria	4.78	16
Iceland	4.70	17
Japan	4.63	18
Korea	4.59	19
Italy	4.53	20
Belgium	4.43	21
New Zealand	4.42	22
Hong Kong SAR	4.38	23
Australia	4.35	24
Brazil	4.21	25
Spain	4.17	26
Estonia	4.12	27
India	4.12	28
Hungary	4.10	29
Chile	4.00	30
Czech Republic	3.97	31
Portugal	3.95	32
Luxembourg	3.79	33
Tunisia	3.76	34
Malaysia	3.65	35
Costa Rica	3.63	36
Slovakia	3.61	37
Poland	3.58	38
Lithuania	3.45	39
South Africa	3.45	40
Latvia	3.38	41
Thailand	3.36	42
Botswana	3.33	43
Greece	3.30	44
Colombia	3.29	45
Slovenia	3.25	46
Dominican Republic	3.25	47
Jordan	3.23	48
Morocco	3.23	49
China	3.20	50
Sri Lanka	3.11	51
Uruguay	3.09	52
Panama	3.08	53
Argentina	3.04	54
Croatia	3.03	55
Namibia	2.98	56
Trinidad and Tobago	2.93	57
Russia	2.91	58
Vietnam	2.90	59
Philippines	2.90	60
Indonesia	2.85	61
Mexico	2.75	62
Ukraine	2.74	63
Zimbabwe	2.72	64
El Salvador	2.71	65
Egypt	2.70	66
Jamaica	2.70	67
Venezuela	2.69	68
Turkey	2.65	69
Bulgaria	2.63	70
Mauritius	2.58	71
Romania	2.58	72
Peru	2.47	73
Paraguay	2.24	74
Bangladesh	2.16	75
Nigeria	2.16	76
Guatemala	2.12	77
Nicaragua	2.12	78
Bolivia	2.01	79
Haiti	1.97	80
Ecuador	1.90	81
Honduras	1.84	82

Country	Policy & Regulatory	Rank
Singapore	5.86	1
Israel	5.84	2
Finland	5.76	3
United States	5.67	4
Canada	5.62	5
Netherlands	5.44	6
Malaysia	5.41	7
Ireland	5.37	8
Iceland	5.31	9
United Kingdom	5.28	10
Austria	5.28	11
Denmark	5.19	12
Australia	5.18	13
Germany	5.15	14
Luxembourg	5.03	15
India	5.00	16
Sweden	4.99	17
Hong Kong SAR	4.98	18
Spain	4.95	19
Belgium	4.91	20
Italy	4.85	21
Switzerland	4.85	22
Taiwan	4.82	23
Tunisia	4.81	24
Portugal	4.81	25
Norway	4.78	26
France	4.73	27
New Zealand	4.70	28
South Africa	4.61	29
Estonia	4.58	30
Hungary	4.54	31
Brazil	4.52	32
Korea	4.50	33
Czech Republic	4.42	34
Slovenia	4.31	35
Botswana	4.30	36
Japan	4.28	37
Namibia	4.27	38
Thailand	4.25	39
Chile	4.21	40
Slovakia	4.20	41
Mauritius	4.16	42
Jordan	4.14	43
Trinidad and Tobago	4.13	44
Morocco	4.05	45
Philippines	4.05	46
Greece	4.04	47
Latvia	4.03	48
Dominican Republic	4.00	49
Turkey	3.97	50
Jamaica	3.96	51
China	3.91	52
Sri Lanka	3.85	53
Croatia	3.77	54
Indonesia	3.70	55
Nigeria	3.70	56
Mexico	3.64	57
Poland	3.61	58
Lithuania	3.56	59
Venezuela	3.54	60
Colombia	3.48	61
Uruguay	3.48	62
Argentina	3.40	63
Egypt	3.39	64
Bangladesh	3.36	65
Panama	3.26	66
El Salvador	3.16	67
Costa Rica	3.11	68
Ukraine	3.06	69
Romania	3.06	70
Peru	2.97	71
Vietnam	2.94	72
Zimbabwe	2.89	73
Russia	2.88	74
Bulgaria	2.77	75
Honduras	2.65	76
Nicaragua	2.59	77
Guatemala	2.50	78
Bolivia	2.36	79
Ecuador	2.22	80
Paraguay	2.03	81
Haiti	1.97	82

Country	Infra-structure	Rank
Iceland	5.94	1
United States	5.75	2
Luxembourg	5.59	3
Japan	5.46	4
Sweden	5.23	5
Germany	5.22	6
Canada	5.20	7
Australia	5.15	8
Denmark	5.13	9
Switzerland	5.09	10
Finland	5.05	11
France	4.89	12
Singapore	4.89	13
United Kingdom	4.87	14
New Zealand	4.86	15
Netherlands	4.80	16
Austria	4.78	17
Hong Kong SAR	4.77	18
Taiwan	4.71	19
Norway	4.70	20
Spain	4.62	21
Israel	4.61	22
Belgium	4.57	23
Italy	4.43	24
Korea	4.39	25
Ireland	4.31	26
Czech Republic	4.15	27
Estonia	4.12	28
Slovenia	4.11	29
Portugal	4.10	30
Hungary	4.07	31
Greece	4.04	32
Argentina	3.97	33
Chile	3.93	34
Uruguay	3.86	35
Slovakia	3.79	36
Brazil	3.78	37
Croatia	3.76	38
Lithuania	3.72	39
Malaysia	3.67	40
Latvia	3.58	41
Namibia	3.58	42
Jordan	3.56	43
Mauritius	3.54	44
Turkey	3.52	45
South Africa	3.52	46
Poland	3.48	47
Dominican Republic	3.42	48
Thailand	3.42	49
Trinidad and Tobago	3.42	50
Peru	3.40	51
Tunisia	3.38	52
China	3.36	53
Botswana	3.36	54
Mexico	3.32	55
Panama	3.32	56
Morocco	3.22	57
Sri Lanka	3.21	58
Bulgaria	3.20	59
Costa Rica	3.17	60
El Salvador	3.16	61
Colombia	3.13	62
Venezuela	3.08	63
Egypt	3.08	64
Philippines	3.05	65
Guatemala	3.01	66
Jamaica	2.93	67
Bolivia	2.87	68
Russia	2.85	69
India	2.84	70
Ecuador	2.83	71
Romania	2.61	72
Paraguay	2.57	73
Ukraine	2.49	74
Indonesia	2.48	75
Nigeria	2.21	76
Honduras	2.10	77
Vietnam	1.99	78
Nicaragua	1.86	79
Zimbabwe	1.63	80
Bangladesh	1.60	81
Haiti	1.55	82

Box 3. CASE STUDY: Broadband rollout in Japan

Japan's incumbent telecom service provider NTT had invested heavily in ISDN with the result that Japan had the world's highest ISDN penetration in 1999. NTT planned to upgrade ISDN to FTTH as the next generation high-speed network. However, Tokyo Metallic convinced Ministry of Post & Telecom (MPT) to open up the NTT infrastructure for DSL service.

Action: MPT swiftly enacted policies to un-bundle local loops of NTT, and in this way to allow other operators. NTT upgraded all exchanges for ADSL. However it continued to provide ISDN to its users. Other operators joined Tokyo Metallic in providing DSL service, which began to take away share from NTT's ISDN subscribers. NTT was thus forced to offer DSL service itself. Yahoo! marked its entry in September 2001 with a DSL offering at half the price of NTT, driving the prices further down.

Result: Japan today has one of the world's most competitive and cheapest broadband services. The uptake has grown exponentially since DSL was introduced.

of growth and direction of development. This component of the NRI measures the impact of a nation's polity, laws, and regulations, and their implementation for the development and use of ICT. The leaders from the political/regulatory perspective are Singapore, Israel, Finland, the United States, and Canada, not a surprising result given that these governments are known for their strong support of and emphasis on ICT. Box 2 presents a case study of Canada, highlighting how government policy can be used aggressively to promote networked readiness.

Infrastructure Infrastructure is defined as the level of availability and quality of the key access infrastructure for ICT within a country. A quality ICT-access infrastructure facilitates the adoption, usage, and impact of these technologies, which in turn promotes investment in infrastructure. Infrastructure thus plays a critical role in influencing the networked readiness of a nation. The countries ranked at the top for this component are Iceland, the United States, Luxembourg, Japan, and Sweden. One notes that India is at 70th place for infrastructure—a very low rank compared to its overall position of 34 in environment—which is perhaps an indication of the heterogeneous proliferation of ICT across different socioeconomic and geographic segments in the country. Box 3 presents a case study of how steps were taken to develop infrastructure and service offerings in Japan by promoting competition within the telecommunications industry. As a consequence of these activities, Japanese consumers can today access one of the most competitively priced broadband services in the world.

Readiness

The readiness of a nation measures the capability of the principal agents of an economy (citizens, businesses, and governments) to leverage the potential of ICT. Such capability becomes manifest in a nation's community in the presence of a combination of factors, such as the relevant skills for using ICT in individuals, access and affordability of ICT for corporations, and local government usage of ICT for its own services and processes. As shown in Table 4, Singapore ranks highest on overall readiness, in spite of placing 11th in business readiness. Singapore is supported by a very strong performance in government readiness, reflecting the fact that ICT is a top-priority item on the government's agenda. Third-ranked United States, on the other hand, has high scores in business readiness. Second-placed Finland shows a consistent performance across all three readiness subindexes, and illustrates the basic concept behind the NRI that a nation's readiness is determined by the degree to which technology permeates across all three stakeholders of the community—individuals, businesses, and government.

Detailed results for each of the subindexes used for measuring readiness (listed below) can be found in Table 6.

Individual readiness measures the readiness of a nation's citizens to utilize and leverage ICT. Factors that are used to measure this include literacy rates, mode and locus of access to the Internet, and the degree of connectivity of individuals. The top three positions on individual readiness go to Finland, Singapore, and Iceland. Korea, at 6th place, has an exceptional score on individual readiness—the country has both high penetration of the Internet in general, and one of the highest penetrations of broadband in the world.

Business readiness

measures the readiness of a cross section of businesses to participate in and benefit from ICT. The aim is to focus not just on the largest corporations, but to also include small- and medium-sized businesses and their willingness to exploit ICT and invest in the ICT skills of their employees. Not surprisingly, the United States has 1st place for business readiness; it is followed by Finland, Israel, and Sweden. Also noteworthy is India's ranking of 27 for business readiness compared to its position of 70 for individual readiness; this indicates a growing digital divide between the different ICT stakeholders in the country.

Government readiness measures the readiness of a government to employ ICT. It is reflected in the policymaking machinery and internal processes of the government, and in the availability of government services online. If the polity of a nation decides to make ICT a priority, this becomes visible in the short- and long-term policy measures and laws that help encourage ICT deployment and use. It is also apparent in the government

Table 6 Readiness Subindexes

Readiness component index = 1/3 Individual Readiness + 1/3 Business Readiness + 1/3 Government Readiness

Country	Individual	
	Readiness	Rank
Finland	6.71	1
Singapore	6.38	2
Iceland	6.38	3
Canada	6.30	4
Sweden	6.29	5
Korea	6.27	6
United States	6.13	7
Australia	6.07	8
United Kingdom	6.06	9
Denmark	6.06	10
Netherlands	6.05	11
Hong Kong SAR	6.03	12
Austria	6.01	13
Belgium	6.00	14
Norway	5.99	15
New Zealand	5.92	16
Switzerland	5.84	17
Estonia	5.78	18
France	5.77	19
Germany	5.76	20
Japan	5.75	21
Taiwan	5.68	22
Czech Republic	5.67	23
Israel	5.54	24
Slovenia	5.52	25
Hungary	5.47	26
Spain	5.45	27
Italy	5.41	28
Ireland	5.39	29
Slovakia	5.17	30
Malaysia	5.12	31
Luxembourg	5.07	32
Croatia	5.03	33
Latvia	5.02	34
Portugal	5.01	35
Poland	4.93	36
Argentina	4.92	37
Panama	4.91	38
Thailand	4.88	39
Greece	4.87	40
Lithuania	4.81	41
Tunisia	4.81	42
Bulgaria	4.79	43
Chile	4.75	44
Brazil	4.75	45
Costa Rica	4.72	46
Turkey	4.68	47
Russia	4.68	48
Romania	4.49	49
Trinidad and Tobago	4.45	50
Jordan	4.43	51
Colombia	4.37	52
Botswana	4.34	53
South Africa	4.33	54
Sri Lanka	4.32	55
Uruguay	4.30	56
Dominican Republic	4.29	57
Ukraine	4.25	58
Mauritius	4.23	59
Indonesia	4.20	60
Mexico	4.10	61
Egypt	4.08	62
Philippines	4.08	63
Namibia	4.07	64
Peru	4.01	65
Jamaica	4.00	66
El Salvador	3.99	67
Vietnam	3.98	68
China	3.96	69
India	3.87	70
Venezuela	3.84	71
Morocco	3.84	72
Guatemala	3.69	73
Bolivia	3.63	74
Paraguay	3.61	75
Zimbabwe	3.60	76
Ecuador	3.23	77
Honduras	3.06	78
Nicaragua	2.84	79
Haiti	2.75	80
Bangladesh	2.66	81
Nigeria	2.18	82

Country	Business	
	Readiness	Rank
United States	6.65	1
Finland	6.45	2
Israel	6.34	3
Sweden	6.30	4
Germany	6.30	5
Switzerland	6.28	6
Japan	6.03	7
Iceland	5.94	8
Taiwan	5.91	9
France	5.88	10
Singapore	5.85	11
Canada	5.83	12
Denmark	5.77	13
United Kingdom	5.72	14
Netherlands	5.66	15
Austria	5.63	16
Belgium	5.54	17
Korea	5.41	18
Ireland	5.29	19
Norway	5.29	20
Australia	5.24	21
Luxembourg	5.12	22
Hong Kong SAR	5.08	23
Brazil	5.03	24
Czech Republic	5.01	25
Spain	5.00	26
India	5.00	27
Estonia	4.95	28
New Zealand	4.93	29
Italy	4.93	30
Costa Rica	4.79	31
Hungary	4.7814	32
Malaysia	4.78	33
Slovenia	4.75	34
South Africa	4.66	35
Tunisia	4.64	36
Chile	4.59	37
Thailand	4.56	38
Slovakia	4.54	39
Latvia	4.39	40
China	4.38	41
Greece	4.36	42
Poland	4.31	43
Botswana	4.27	44
Namibia	4.25	45
Egypt	4.22	46
Turkey	4.20	47
Morocco	4.18	48
Mexico	4.13	49
Mauritius	4.09	50
Portugal	4.09	51
Indonesia	4.07	52
Lithuania	4.03	53
Dominican Republic	4.02	54
Argentina	3.97	55
Jordan	3.94	56
Sri Lanka	3.91	57
Jamaica	3.90	58
Panama	3.80	59
Trinidad and Tobago	3.78	60
Peru	3.73	61
Ukraine	3.72	62
Vietnam	3.72	63
Russia	3.71	64
Colombia	3.66	65
El Salvador	3.58	66
Croatia	3.56	67
Venezuela	3.51	68
Bulgaria	3.48	69
Uruguay	3.47	70
Guatemala	3.42	71
Zimbabwe	3.41	72
Philippines	3.35	73
Paraguay	3.34	74
Bangladesh	3.25	75
Romania	3.15	76
Ecuador	3.02	77
Nigeria	2.95	78
Honduras	2.91	79
Nicaragua	2.47	80
Bolivia	2.40	81
Haiti	2.29	82

Country	Government	
	Readiness	Rank
Singapore	7.00	1
Taiwan	5.86	2
Finland	5.86	3
Tunisia	5.56	4
Israel	5.54	5
Canada	5.47	6
United States	5.41	7
United Kingdom	5.36	8
Iceland	5.27	9
Sweden	5.27	10
Hong Kong SAR	5.26	11
Ireland	5.24	12
Estonia	5.15	13
China	5.14	14
Korea	5.12	15
Switzerland	5.08	16
Denmark	5.04	17
Malaysia	4.94	18
Japan	4.91	19
France	4.87	20
Netherlands	4.81	21
Hungary	4.74	22
Australia	4.74	23
Austria	4.66	24
Sri Lanka	4.66	25
Spain	4.65	26
Germany	4.61	27
Luxembourg	4.61	28
Norway	4.58	29
New Zealand	4.50	30
Czech Republic	4.45	31
Brazil	4.37	32
India	4.18	33
Chile	4.18	34
Lithuania	4.16	35
Portugal	4.14	36
Jamaica	4.06	37
Belgium	4.06	38
Thailand	4.04	39
Morocco	4.01	40
Italy	4.00	41
Slovenia	3.99	42
Vietnam	3.99	43
Botswana	3.86	44
Latvia	3.82	45
South Africa	3.69	46
Mexico	3.68	47
Namibia	3.63	48
Jordan	3.48	49
Croatia	3.47	50
Slovakia	3.44	51
Mauritius	3.40	52
Poland	3.37	53
Dominican Republic	3.34	54
Bulgaria	3.25	55
Colombia	3.25	56
Costa Rica	3.18	57
Greece	3.17	58
Trinidad and Tobago	3.15	59
Uruguay	3.07	60
Russia	2.95	61
Indonesia	2.88	62
El Salvador	2.88	63
Philippines	2.87	64
Ukraine	2.77	65
Peru	2.76	66
Nigeria	2.71	67
Nicaragua	2.55	68
Bangladesh	2.53	69
Turkey	2.48	70
Romania	2.42	71
Egypt	2.41	72
Panama	2.41	73
Ecuador	2.30	74
Argentina	2.20	75
Honduras	2.01	76
Venezuela	1.96	77
Bolivia	1.84	78
Zimbabwe	1.61	79
Paraguay	1.60	80
Guatemala	1.58	81
Haiti	1.52	82

itself using ICT and equipping its people to do the same. Singapore leads on government readiness, followed by Taiwan and Finland. Of note is Estonia, which at 13th place in government readiness, an indication of the government's push in ICT; government readiness is one of the factors contributing to Estonia's overall rank of 24.

Usage

The usage component is a measure of the level of impact that ICT has had on the principal stakeholders in the NRI Framework—that is, individuals, businesses, and governments. The assessment of usage includes changes in behaviors and lifestyles, and changes in other economic and noneconomic factors brought about by the adoption of ICT. Finland, Singapore, and Sweden are the top three performers with regards to overall usage, as shown in Table 4. One can observe variances in country performance across the three subindexes, reflecting uneven effects across the three principal stakeholders. For example, Germany is ranked high for business usage (1st), but relatively low for individual (17th) and government (20th) usage. Another notable example is Estonia, with high government readiness (13th place) and usage (8th), but relatively low positions for individual (28th) and business (31st) usage. Table 7 shows detailed results and scores for each of the three subindexes (listed below) used for measuring usage:

Individual usage gives an indication of the level of adoption and usage of ICTs by a nation's citizens. This information is generated by assessing the deployment of connectivity-enhancing technologies such as telephones and Internet connections, the levels of Internet usage, and money spent online. Individual usage rankings differ significantly from rankings of individual readiness. The top performers in individual usage are Korea, Finland, Denmark, the Netherlands, and Sweden. Korea and the Netherlands stand out, as they are ranked significantly lower for both the overall NRI and overall usage.

Business usage measures the level of deployment and use of ICT across all businesses in a nation. Business usage is measured by factors such as the level of business-to-business and business-to-consumer e-commerce, the use of ICT for activities such as marketing, and levels of online transactions. The top five performers are Germany, Sweden, the United States, Finland, and Iceland.

Government usage is the level of use of ICT technologies by the government of a given country. The government, besides making ICT a priority, can also benefit from the usage of ICT itself. This usage can help the government streamline services to its citizens and improve its overall functioning. Factors used to measure this usage include the volume of transactions

Box 4. CASE STUDY: Health Industry in France

In 1996, the French government launched the Sesam-Vitale program to control health expenditures (10 percent of GDP). The objective of the program was to fully replace the paper-based system of reporting doctor visits with an electronic system. The program was expected to help better understand expenditure, to improve efficiency and to enhance quality of healthcare.

Action: A card (Carte Vitale) with an embedded microchip has been handed out to individuals covered by healthcare insurance. Healthcare Professionals (HCP) and pharmacists received similar identification cards. During visit to a doctor, the visitor's card is inserted into a dedicated terminal, which automatically records the visit. Information at the end of the day is transmitted via Internet to the appropriate organization.

Results: About 41 percent of HCPs currently transmit forms online. About 80 percent of doctors possess PC (compared to 10–15 percent in 1995). Individuals get automatically reimbursed within 5 days versus several weeks before. Net annual savings to government: Euro 150–200m.

that businesses have with governments and the presence of government services online. The top-ranking countries on this measure are Finland, Singapore, Iceland, Taiwan, and Sweden. Of note is Estonia at 8th place, reflecting the fact that the country's government is "walking the talk"—both promoting ICT in the country, and also using ICT for its own functioning. Box 4 presents the case of Carte Vitale and shows how the French government has benefited from the use of ICTs in the health care sector.

Understanding Networked Readiness

More than a single measure

The degree of a nation's networked readiness is the result of a multitude of effects. Our research started with a set of more than 130 different variables or indicators for evaluating networked readiness, and these were narrowed down by statistical analysis to a set of sixty-four variables. These sixty-four variables were grouped under the nine subindexes of the NRI Framework. This provides us with an opportunity to study some of the interrelationships across the variables and the components/subindexes of the NRI Framework.

GDP and networked readiness

Any attempt to use a single measure to approximate networked readiness would be a simplification. One of the most intuitive and appealing measures that one may be tempted to use as a proxy is the GDP per capita of a country.

Table 7 Usage Subindexes

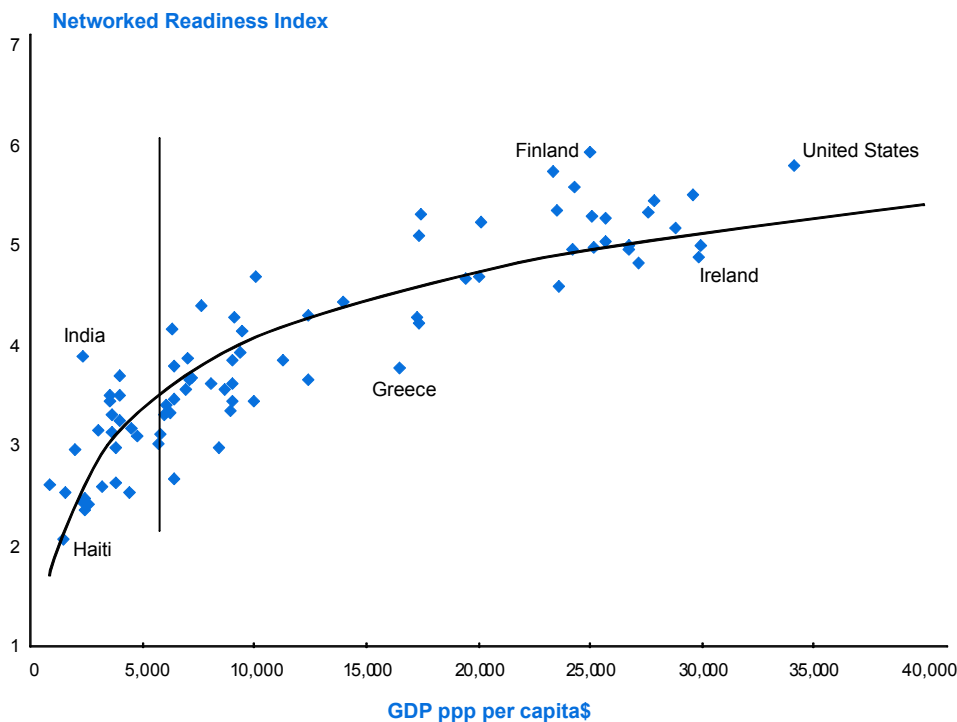
Usage component index = 1/3 Individual Usage + 1/3 Business Usage + 1/3 Government Usage

Country	Individual	
	Usage	Rank
Korea	5.19	1
Finland	4.90	2
Denmark	4.87	3
Netherlands	4.81	4
Sweden	4.64	5
Japan	4.62	6
United States	4.57	7
Luxembourg	4.57	8
Singapore	4.53	9
United Kingdom	4.51	10
Canada	4.46	11
Norway	4.46	12
Belgium	4.39	13
Taiwan	4.38	14
Switzerland	4.28	15
Australia	4.24	16
Germany	4.17	17
Slovenia	4.13	18
Iceland	4.05	19
Israel	3.99	20
Ireland	3.97	21
Austria	3.96	22
Hong Kong SAR	3.91	23
New Zealand	3.79	24
France	3.68	25
Portugal	3.66	26
Italy	3.62	27
Estonia	3.44	28
Greece	3.43	29
Spain	3.39	30
Czech Republic	3.14	31
Latvia	3.11	32
Uruguay	3.02	33
Hungary	2.91	34
Slovakia	2.84	35
Argentina	2.78	36
Turkey	2.74	37
Chile	2.71	38
Lithuania	2.63	39
Trinidad and Tobago	2.62	40
Poland	2.58	41
Croatia	2.54	42
Malaysia	2.50	43
Brazil	2.44	44
Mexico	2.43	45
Venezuela	2.40	46
Bulgaria	2.37	47
Jamaica	2.35	48
South Africa	2.31	49
Panama	2.29	50
Mauritius	2.28	51
Costa Rica	2.21	52
Ukraine	2.18	53
El Salvador	2.14	54
Colombia	2.08	55
Peru	2.06	56
Philippines	1.98	57
Russia	1.97	58
Paraguay	1.96	59
Tunisia	1.96	60
China	1.95	61
Romania	1.95	62
Morocco	1.93	63
Thailand	1.92	64
Botswana	1.91	65
Nicaragua	1.91	66
Bolivia	1.86	67
Dominican Republic	1.84	68
Guatemala	1.79	69
Sri Lanka	1.78	70
Egypt	1.76	71
Ecuador	1.76	72
Namibia	1.74	73
Jordan	1.71	74
Honduras	1.68	75
Zimbabwe	1.65	76
Indonesia	1.53	77
Nigeria	1.51	78
India	1.47	79
Bangladesh	1.47	80
Vietnam	1.44	81
Haiti	1.32	82

Country	Business	
	Usage	Rank
Germany	6.19	1
Sweden	5.96	2
United States	5.95	3
Finland	5.93	4
Iceland	5.88	5
Netherlands	5.51	6
Singapore	5.49	7
United Kingdom	5.42	8
Denmark	5.40	9
Switzerland	5.39	10
Norway	5.23	11
Korea	5.20	12
France	5.14	13
Canada	5.14	14
Hong Kong SAR	5.08	15
Australia	5.06	16
Argentina	5.05	17
Taiwan	5.05	18
Brazil	5.03	19
Spain	5.03	20
Italy	5.01	21
Belgium	4.96	22
Japan	4.90	23
Austria	4.85	24
Poland	4.72	25
Israel	4.72	26
Czech Republic	4.71	27
South Africa	4.69	28
New Zealand	4.54	29
Ireland	4.45	30
Estonia	4.35	31
Mexico	4.31	32
Venezuela	4.01	33
Portugal	3.99	34
Chile	3.98	35
Malaysia	3.95	36
Slovenia	3.94	37
Turkey	3.89	38
Botswana	3.80	39
Costa Rica	3.76	40
Croatia	3.74	41
India	3.71	42
Tunisia	3.65	43
Slovakia	3.63	44
Thailand	3.60	45
El Salvador	3.60	46
Indonesia	3.59	47
Philippines	3.58	48
Luxembourg	3.56	49
Latvia	3.48	50
Jordan	3.44	51
Morocco	3.44	52
Panama	3.43	53
Hungary	3.43	54
Ecuador	3.40	55
Uruguay	3.36	56
Peru	3.31	57
Namibia	3.24	58
Nicaragua	3.23	59
Nigeria	3.18	60
Egypt	3.17	61
Colombia	3.17	62
Greece	3.17	63
Honduras	3.13	64
Bolivia	3.10	65
Dominican Republic	3.06	66
Bangladesh	3.05	67
Haiti	3.04	68
Guatemala	3.02	69
Mauritius	3.01	70
Sri Lanka	3.00	71
China	2.98	72
Trinidad and Tobago	2.89	73
Paraguay	2.80	74
Ukraine	2.72	75
Jamaica	2.65	76
Vietnam	2.56	77
Lithuania	2.55	78
Zimbabwe	2.40	79
Bulgaria	2.16	80
Russia	2.12	81
Romania	1.82	82

Country	Government	
	Usage	Rank
Finland	6.73	1
Singapore	6.72	2
Iceland	6.46	3
Taiwan	6.23	4
Sweden	5.98	5
United States	5.94	6
Canada	5.91	7
Estonia	5.75	8
Denmark	5.69	9
Brazil	5.49	10
Hong Kong SAR	5.39	11
Australia	5.35	12
United Kingdom	5.32	13
Korea	5.26	14
Netherlands	5.18	15
Norway	5.14	16
Austria	5.11	17
Ireland	5.09	18
Israel	5.09	19
Germany	5.08	20
Chile	4.96	21
Switzerland	4.95	22
Tunisia	4.89	23
France	4.83	24
India	4.80	25
Portugal	4.79	26
Spain	4.72	27
Hungary	4.68	28
Belgium	4.63	29
New Zealand	4.62	30
Italy	4.58	31
Malaysia	4.48	32
China	4.44	33
Czech Republic	4.38	34
Mexico	4.26	35
Thailand	4.20	36
South Africa	4.19	37
Poland	4.07	38
Slovenia	4.05	39
Latvia	4.03	40
Japan	4.01	41
Turkey	3.97	42
Lithuania	3.96	43
Botswana	3.93	44
Croatia	3.71	45
Argentina	3.69	46
Mauritius	3.67	47
Jordan	3.65	48
Greece	3.57	49
Costa Rica	3.57	50
Colombia	3.56	51
Luxembourg	3.56	52
Morocco	3.55	53
Namibia	3.50	54
Slovakia	3.43	55
Philippines	3.42	56
Dominican Republic	3.40	57
Uruguay	3.37	58
Egypt	3.34	59
El Salvador	3.29	60
Sri Lanka	3.26	61
Panama	3.24	62
Jamaica	3.23	63
Peru	3.19	64
Indonesia	3.16	65
Vietnam	3.09	66
Nigeria	2.99	67
Venezuela	2.96	68
Trinidad and Tobago	2.84	69
Ukraine	2.84	70
Russia	2.80	71
Paraguay	2.73	72
Ecuador	2.70	73
Bangladesh	2.70	74
Bulgaria	2.61	75
Guatemala	2.53	76
Nicaragua	2.37	77
Haiti	2.20	78
Bolivia	2.18	79
Honduras	1.94	80
Romania	1.89	81
Zimbabwe	1.87	82

Figure 6. GDP ppp per Capita versus Network Readiness Index, Partial Log Regression



Source: Technology Management Department, INSEAD

A closer look at the NRI results would show that Estonia, with a GDP per capita of US\$10,066, has an NRI score of 4.69 and is ranked 24th overall; however, Mauritius, with a very similar GDP per capita of US\$10,017 has a score of 3.44 and an overall ranking of 56. There is thus a wide spread in the NRI score for a given GDP purchasing power parity (PPP) per capita; this is but one of many such examples.

Nevertheless, one could look at the relationship between the NRI and GDP in order to obtain a better understanding of trends, and also to identify over- and underperformers with respect to the trend. Figure 6 gives a plot between GDP PPP per capita and the Networked Readiness Index. The partial log regression plot presents a possible trend. One would immediately notice the following:

1. For a given GDP PPP per capita, there is a spread in the NRI scores around the regression plot as presented above
2. The impact of GDP seems to be very high at low GDP values, and the NRI score increases rapidly with small increases in GDP
3. Around a GDP per capita of US\$9,000, the curve tapers off and the effect of increasing GDP is much less pronounced;

Countries widely distanced from the regression plot could be examples of underperformers or overperformers. Thus, Luxembourg, with a very high GDP per capita, has a moderate NRI score, whereas Finland with about half the GDP per capita of Luxembourg leads the NRI ranking.

Similarly, India would be overperforming on its NRI score with respect to its GDP per capita.

ICT expense and networked readiness

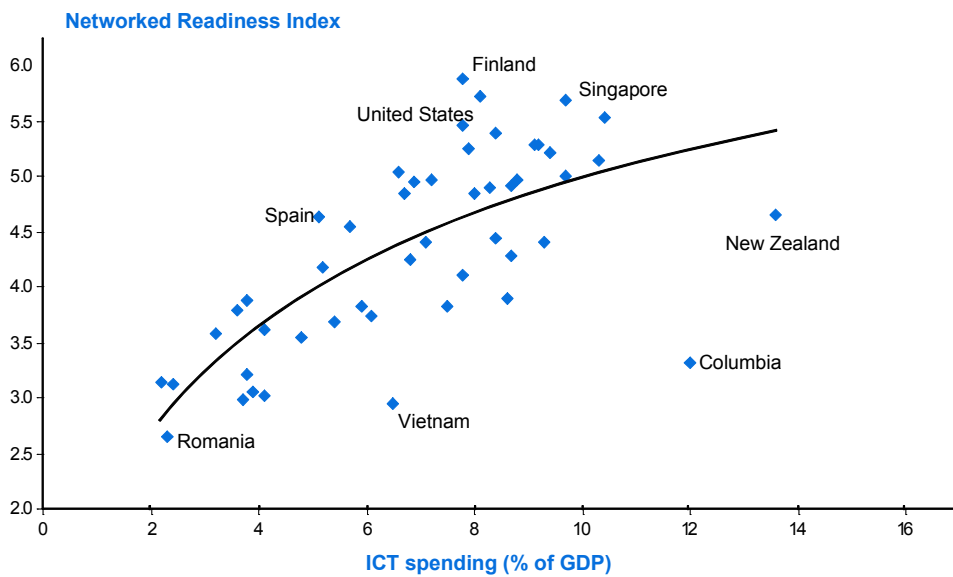
Plotting ICT spending versus NRI gives a similar trend to that of GDP PPP per capita versus NRI. It is notable, however, that there is a very large spread in the NRI score (see Figure 7) at a given ICT expense (as a percentage of GDP); this raises the question of whether or not the ICT dollar is effectively promoting networked readiness. For example, Spain spends less on ICT (as a percentage of GDP) than Vietnam, but has a significantly higher score on the NRI. This emphasizes the importance of other variables (such as market and regulatory factors); these variables play a significant role in determining the degree of networked readiness of a nation. Notable observations from Figure 7 include:

1. The United States, Finland, and Spain are among the leading overperformers
2. Romania, Vietnam, Columbia, and New Zealand are among the leading underperformers
3. New Zealand, with the highest ICT expenditure (percentage of GDP), has a modest NRI score of 4.70.

Internet users per 100 and readiness component index

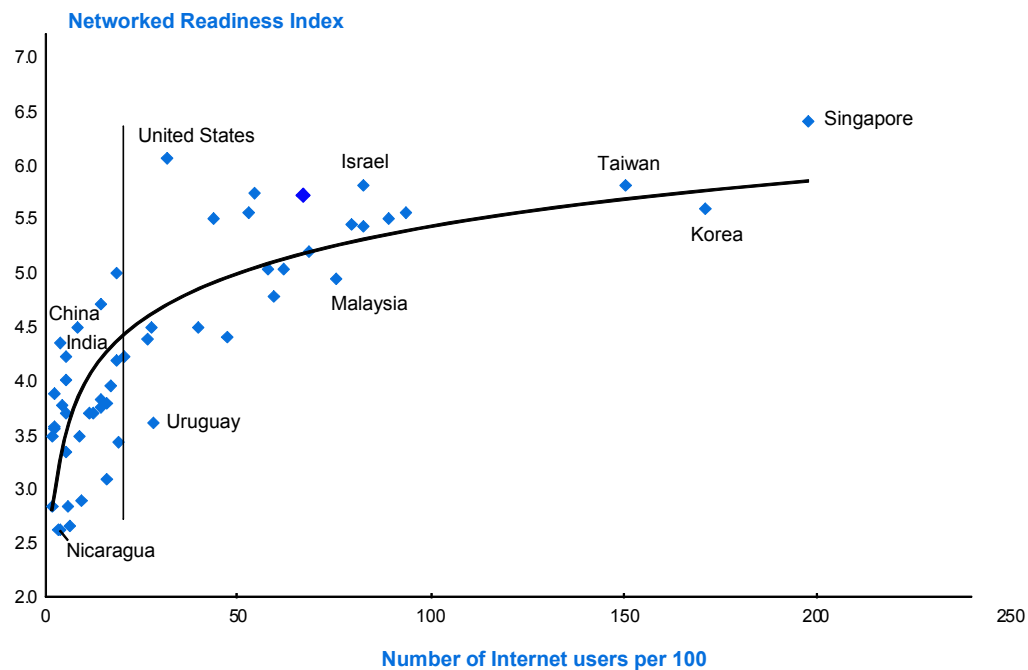
One could be tempted to use the number of Internet users in a country as a proxy estimate of the networked readiness

Figure 7. ICT Expense (Percent GDP) vs Networked Readiness Index, Partial log regression



Source: Technology Management Department, INSEAD

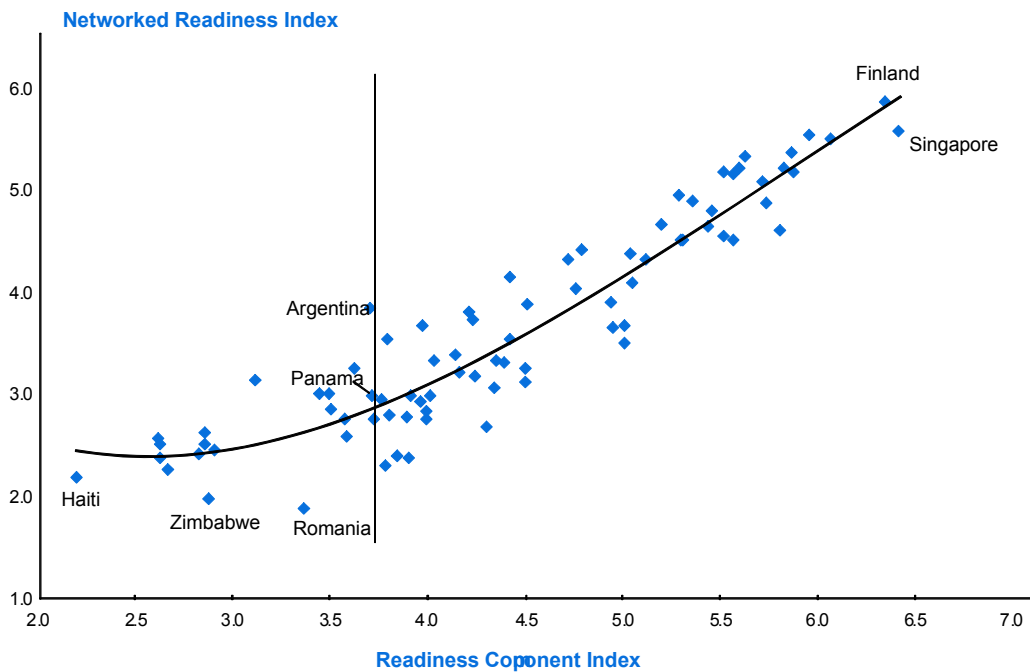
Figure 8. Number of Internet Users per 100 versus Readiness Component Index, Partial Log Regression



of a country. Figure 8 shows a plot between the number of Internet users per 100 persons (number of Internet accounts) and the readiness component index. One would thus see the existence of a possible relationship between these, represented by the partial logarithmic regression plot. One sees that readiness scores increase sharply from 0 to 20 Internet users per 100, and much more gradually thereafter. The relatively flat curve at above 20 to 30 Internet users per 100 persons implies the importance of other factors beyond this point in influencing the degree of readiness of a nation, factors such as the quality of connectivity, speed of connectivity, and the

- availability of online services, among others. Interesting observations that can be made from analyzing this plot are:
1. Singapore, with one of the highest Internet users per 100 persons ratio, outperforms the trend line with the highest readiness component index scores. Apart from a high concentration of businesses and the presence of a skilled workforce, Singapore benefits from a strong government push in ICT.
 2. Korea, with the second highest number of Internet users, performs relatively moderately on the readiness component

Figure 9. Readiness Component Index versus Usage Component Index, Partial Polynomial Regression



Source: Technology Management Department, INSEAD

index—the country is at 12th place, despite having one of the best broadband connectivities in the world. Korea shows higher readiness on the individual dimension compared with their business and government readiness.

- India and China, with relatively low numbers of Internet users, have relatively higher readiness scores; this is probably because of the regional and demographic digital divides in these countries.
- A number of South American countries, such as Nicaragua and Uruguay, are only just starting to witness the propagation of the Internet; this is reflected in lower readiness scores.

Is there a threshold for usage to take off?

One would expect the readiness and usage scores of a nation to move hand in hand. A country having a high degree of readiness would be able to transform this ICT capability into usage statistics, and hence show a high score on the usage component index. For example, Singapore and Finland have among the highest readiness component index scores, and this readiness is translated into real ICT usage and represented by high usage scores (see Figure 9).

A closer look at the trend of readiness versus usage at lower values of readiness will reveal that usage remains rather flat with initial increases in readiness. This leads us to believe that there is a threshold to readiness; a country needs to have a certain level of readiness with regards to ICT before

there can be effective usage of and a consequent impact from ICT. A certain critical mass in terms of numbers of users, or the availability of narrowband and broadband services or of services online, is essential before these indicators are reflected in real usage metrics. Thus it can be determined that:

- Haiti, with a readiness score of 2.19 and a low usage score of 2.19, must develop its readiness before usage starts increasing significantly
- Romania is a significant underperformer below the threshold level, and while it has a readiness score of 3.35, this does not result in a correspondingly higher usage level
- Panama and Argentina are at the threshold level; Argentina, however, is a significant overperformer, with a usage level of 3.84.

Research Challenges

Finding the facts. Even the best-planned frameworks can face seemingly insurmountable obstacles to their implementation because of the lack of reliable data. The overriding aim in our research and analysis has been to provide a scientific and credible interpretation of reality. Thus, the first step in our research has been to collect the most complete and high-quality set of data relating to ICT. We used two types of data in our research: soft data, which are subjective data gathered from questionnaires

(such as the Global Competitiveness Survey); and hard data, which are driven by statistics collected by reputable independent agencies (such as the World Bank and the International Telecommunication Union). Both these sets of data play a crucial role in the overall analysis. The soft data are critical in determining the opinion of the decision makers and influencers who are intimately familiar with a nation's economy. On the other hand, the hard data captures fundamental elements related to the development of infrastructure, human capital, and ICT.

Absence of key usage metrics. Key ICTs, such as mobile telephony and the Internet, are still undergoing rapid development. Owing to this dynamism, accurate usage metrics are difficult, if not impossible, to obtain and/or are not up to date. In the absence of such usage metrics, one has to devise ways to best estimate the development of a country's ICT. For example, metrics on cost savings on high-speed Internet access and usage, on key measures of policy and regulation, and on the use of ICT by governments, remain elusive.

Selection of countries. Availability of objective and reliable data are critical while preparing a report of this type. To ensure quality information, we have restricted the study to eighty-two countries. Availability of data has, in fact, been a key factor in selecting the countries that form part of this study. As a consequence, regions suffering from a chronic lack of reliable statistics, such as Africa and Central Asia, are underrepresented in the NRI.

Ensuring statistical significance. Once solid and reliable facts had been accumulated, a comprehensive statistical analysis was conducted. Following the classic steps of any such analysis, correlation and factor analyses were conducted to drop closely correlated or interrelated variables. Following this, missing data in the dataset were estimated using regression and clustering techniques. The variables were then classified along the lines of the NRI Framework.

Data estimation. Despite our best efforts to collect data from all major international sources, it has been necessary at times to cope with incomplete sets of data for the countries under consideration. In order to compensate for this, statistical procedures, mainly regression and clustering techniques, have been used to estimate missing data. Control procedures and checks have been devised to ensure that estimations were reasonable and not overly favorable or disadvantageous in their representation of the concerned country.

Calculating the NRI. In order to calculate the Index, the data were first transformed on a scale of 1 to 7 to give each piece of information equal weight. Next, each subindex was computed as a mathematical average of the variables composing it. The same approach was used to calculate the component

indexes. Finally, the NRI was computed as an average of the three component indexes. The detailed statistical procedures followed can be found in the Networked Readiness Index: Methodology section of this report.

Summary

Measuring a country's networked readiness remains a significant challenge, and any framework or model representing networked readiness remains, at best, a simplified representation of reality. The NRI Framework attempts to interpret the underlying complexity of the development and use of ICT in an intuitive and easy-to-comprehend model. The overall NRI is a summary measure of a nation's ability to participate in and benefit from ICT. The NRI provides guidance to business leaders and public policymakers to enhance the impact of ICT on all key stakeholders—individuals, businesses, and governments.

The essence of networked readiness extends beyond any single metric; that said, there are over- and underperforming countries—countries that have put ICT on the national agenda and have strived to make it an area of excellence, and others that have not done so. The former countries have succeeded in going beyond individual measures of national income or national ICT spending to provide an optimal environment for ICT development, thus promoting high levels of readiness and usage for all three key stakeholders. Finland, Singapore, and Korea are such leaders; these three could serve as role models for other nations in their quest for ICT excellence. The NRI allows a nation to benchmark its ICT performance and determine the effectiveness of policy. It also permits a country to learn from the policy and performance of other countries with similar profiles, and to identify best practice.

ICT is the key to the evolution of our practices in many domains, such as education, work, personal relations, work effectiveness, and national productivity. An interesting characteristic of ICT, such as that of the Internet and mobile communications, is that overall value increases nonlinearly with the number of connected individuals and organizations. Increasing developing countries' levels of participation in ICT not only creates benefits for these countries; it also increases the overall potential of all connected stakeholders to realize value.

Endnotes

1. United Nations Development Programme (2001); Schwab et al (2002).
2. An NRI ranking of nations was presented for 2001 to 2002 in Kirkman et al (2002). The Networked Readiness Index 2002–2003 ranking cannot be directly compared with this earlier ranking, as the underlying framework and variables used in our research differ from those used in the earlier research by Kirkman et al.

3. For example, Israel with an overall ranking of 12, does well on environment (where it is ranked 5th) and readiness (8th) dimensions, as compared to the usage dimension where it is ranked 19th. See Table 4.

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Technical Appendix: Constructing the Networked Readiness Index

The Networked Readiness Index 2002–2003 separates environmental factors from ICT readiness and usage, and hence there are three component indexes each for environment, readiness, and usage. Starting from a set of more than 130 ICT-related variables, we have divided these variables among the nine subindexes. We then eliminated variables based on analytic procedures such as correlation analysis, and Cronbachs Alpha test.. The detailed statistical procedures that we followed can be found in the Networked Readiness Index: Methodology section of this report. Our final NRI computation is based on a set of sixty-four variables.

Definitions of the Networked Readiness Index, component indexes and subindexes

The Networked Readiness Index is defined as follows:

Networked Readiness Index = 1/3 Environment + 1/3 Networked Readiness + 1/3 Network Usage

A. Environment component index is defined as follows:

Environment = 1/3 Market + 1/3 Political/Regulatory Factors + 1/3 Infrastructure

1. Market subindex is defined by the following data variables:

- i. Venture capital availability
- ii. State of cluster development
- iii. Competition in the telecommunications sector
- iv. Availability of scientists and engineers
- v. Brain drain
- vi. Public spending on education (percentage of GDP)
- vii. Domestic software companies in international markets
- viii. Domestic manufacturing of IT hardware
- ix. ICT expenditure (percentage of GDP)

2. Political/regulatory subindex is defined by the following data variables:

- i. Effectiveness of law-making bodies
- ii. Legal framework for ICT Development
- iii. Subsidies for firm-level research and development
- iv. Government restrictions on Internet content
- v. Prevalence of foreign technology licensing

3. Infrastructure is defined by the following variables:

- i. Overall infrastructure quality
- ii. Local availability of specialized IT services
- iii. Number of telephone mainlines (per 1,000 people)
- iv. Number of telephone faults (per 100 main lines)
- v. Number of telephone mainlines per employee
- vi. Number of fax machines (per 1,000 people)
- vii. Local switch capacity (per 100,000 people)
- viii. Ease of obtaining new telephone lines
- ix. Waiting time for telephone mainlines (in years)
- x. Number of secure Internet servers

B. The readiness component index is defined as follows:

Readiness = 1/3 Individual Readiness + 1/3 Business Readiness + 1/3 Government Readiness

1. Individual readiness is defined by the following variables:

- i. Sophistication of local buyers' products and processes
- ii. Availability of mobile Internet access
- iii. Availability of broadband access
- iv. Public access to the Internet

- v. Secondary school enrollment (percentage net)
- vi. Total adult illiteracy rate (in percent)
- vii. Quality of math and science education
- viii. Cost of local call (US\$ per 3 minutes)
- ix. Cost of off-peak local cellular telephone call (US\$ per 3 minutes)
- x. Cost of residential telephone subscription (US\$ per month)

2. Business readiness is defined by the following variables:

- i. Firm-level technology absorption
- ii. Firm-level innovation
- iii. Capacity for innovation
- iv. Business Intranet sophistication
- v. Quality of local IT training programs
- vi. Cost of business telephone subscription (US\$ per month)

3. Government readiness is defined by the following variables:

- i. Government prioritization of ICT
- ii. Government procurement of advanced technology products
- iii. Competence of public officials
- iv. Government online services

C. The Usage component index is defined as follows:

Usage = 1/3 Individual Usage + 1/3 Business Usage + 1/3 Government Usage

1. Individual usage is defined by the following variables:

- i. Use of online payment systems
- ii. Number of radios (per 1,000 people)
- iii. Number of television sets (per 1,000 people)
- iv. Number of cable television subscribers (per 1,000 people)
- v. Number of mobile telephones (per 1,000 people)
- vi. Number of Internet users (per 100 people)
- vii. Number of narrowband subscriber lines (per 100 people)
- viii. Number of broadband subscriber lines (per 100 people)
- ix. Household Spending on ICT (US\$ per month)

2. Business usage is defined by the following variables:

- i. Use of Internet for coordination with customers and suppliers
- ii. Businesses using e-commerce (in percent)
- iii. Use of Internet for general research
- iv. Sophistication of online marketing
- v. Presence of wireless e-business applications
- vi. Use of email for internal correspondence (in percent)
- vii. Use of email for external correspondence (in percent)
- viii. Pervasiveness of company Web pages

3. Government usage is defined by the following variables

- i. Use of Internet-based transactions with government
- ii. Government online services
- iii. Government success in ICT promotion