Part 1

Selected Issues of Networked Readiness

CHAPTER 1.1

Networked Readiness and the Benchmarking of ICT Competitiveness

SOUMITRA DUTTA, INSEAD
AMIT JAIN, INSEAD

Introduction

Recent years have seen strong shifts in the global landscape of information and communication technologies (ICT). Countries such as India have transformed their economies in large measure owing to the benefits of the ICT revolution. Others, such as Ireland and Israel, have experienced similar benefits and emerged as centres of software development. Countries, such as Singapore, Hong Kong and Taiwan, while not hubs of software development on the level of the aforementioned nations, have incorporated the key ingredients of networked readiness, in order to provide an optimal environment for the functioning of key stakeholders, especially businesses.

Since the world's inhabitants have become increasingly dependent on the Internet as a tool for information sharing and exchange, the networked readiness of a nation is significant. INSEAD is pleased to collaborate, once again, with the World Economic Forum in the annual update of the Networked Readiness Index (NRI).[1]

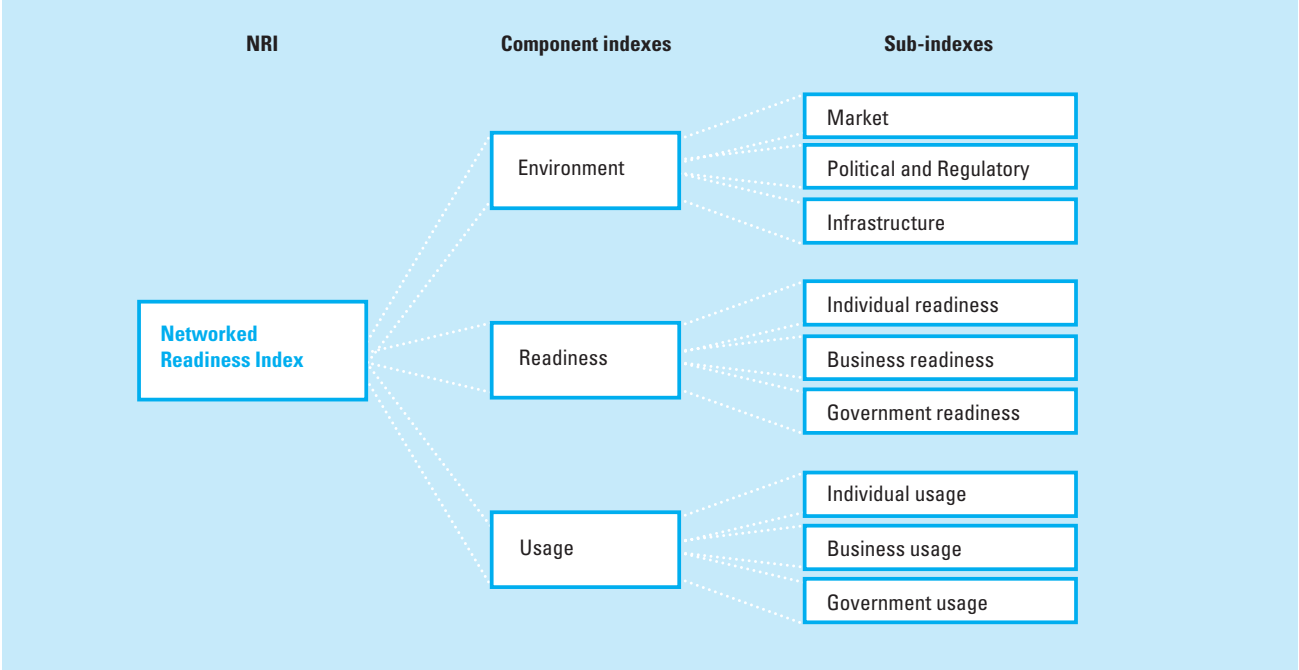
The NRI measures a nation's or community's degree of preparedness for participating in and benefiting from ICT developments. This chapter presents the results of the computation of the NRI for 115 countries around the globe. The immediate objective is to facilitate the task of policy- and decision makers in their endeavor to understand the complexity and diversity of factors underlying a nation's ICT development, and use this understanding to work toward their development objectives. It is hoped that this report will contribute to the development of good public policy, and to the diffusion and usage of ICT.

This chapter is structured as follows. First, we will discuss how the NRI has been used to capture the concept of ICT preparedness and to quantify the extent of its use to leverage development. Second, the results of the research and analysis are presented in the form of a relative ranking of nations, based on their degrees of networked readiness. In the third section, some key trends in the evolution of the diffusion and usage of ICT are presented, based on the analysis of three key ICT indicators: the number of telephone mainlines, the number of personal computers, and the number of Internet users. Analysis is carried out on the international and regional level, and this is followed by an examination of the trends in the seven most populous nations of the world. The fourth section shows how the NRI and its constituent indicators can be used to benchmark a country's ICT development with neighboring or comparable countries. In conclusion, we present some of the key challenges faced in conducting the study.

The Networked Readiness framework 2005–2006

The framework used to compute the NRI rankings this year is identical to that used to compute those for 2002–2003,[2] 2003–2004, and 2004–2005. The NRI and

Figure 1: The framework of the Networked Readiness Index 2005–2006



Source: INSEAD.

its components provide not only a model for evaluating a country's relative development and use of ICT, but also allow for a better understanding of a nation's strengths and weaknesses with respect to ICT.

Figure 1 depicts the structure and premises of the NRI used in this research, an aggregation of three components (see further details in Technical Appendix):

- The three main stakeholders: individuals, businesses, and governments;
- The general macroeconomic and regulatory *environment* for ICT in which the stakeholders play their respective roles;
- The degree of ICT *usage* by the three stakeholders—hence its impact on them— linked to their degrees of *readiness* (or capability) to use and benefit from ICT.

NRI results for 2005–2006

Table 1 shows the overall results for the Networked Readiness Index 2005–2006. The United States received the top ranking, followed by Singapore. Singapore has consistently been ranked in the top three places for the past few years (3rd in 2002–2003, 2nd in the 2003–2004 and 1st in 2004–2005). This excellent performance of Singapore has been attributed to many factors, not the least of which is the government's proactive strategy for promotion of ICT penetration and usage. Denmark, Iceland, and Finland occupy the 3rd, 4th, and 5th places, respectively, confirming the preeminence of the Nordic countries in ICT networked readiness. Canada was ranked 6th, followed by Taiwan, Sweden, and Switzerland. The United Kingdom was ranked 10th.

It is also interesting to note the rankings of other countries: in Asia and Pacific region, Singapore (2nd) and Taiwan (7th) have the highest rankings among the top 10, followed by Hong Kong (11th), Korea (14th), Australia (15th), and Japan (16th). India falls one rank to 40th position (compared with last year), and China falls from the 41st to 50th position. Israel continues to lead the middle-east group of countries at 19th place, and the United Arab Emirates follows at 28th place.

Of the new member states of the European Union, Estonia (23rd) leads, followed closely by Malta (30th) and Cyprus (33rd).

In Latin America, Chile (29th) leads, 23 positions ahead of Brazil (52nd), the second best performer in the region. Other larger economies in the region do less well, with Mexico (55th), Colombia (62nd) and Argentina (71st) showing mediocre positions in the overall ranking.

Russia fell from its 62nd position in last year's ranking to 72nd.

Among the sub-Saharan African countries, South Africa (37th) leads, followed by Mauritius (45th), and Botswana (56th).

Evolution of the NRI over time

The measurement of a nation on the NRI is dynamic, and evolves over time, as a result of multiple factors including changes occurring in the global environment, policy measures taken by government, and the actions of business leaders. Analyzing the changes in NRI rankings over time (Table 2), one observes that the United States and Finland have consistently been in the top five positions, whereas Singapore has rapidly progressed from 8th place in 2001–2002, to its current leading position.

One must add a note of caution to the comparison shown in Table 2, because the NRI framework used for the 2001–2002 study was different from that used in succeeding years (see Kirkman et al., 2002). Also, while the NRI framework is constant during the 2002–2006 studies, the underlying data variables used for the computation of the various indexes of the NRI differ slightly from one year to the next. These differences are partly due to the limited availability of reliable, up-to-date data for several countries, and the expanded coverage of the NRI in recent years, particularly in the developing world. The differences also reflect the occasional inclusion of new variables which, in a rapidly changing industry, have become necessary for the appropriate measurement of networked readiness. However, advanced statistical methods, such as factor analysis, are used to ensure that the variables used for the computation of the NRI accurately represent the component and sub-indexes of the NRI framework.

Interpreting the results

The NRI captures key factors relating to the environment, the degree of preparedness and the extent of ICT usage of three stakeholders: individuals, businesses and governments. The component index and sub-index rankings serve to identify key areas where a nation is under-performing or excelling. One would, for instance, be able to identify relative imbalances in development across the three component indexes (environment, readiness, and usage), and, as needed, identify particular strengths and weaknesses as regards specific areas captured in one of these broad categories—for instance, deficiencies in the regulatory environment due to excessive bureaucracy and red tape, or an inadequate educational infrastructure.

The NRI index was computed on an increasing scale from 1 to 7 for the years 2001–2004. Due to improvements in the underlying statistical procedures, this 7-point scale is no longer used. Instead, from last year onwards, the NRI and its constituent sub-index scores are standardized with a mean of 0. This results in the scores of the countries being distributed above and below the mean score of zero. The fact that the score of a given country is positive merely reflects the fact that the country performs better than the mean performance across the 115 countries

Table 1: Networked Readiness Index 2005–2006

Country	Score	Rank
United States	2.02	1
Singapore	1.89	2
Denmark	1.80	3
Iceland	1.78	4
Finland	1.72	5
Canada	1.54	6
Taiwan	1.51	7
Sweden	1.49	8
Switzerland	1.48	9
United Kingdom	1.44	10
Hong Kong SAR	1.44	11
Netherlands	1.39	12
Norway	1.33	13
Korea, Rep.	1.31	14
Australia	1.28	15
Japan	1.24	16
Germany	1.18	17
Austria	1.18	18
Israel	1.16	19
Ireland	1.15	20
New Zealand	1.14	21
France	1.11	22
Estonia	0.96	23
Malaysia	0.93	24
Belgium	0.87	25
Luxembourg	0.80	26
Portugal	0.56	27
United Arab Emirates	0.54	28
Chile	0.52	29
Malta	0.51	30
Spain	0.47	31
Czech Republic	0.36	32
Cyprus	0.36	33
Thailand	0.35	34
Slovenia	0.34	35
Tunisia	0.33	36
South Africa	0.30	37
Hungary	0.27	38
Qatar	0.25	39
India	0.23	40
Slovak Republic	0.19	41
Italy	0.16	42
Greece	0.08	43
Lithuania	0.08	44
Mauritius	0.07	45
Kuwait	0.06	46
Jordan	0.03	47
Turkey	0.00	48
Bahrain	0.00	49
China	–0.01	50
Latvia	–0.03	51
Brazil	–0.04	52
Poland	–0.09	53
Jamaica	–0.11	54
Mexico	–0.14	55
Botswana	–0.16	56
Croatia	–0.23	57
Romania	–0.23	58
El Salvador	–0.24	59
Kazakhstan	–0.24	60
Ghana	–0.25	61
Colombia	–0.27	62
Egypt	–0.29	63
Bulgaria	–0.31	64
Uruguay	–0.31	65
Panama	–0.33	66
Pakistan	–0.34	67
Indonesia	–0.36	68
Costa Rica	–0.37	69
Philippines	–0.37	70
Argentina	–0.38	71
Russian Federation	–0.39	72
Azerbaijan	–0.40	73
Trinidad and Tobago	–0.42	74
Vietnam	–0.47	75
Ukraine	–0.49	76
Morocco	–0.51	77
Namibia	–0.53	78
Uganda	–0.60	79
Serbia and Montenegro	–0.63	80
Venezuela	–0.65	81
Macedonia, FYR	–0.67	82
Sri Lanka	–0.68	83
Tanzania	–0.69	84
Peru	–0.70	85
Armenia	–0.72	86
Algeria	–0.72	87
Gambia	–0.72	88
Dominican Republic	–0.73	89
Nigeria	–0.74	90
Kenya	–0.75	91
Mongolia	–0.76	92
Tajikistan	–0.77	93
Moldova	–0.78	94
Mali	–0.78	95
Georgia	–0.82	96
Bosnia and Herzegovina	–0.87	97
Guatemala	–0.88	98
Cameroon	–0.88	99
Honduras	–0.89	100
Mozambique	–0.94	101
Madagascar	–0.99	102
Kyrgyz Republic	–1.01	103
Cambodia	–1.03	104
Zimbabwe	–1.04	105
Albania	–1.04	106
Ecuador	–1.07	107
Benin	–1.07	108
Bolivia	–1.10	109
Bangladesh	–1.11	110
Guyana	–1.11	111
Nicaragua	–1.14	112
Paraguay	–1.23	113
Chad	–1.36	114
Ethiopia	–1.39	115

(cont'd.)

Source: INSEAD.

Table 2: Evolution of Networked Readiness from 2001 to 2004

Country	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006
(Number of nations)	(72)	(82)	(102)	(104)	(115)
United States	1	2	1	5	1
Singapore	8	3	2	1	2
Denmark	7	8	5	4	3
Iceland	2	5	10	2	4
Finland	3	1	3	3	5
Canada	12	6	6	10	6
Taiwan	15	9	17	15	7
Sweden	4	4	4	6	8
Switzerland	16	13	7	9	9
United Kingdom	10	7	15	12	10

Source: INSEAD.

studied. Likewise, a negative score implies that the country's performance is below the mean performance of the total set of countries.

We must emphasize, however, that while rankings are useful as relative indicators of a nation's ICT excellence, there are several limitations to the analytic process. Caution should be exercised when comparing countries that are closely ranked. For instance, such countries can show very small variation in their index scores: the United Kingdom (NRI score = 1.44, rank of 10) and Hong Kong (NRI score = 1.44, rank of 11) even have the same overall scores (see Table 1). In this case, the United Kingdom has an overall index score marginally higher than that of Hong Kong, but this is only at the third decimal place. Moreover, small differences in the index may be outside the limits of statistical significance, due to the fact that some missing observations were estimated using analytic techniques such as regression and clustering.

One must also remember that while the number of countries included in the current study has increased from 72 in the 2001–2002 *GITR* to 115 in the current edition, a number of nations could not be included in the research due to limitations in the availability of reliable data. Country selection was largely determined by the range of countries covered by the Executive Opinion Survey of the World Economic Forum (Survey). Ranking an even larger set of nations remains a challenge for the future. Any overall global ranking would need to account for these missing countries, and any inferences drawn from the current relative positions of the 115 nations included should be made with this limitation in mind.

Finally, the complexity of ICT can be obscured by the numerical score of a country's NRI. Countries such as India or China, for instance, show enormous internal geographic and demographic divides in ICT readiness and usage. Such regional differences are not captured adequately by the overall NRI scores, which very much remain an average concept for the country.

The building blocks of the Networked Readiness Index

The NRI provides a 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 insight into areas of good or poor performance of a nation, and to understand the key drivers determining the results. This can be done by looking at the component indexes: Environment, Readiness, and Usage. Tables 3, 4, and 5 present the overall results of each component index. Further insight may be obtained by looking at the sub-indexes composing each component index. The final level of detail can be obtained by observing the 66 variables comprising the sub-indexes, which are presented in the data tables section of this report.

Environment

The Environment component index is designed to measure the degree to which the environment of a country is conducive to the development and use of ICT. As can be seen from Table 3, the top countries for Environment are Iceland, the United States and Singapore.

Tables 6, 7, and 8 present the detailed ranking and scores for each of the three subindexes comprising the Environment component: the Market Environment, the Political and Regulatory Environment, and the Infrastructure Environment.

Market Environment

The Market Environment component assesses the presence of 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 trade openness, commercial measures, such as the availability of funding and skilled labor, and the level of development of the corporate environment. The leader for this sub-index is Singapore, followed by Hong Kong and Taiwan. United States and Iceland take the fourth and fifth places, respectively.

Political and Regulatory Environment

This component of the NRI measures the impact of a nation's policies, laws, and regulations, and their impact on the development and use of ICT. The leaders for this sub-component are Denmark, Singapore, and United Kingdom. The United States is ranked high (4th), whereas Iceland is ranked 5th.

Table 3: Environment Component Index

Country	Score	Rank
Iceland	2.62	1
United States	2.49	2
Singapore	1.90	3
Finland	1.83	4
Denmark	1.71	5
Canada	1.66	6
Norway	1.66	7
Switzerland	1.65	8
Australia	1.47	9
Taiwan	1.43	10
Hong Kong SAR	1.42	11
Netherlands	1.41	12
United Kingdom	1.41	13
Sweden	1.41	14
New Zealand	1.40	15
Ireland	1.30	16
Luxembourg	1.24	17
Japan	1.15	18
Austria	1.11	19
Germany	1.05	20
Israel	0.92	21
Malaysia	0.88	22
France	0.85	23
Estonia	0.84	24
Korea, Rep.	0.82	25
Cyprus	0.71	26
United Arab Emirates	0.57	27
Qatar	0.54	28
Portugal	0.47	29
Belgium	0.46	30
Spain	0.44	31
Kuwait	0.42	32
Chile	0.33	33
Malta	0.32	34
South Africa	0.30	35
Tunisia	0.29	36
Bahrain	0.24	37
Thailand	0.21	38
Jordan	0.15	39
India	0.14	40
Hungary	0.12	41
Slovak Republic	0.12	42
Botswana	0.10	43
Greece	0.09	44
Slovenia	0.09	45
Czech Republic	0.07	46
Ghana	0.03	47
Latvia	–0.06	48
Italy	–0.09	49
Lithuania	–0.10	50
Mauritius	–0.14	51
China	–0.16	52
Poland	–0.16	53
Jamaica	–0.23	54
Turkey	–0.24	55
Uruguay	–0.25	56
Namibia	–0.31	57
Kazakhstan	–0.32	58
Egypt	–0.33	59
Costa Rica	–0.33	60
Trinidad and Tobago	–0.33	61
Tanzania	–0.34	62
Indonesia	–0.38	63
Panama	–0.39	64
El Salvador	–0.39	65
Croatia	–0.41	66
Azerbaijan	–0.43	67
Bulgaria	–0.44	68
Nigeria	–0.46	69
Colombia	–0.48	70
Mexico	–0.48	71
Romania	–0.49	72
Philippines	–0.52	73
Mali	–0.54	74
Sri Lanka	–0.55	75
Pakistan	–0.56	76
Gambia	–0.56	77
Russian Federation	–0.57	78
Uganda	–0.57	79
Brazil	–0.58	80
Vietnam	–0.60	81
Morocco	–0.62	82
Argentina	–0.62	83
Ukraine	–0.63	84
Kenya	–0.67	85
Georgia	–0.67	86
Armenia	–0.70	87
Tajikistan	–0.70	88
Serbia and Montenegro	–0.71	89
Macedonia, FYR	–0.74	90
Dominican Republic	–0.75	91
Madagascar	–0.78	92
Bangladesh	–0.79	93
Moldova	–0.80	94
Honduras	–0.81	95
Mozambique	–0.83	96
Algeria	–0.85	97
Cambodia	–0.88	98
Zimbabwe	–0.88	99
Venezuela	–0.89	100
Albania	–0.90	101
Cameroon	–0.90	102
Mongolia	–0.90	103
Peru	–0.91	104
Paraguay	–0.95	105
Benin	–0.96	106
Kyrgyz Republic	–0.96	107
Guatemala	–0.96	108
Bosnia and Herzegovina	–0.98	109
Nicaragua	–1.02	110
Ethiopia	–1.03	111
Bolivia	–1.04	112
Guyana	–1.05	113
Ecuador	–1.08	114
Chad	–1.34	115

Source: INSEAD.

(cont'd.)

Table 4: Readiness Component Index

Country	Score	Rank
Singapore	1.89	1
United States	1.82	2
Finland	1.73	3
Denmark	1.70	4
United Kingdom	1.57	5
Canada	1.49	6
Korea, Rep.	1.38	7
Taiwan	1.38	8
Netherlands	1.35	9
Germany	1.33	10
Switzerland	1.31	11
Sweden	1.31	12
Hong Kong SAR	1.30	13
Japan	1.29	14
France	1.29	15
Israel	1.25	16
Belgium	1.22	17
Australia	1.20	18
Austria	1.17	19
New Zealand	1.05	20
Ireland	1.02	21
Norway	0.99	22
Iceland	0.98	23
Malaysia	0.96	24
Estonia	0.81	25
Czech Republic	0.53	26
Chile	0.53	27
Luxembourg	0.51	28
India	0.48	29
Tunisia	0.46	30
Slovenia	0.46	31
Thailand	0.45	32
Spain	0.40	33
South Africa	0.37	34
Portugal	0.37	35
Hungary	0.32	36
Malta	0.31	37
Italy	0.24	38
United Arab Emirates	0.24	39
Mauritius	0.24	40
Slovak Republic	0.20	41
Lithuania	0.14	42
Mexico	0.13	43
Poland	0.12	44
Colombia	0.12	45
Brazil	0.11	46
Turkey	0.10	47
Greece	0.07	48
Cyprus	0.05	49
China	0.05	50
Latvia	–0.02	51
Romania	–0.04	52
Qatar	–0.07	53
Jordan	–0.08	54
Russian Federation	–0.08	55
Kazakhstan	–0.10	56
Argentina	–0.11	57
Botswana	–0.11	58
Ukraine	–0.13	59
Croatia	–0.13	60
Indonesia	–0.14	61
Costa Rica	–0.15	62
Bulgaria	–0.16	63
Jamaica	–0.18	64
El Salvador	–0.19	65
Kuwait	–0.20	66
Pakistan	–0.21	67
Trinidad and Tobago	–0.23	68
Panama	–0.25	69
Ghana	–0.27	70
Bahrain	–0.29	71
Egypt	–0.31	72
Uruguay	–0.36	73
Venezuela	–0.38	74
Philippines	–0.38	75
Vietnam	–0.43	76
Azerbaijan	–0.44	77
Armenia	–0.46	78
Serbia and Montenegro	–0.48	79
Macedonia, FYR	–0.51	80
Algeria	–0.56	81
Mongolia	–0.56	82
Morocco	–0.58	83
Peru	–0.59	84
Namibia	–0.61	85
Uganda	–0.63	86
Bosnia and Herzegovina	–0.70	87
Sri Lanka	–0.71	88
Tajikistan	–0.73	89
Kyrgyz Republic	–0.76	90
Kenya	–0.76	91
Cameroon	–0.77	92
Nigeria	–0.81	93
Honduras	–0.81	94
Dominican Republic	–0.82	95
Guatemala	–0.87	96
Zimbabwe	–0.89	97
Moldova	–0.89	98
Gambia	–0.90	99
Guyana	–0.92	100
Georgia	–0.94	101
Ecuador	–1.04	102
Cambodia	–1.05	103
Albania	–1.07	104
Tanzania	–1.09	105
Mozambique	–1.18	106
Bolivia	–1.18	107
Chad	–1.21	108
Benin	–1.26	109
Mali	–1.27	110
Nicaragua	–1.28	111
Paraguay	–1.28	112
Bangladesh	–1.29	113
Madagascar	–1.37	114
Ethiopia	–1.65	115

Source: INSEAD.

(cont'd.)

Table 5: Usage Component Index

Country	Score	Rank
Denmark	1.98	1
Singapore	1.89	2
Sweden	1.77	3
Iceland	1.75	4
Taiwan	1.74	5
United States	1.74	6
Korea, Rep.	1.73	7
Finland	1.61	8
Hong Kong SAR	1.60	9
Switzerland	1.48	10
Canada	1.45	11
Netherlands	1.41	12
Norway	1.35	13
United Kingdom	1.34	14
Israel	1.31	15
Japan	1.28	16
Austria	1.26	17
Estonia	1.24	18
France	1.19	19
Australia	1.18	20
Germany	1.16	21
Ireland	1.13	22
New Zealand	0.98	23
Malaysia	0.95	24
Belgium	0.94	25
Malta	0.90	26
Portugal	0.85	27
United Arab Emirates	0.82	28
Chile	0.71	29
Luxembourg	0.66	30
Spain	0.57	31
Czech Republic	0.49	32
Slovenia	0.48	33
Thailand	0.38	34
Hungary	0.36	35
Italy	0.34	36
Cyprus	0.34	37
Brazil	0.33	38
Qatar	0.27	39
Slovak Republic	0.25	40
Tunisia	0.25	41
South Africa	0.25	42
Lithuania	0.19	43
Turkey	0.14	44
Mauritius	0.12	45
India	0.09	46
Greece	0.09	47
Jamaica	0.08	48
China	0.06	49
Bahrain	0.04	50
Jordan	0.03	51
Latvia	–0.01	52
Kuwait	–0.04	53
Mexico	–0.06	54
El Salvador	–0.12	55
Croatia	–0.13	56
Romania	–0.16	57
Egypt	–0.22	58
Philippines	–0.22	59
Poland	–0.25	60
Pakistan	–0.26	61
Kazakhstan	–0.29	62
Bulgaria	–0.32	63
Uruguay	–0.33	64
Azerbaijan	–0.34	65
Morocco	–0.35	66
Panama	–0.35	67
Vietnam	–0.39	68
Argentina	–0.41	69
Colombia	–0.44	70
Botswana	–0.48	71
Ghana	–0.52	72
Russian Federation	–0.53	73
Mali	–0.54	74
Indonesia	–0.58	75
Uganda	–0.59	76
Peru	–0.60	77
Dominican Republic	–0.63	78
Costa Rica	–0.63	79
Moldova	–0.64	80
Tanzania	–0.65	81
Namibia	–0.67	82
Venezuela	–0.68	83
Serbia and Montenegro	–0.70	84
Ukraine	–0.71	85
Gambia	–0.71	86
Trinidad and Tobago	–0.71	87
Algeria	–0.76	88
Sri Lanka	–0.77	89
Macedonia, FYR	–0.78	90
Guatemala	–0.79	91
Kenya	–0.81	92
Madagascar	–0.81	93
Mongolia	–0.82	94
Mozambique	–0.82	95
Georgia	–0.84	96
Tajikistan	–0.89	97
Bosnia and Herzegovina	–0.91	98
Cameroon	–0.96	99
Nigeria	–0.97	100
Armenia	–0.99	101
Benin	–1.00	102
Honduras	–1.06	103
Bolivia	–1.09	104
Ecuador	–1.10	105
Nicaragua	–1.12	106
Cambodia	–1.15	107
Albania	–1.16	108
Bangladesh	–1.24	109
Kyrgyz Republic	–1.29	110
Zimbabwe	–1.35	111
Guyana	–1.36	112
Paraguay	–1.45	113
Ethiopia	–1.47	114
Chad	–1.52	115

Source: INSEAD.

(cont'd.)

Table 6: Market Environment

Country	Score	Rank
Singapore	2.53	1
Hong Kong SAR	2.16	2
Taiwan	1.96	3
United States	1.94	4
Iceland	1.74	5
Malaysia	1.62	6
Switzerland	1.57	7
Finland	1.54	8
Ireland	1.44	9
United Arab Emirates	1.39	10
Estonia	1.22	11
Japan	1.17	12
United Kingdom	1.04	13
Denmark	1.04	14
Korea, Rep.	1.01	15
Qatar	0.98	16
Canada	0.98	17
Norway	0.89	18
Israel	0.89	19
Austria	0.88	20
Tunisia	0.88	21
Luxembourg	0.86	22
Sweden	0.85	23
Netherlands	0.82	24
New Zealand	0.78	25
Cyprus	0.77	26
Bahrain	0.77	27
Thailand	0.76	28
Australia	0.66	29
Chile	0.64	30
Kuwait	0.61	31
Spain	0.54	32
Germany	0.49	33
Slovak Republic	0.48	34
Jordan	0.45	35
France	0.42	36
India	0.42	37
Botswana	0.41	38
Portugal	0.40	39
Ghana	0.40	40
Latvia	0.22	41
South Africa	0.20	42
China	0.15	43
Hungary	0.05	44
Lithuania	0.04	45
Czech Republic	0.00	46
Belgium	–0.01	47
Indonesia	–0.01	48
Nigeria	–0.07	49
Poland	–0.09	50
Greece	–0.10	51
El Salvador	–0.14	52
Tanzania	–0.15	53
Trinidad and Tobago	–0.17	54
Azerbaijan	–0.18	55
Kazakhstan	–0.20	56
Panama	–0.24	57
Pakistan	–0.25	58
Namibia	–0.25	59
Egypt	–0.27	60
Gambia	–0.28	61
Turkey	–0.31	62
Costa Rica	–0.33	63
Slovenia	–0.34	64
Jamaica	–0.35	65
Mauritius	–0.37	66
Romania	–0.37	67
Sri Lanka	–0.38	68
Philippines	–0.39	69
Armenia	–0.44	70
Uganda	–0.50	71
Morocco	–0.51	72
Malta	–0.51	73
Kenya	–0.52	74
Vietnam	–0.52	75
Italy	–0.53	76
Bangladesh	–0.54	77
Georgia	–0.55	78
Bulgaria	–0.55	79
Russian Federation	–0.55	80
Mexico	–0.57	81
Croatia	–0.58	82
Mali	–0.60	83
Uruguay	–0.61	84
Cambodia	–0.62	85
Dominican Republic	–0.63	86
Ukraine	–0.64	87
Colombia	–0.66	88
Argentina	–0.68	89
Macedonia, FYR	–0.75	90
Madagascar	–0.75	91
Mozambique	–0.77	92
Honduras	–0.80	93
Venezuela	–0.81	94
Tajikistan	–0.82	95
Serbia and Montenegro	–0.82	96
Mongolia	–0.84	97
Ethiopia	–0.84	98
Paraguay	–0.86	99
Nicaragua	–0.87	100
Albania	–0.88	101
Algeria	–0.92	102
Guatemala	–0.93	103
Peru	–0.94	104
Zimbabwe	–0.95	105
Bolivia	–1.00	106
Kyrgyz Republic	–1.02	107
Moldova	–1.03	108
Cameroon	–1.09	109
Guyana	–1.09	110
Ecuador	–1.12	111
Brazil	–1.12	112
Bosnia and Herzegovina	–1.20	113
Benin	–1.23	114
Chad	–1.51	115

Source: INSEAD.

(cont'd.)

Table 7: Political and Regulatory Environment

Country	Score	Rank
Denmark	1.97	1
Singapore	1.96	2
United Kingdom	1.92	3
United States	1.89	4
Iceland	1.82	5
Germany	1.80	6
Finland	1.77	7
Australia	1.76	8
New Zealand	1.70	9
Netherlands	1.69	10
Switzerland	1.65	11
Austria	1.54	12
Norway	1.54	13
Ireland	1.50	14
Canada	1.48	15
France	1.43	16
Malaysia	1.43	17
Sweden	1.31	18
Hong Kong SAR	1.27	19
Japan	1.25	20
Israel	1.20	21
Luxembourg	1.19	22
South Africa	1.07	23
Estonia	0.97	24
Taiwan	0.94	25
Portugal	0.89	26
Belgium	0.89	27
Korea, Rep.	0.83	28
Cyprus	0.79	29
India	0.76	30
Malta	0.76	31
Chile	0.64	32
Tunisia	0.62	33
Jordan	0.59	34
Ghana	0.51	35
Spain	0.50	36
Thailand	0.46	37
Botswana	0.43	38
Hungary	0.31	39
Kuwait	0.31	40
Slovenia	0.30	41
Greece	0.23	42
Qatar	0.22	43
Mauritius	0.15	44
Jamaica	0.11	45
Italy	0.09	46
United Arab Emirates	0.03	47
Uruguay	0.02	48
Namibia	0.01	49
Czech Republic	–0.01	50
Tanzania	–0.03	51
Slovak Republic	–0.03	52
Turkey	–0.07	53
Egypt	–0.10	54
China	–0.10	55
Latvia	–0.17	56
Lithuania	–0.20	57
Mali	–0.21	58
Bahrain	–0.21	59
Colombia	–0.23	60
Brazil	–0.25	61
Poland	–0.26	62
Kazakhstan	–0.32	63
Indonesia	–0.35	64
El Salvador	–0.37	65
Costa Rica	–0.40	66
Philippines	–0.42	67
Mexico	–0.42	68
Uganda	–0.42	69
Panama	–0.44	70
Nigeria	–0.48	71
Sri Lanka	–0.51	72
Vietnam	–0.52	73
Azerbaijan	–0.54	74
Croatia	–0.55	75
Morocco	–0.59	76
Trinidad and Tobago	–0.61	77
Tajikistan	–0.62	78
Pakistan	–0.63	79
Gambia	–0.65	80
Kenya	–0.66	81
Romania	–0.67	82
Bulgaria	–0.74	83
Madagascar	–0.77	84
Cameroon	–0.78	85
Benin	–0.81	86
Argentina	–0.85	87
Moldova	–0.86	88
Honduras	–0.88	89
Georgia	–0.89	90
Algeria	–0.90	91
Zimbabwe	–0.92	92
Ukraine	–0.92	93
Mozambique	–0.92	94
Russian Federation	–0.99	95
Serbia and Montenegro	–0.99	96
Bangladesh	–1.00	97
Dominican Republic	–1.03	98
Peru	–1.08	99
Macedonia, FYR	–1.09	100
Armenia	–1.11	101
Albania	–1.13	102
Mongolia	–1.15	103
Cambodia	–1.23	104
Kyrgyz Republic	–1.25	105
Guatemala	–1.25	106
Venezuela	–1.35	107
Bosnia and Herzegovina	–1.37	108
Bolivia	–1.39	109
Ethiopia	–1.42	110
Nicaragua	–1.44	111
Guyana	–1.45	112
Ecuador	–1.47	113
Paraguay	–1.68	114
Chad	–1.70	115

Source: INSEAD.

(cont'd.)

Table 8: Infrastructure Environment

Country	Score	Rank
Iceland	4.29	1
United States	3.62	2
Norway	2.54	3
Canada	2.53	4
Finland	2.19	5
Denmark	2.13	6
Sweden	2.06	7
Australia	1.98	8
New Zealand	1.73	9
Netherlands	1.73	10
Switzerland	1.72	11
Luxembourg	1.67	12
Taiwan	1.37	13
United Kingdom	1.27	14
Singapore	1.20	15
Japan	1.02	16
Ireland	0.97	17
Austria	0.91	18
Germany	0.87	19
Hong Kong SAR	0.83	20
Malta	0.72	21
France	0.70	22
Israel	0.68	23
Korea, Rep.	0.61	24
Cyprus	0.56	25
Belgium	0.49	26
Qatar	0.43	27
Estonia	0.32	28
Kuwait	0.32	29
Slovenia	0.31	30
Spain	0.28	31
United Arab Emirates	0.28	32
Czech Republic	0.21	33
Bahrain	0.16	34
Italy	0.16	35
Greece	0.13	36
Portugal	0.11	37
Hungary	0.00	38
Bulgaria	–0.03	39
Slovak Republic	–0.09	40
Croatia	–0.10	41
Poland	–0.13	42
Uruguay	–0.15	43
Lithuania	–0.15	44
Russian Federation	–0.16	45
Mauritius	–0.20	46
Trinidad and Tobago	–0.22	47
Latvia	–0.24	48
Costa Rica	–0.26	49
Paraguay	–0.30	50
Serbia and Montenegro	–0.30	51
Chile	–0.31	52
Argentina	–0.32	53
Ukraine	–0.34	54
Brazil	–0.35	55
Turkey	–0.36	56
Bosnia and Herzegovina	–0.36	57
Macedonia, FYR	–0.37	58
South Africa	–0.38	59
Malaysia	–0.41	60
Romania	–0.44	61
Kazakhstan	–0.45	62
Mexico	–0.45	63
Jamaica	–0.46	64
Panama	–0.48	65
Venezuela	–0.50	66
Moldova	–0.51	67
China	–0.51	68
Colombia	–0.54	69
Botswana	–0.55	70
Armenia	–0.55	71
Azerbaijan	–0.57	72
Georgia	–0.58	73
Dominican Republic	–0.58	74
Thailand	–0.60	75
Jordan	–0.61	76
Egypt	–0.61	77
Kyrgyz Republic	–0.61	78
Tunisia	–0.63	79
Guyana	–0.63	80
Ecuador	–0.63	81
El Salvador	–0.65	82
Tajikistan	–0.67	83
Albania	–0.68	84
Peru	–0.70	85
Guatemala	–0.71	86
Namibia	–0.71	87
Algeria	–0.71	88
Mongolia	–0.72	89
Bolivia	–0.72	90
Honduras	–0.74	91
Vietnam	–0.75	92
Gambia	–0.76	93
Philippines	–0.76	94
Sri Lanka	–0.76	95
Nicaragua	–0.76	96
Morocco	–0.76	97
India	–0.76	98
Indonesia	–0.77	99
Zimbabwe	–0.78	100
Pakistan	–0.78	101
Cambodia	–0.79	102
Uganda	–0.79	103
Chad	–0.80	104
Mali	–0.80	105
Mozambique	–0.80	106
Madagascar	–0.81	107
Ghana	–0.81	108
Kenya	–0.82	109
Cameroon	–0.83	110
Nigeria	–0.83	111
Bangladesh	–0.83	112
Benin	–0.83	113
Tanzania	–0.84	114
Ethiopia	–0.84	115

Source: INSEAD.

(cont'd.)

Infrastructure Environment

The Infrastructure component is a measure of the 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, promote investment in ICT infrastructure. The top ranks for this component go to Iceland, United States, and Norway. It is interesting to note that China is ranked 68th on the Infrastructure sub-index, whereas India is at 98th place, a very low rank compared to its overall 40th position in the Environment component index. This is an indication of the difficulty of developing a universally available quality ICT infrastructure for all socio-economic segments of the country's population.

Readiness

The Readiness component measures the capability of the principal agents of a given nation's economy (citizens, businesses, and governments) to leverage the potential of ICT. This capability is based on a combination of factors, such as the presence of relevant human skills for using ICT, access and affordability of ICT for corporations, and the government's own use of ICT for its services and processes. As shown in Table 4, Singapore ranks highest on overall Readiness and shows a consistent performance across all three Readiness sub-indexes. United States is in second place and is supported by a very strong performance in Business and Government Readiness. Third-ranked Finland benefits from high scores in Readiness on each of the three sub-indexes.

Detailed results for each of the sub-indexes used for measuring Readiness can be found in Tables 9, 10, and 11.

Individual Readiness

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 level of access to the Internet, and the degree of citizen connectivity. The top three positions on Individual Readiness go to Singapore, Finland, and Iceland. Taiwan is ranked 4th and Switzerland is ranked 5th.

Business Readiness

Business Readiness measures how well businesses are prepared to participate in and benefit from ICT. The aim is not only to focus on the largest corporations, but also to include small and medium-sized businesses, and their willingness to exploit ICT and invest in the ICT skills of their employees. The United States is placed in the top position in Business Readiness, and is followed by Switzerland. Germany, Finland, and Denmark, ranked 3rd, 4th and 5th respectively.

Table 9: Individual Readiness

Country	Score	Rank
Singapore	1.40	1
Finland	1.38	2
Iceland	1.22	3
Taiwan	1.19	4
Switzerland	1.18	5
France	1.15	6
Belgium	1.14	7
Denmark	1.13	8
Hong Kong SAR	1.13	9
Canada	1.13	10
Australia	1.10	11
Netherlands	1.09	12
Japan	1.08	13
United States	1.05	14
Ireland	1.03	15
Austria	1.01	16
New Zealand	0.99	17
Sweden	0.98	18
Korea, Rep.	0.97	19
United Kingdom	0.91	20
Germany	0.90	21
Malaysia	0.89	22
Israel	0.89	23
Luxembourg	0.83	24
Norway	0.82	25
Estonia	0.81	26
Cyprus	0.75	27
Czech Republic	0.74	28
United Arab Emirates	0.73	29
Slovenia	0.72	30
Tunisia	0.71	31
Malta	0.61	32
Spain	0.55	33
Qatar	0.53	34
Hungary	0.51	35
Lithuania	0.50	36
Slovak Republic	0.49	37
Italy	0.47	38
Kuwait	0.47	39
Greece	0.42	40
Latvia	0.42	41
Portugal	0.39	42
Thailand	0.36	43
Mauritius	0.35	44
Poland	0.34	45
Russian Federation	0.34	46
Bahrain	0.33	47
Romania	0.29	48
Costa Rica	0.23	49
India	0.20	50
Turkey	0.20	51
Botswana	0.20	52
Croatia	0.19	53
Chile	0.16	54
Kazakhstan	0.16	55
Bulgaria	0.15	56
Trinidad and Tobago	0.15	57
Jordan	0.10	58
El Salvador	0.10	59
Ukraine	0.05	60
Colombia	0.02	61
South Africa	0.01	62
Argentina	0.00	63
Uruguay	–0.02	64
China	–0.04	65
Jamaica	–0.04	66
Indonesia	–0.05	67
Macedonia, FYR	–0.09	68
Armenia	–0.10	69
Brazil	–0.15	70
Algeria	–0.16	71
Mexico	–0.16	72
Panama	–0.20	73
Serbia and Montenegro	–0.22	74
Venezuela	–0.23	75
Egypt	–0.26	76
Namibia	–0.28	77
Bosnia and Herzegovina	–0.31	78
Pakistan	–0.31	79
Mongolia	–0.34	80
Tajikistan	–0.35	81
Ghana	–0.37	82
Kyrgyz Republic	–0.37	83
Azerbaijan	–0.41	84
Vietnam	–0.42	85
Guyana	–0.46	86
Morocco	–0.51	87
Albania	–0.53	88
Peru	–0.56	89
Georgia	–0.60	90
Chad	–0.60	91
Ecuador	–0.60	92
Honduras	–0.62	93
Zimbabwe	–0.76	94
Guatemala	–0.81	95
Paraguay	–0.86	96
Moldova	–0.88	97
Cameroon	–0.90	98
Sri Lanka	–0.91	99
Philippines	–1.01	100
Gambia	–1.01	101
Bolivia	–1.10	102
Nigeria	–1.12	103
Dominican Republic	–1.12	104
Uganda	–1.14	105
Cambodia	–1.26	106
Kenya	–1.38	107
Mozambique	–1.60	108
Nicaragua	–1.77	109
Bangladesh	–1.94	110
Benin	–2.00	111
Tanzania	–2.22	112
Mali	–2.38	113
Ethiopia	–2.40	114
Madagascar	–2.52	115

(cont'd.)

Source: INSEAD.

Table 10: Business Readiness

Country	Score	Rank
United States	2.41	1
Switzerland	2.23	2
Germany	2.05	3
Finland	2.04	4
Denmark	2.04	5
Sweden	1.98	6
United Kingdom	1.93	7
Israel	1.83	8
Japan	1.79	9
France	1.72	10
Canada	1.72	11
Singapore	1.71	12
Netherlands	1.68	13
Belgium	1.63	14
Austria	1.60	15
Taiwan	1.46	16
Australia	1.38	17
Norway	1.35	18
Iceland	1.28	19
Korea, Rep.	1.25	20
New Zealand	1.20	21
Ireland	1.19	22
Hong Kong SAR	0.92	23
Malaysia	0.90	24
South Africa	0.86	25
Czech Republic	0.78	26
Spain	0.74	27
Slovenia	0.63	28
India	0.63	29
Estonia	0.56	30
Chile	0.40	31
Thailand	0.37	32
Costa Rica	0.34	33
Brazil	0.31	34
Luxembourg	0.29	35
Tunisia	0.28	36
Italy	0.27	37
Portugal	0.25	38
Poland	0.24	39
Slovak Republic	0.17	40
Hungary	0.13	41
Lithuania	0.11	42
Argentina	0.10	43
Turkey	0.08	44
Colombia	0.06	45
Greece	0.03	46
Latvia	0.01	47
China	0.00	48
Cyprus	–0.11	49
Mauritius	–0.13	50
Mexico	–0.16	51
Kenya	–0.21	52
Russian Federation	–0.21	53
Indonesia	–0.22	54
Ghana	–0.25	55
Jamaica	–0.28	56
United Arab Emirates	–0.29	57
Panama	–0.29	58
Kuwait	–0.30	59
Ukraine	–0.30	60
Trinidad and Tobago	–0.31	61
Kazakhstan	–0.32	62
Croatia	–0.35	63
Philippines	–0.35	64
El Salvador	–0.40	65
Romania	–0.41	66
Uruguay	–0.42	67
Botswana	–0.44	68
Azerbaijan	–0.44	69
Jordan	–0.44	70
Egypt	–0.44	71
Malta	–0.49	72
Pakistan	–0.51	73
Bulgaria	–0.52	74
Macedonia, FYR	–0.55	75
Zimbabwe	–0.55	76
Sri Lanka	–0.56	77
Peru	–0.56	78
Morocco	–0.58	79
Qatar	–0.60	80
Uganda	–0.61	81
Vietnam	–0.62	82
Venezuela	–0.63	83
Cameroon	–0.66	84
Serbia and Montenegro	–0.67	85
Namibia	–0.69	86
Nigeria	–0.70	87
Guatemala	–0.76	88
Armenia	–0.76	89
Bahrain	–0.83	90
Tanzania	–0.84	91
Dominican Republic	–0.86	92
Bosnia and Herzegovina	–0.88	93
Mongolia	–0.90	94
Algeria	–0.91	95
Moldova	–0.95	96
Honduras	–0.96	97
Bangladesh	–0.99	98
Ecuador	–0.99	99
Georgia	–1.01	100
Madagascar	–1.05	101
Gambia	–1.10	102
Tajikistan	–1.13	103
Nicaragua	–1.14	104
Cambodia	–1.17	105
Mozambique	–1.18	106
Bolivia	–1.20	107
Guyana	–1.21	108
Mali	–1.24	109
Benin	–1.27	110
Paraguay	–1.29	111
Kyrgyz Republic	–1.31	112
Ethiopia	–1.40	113
Albania	–1.46	114
Chad	–1.52	115

Source: INSEAD.

(cont'd.)

Table 11: Government Readiness

Country	Score	Rank
Singapore	2.55	1
United States	2.02	2
Denmark	1.94	3
Korea, Rep.	1.92	4
United Kingdom	1.86	5
Hong Kong SAR	1.86	6
Finland	1.76	7
Canada	1.63	8
Taiwan	1.48	9
Netherlands	1.27	10
Australia	1.11	11
Malaysia	1.08	12
Estonia	1.07	13
Germany	1.06	14
Israel	1.05	15
Chile	1.03	16
Japan	1.01	17
France	1.00	18
New Zealand	0.96	19
Sweden	0.96	20
Belgium	0.90	21
Austria	0.89	22
Ireland	0.83	23
Malta	0.82	24
Norway	0.78	25
Mexico	0.73	26
Thailand	0.62	27
India	0.59	28
Switzerland	0.53	29
Mauritius	0.49	30
Portugal	0.46	31
Iceland	0.45	32
Luxembourg	0.42	33
Tunisia	0.41	34
Hungary	0.33	35
United Arab Emirates	0.28	36
Colombia	0.27	37
South Africa	0.24	38
Philippines	0.22	39
China	0.19	40
Pakistan	0.18	41
Brazil	0.18	42
Jordan	0.11	43
Czech Republic	0.08	44
Slovenia	0.04	45
Romania	0.01	46
Turkey	0.01	47
Italy	–0.02	48
Slovak Republic	–0.04	49
Spain	–0.08	50
Botswana	–0.10	51
Bulgaria	–0.12	52
Qatar	–0.13	53
Ukraine	–0.13	54
Indonesia	–0.14	55
Kazakhstan	–0.14	56
Uganda	–0.14	57
Ghana	–0.18	58
Lithuania	–0.18	59
Mali	–0.19	60
Poland	–0.21	61
Tanzania	–0.21	62
Jamaica	–0.21	63
Egypt	–0.22	64
Croatia	–0.24	65
Greece	–0.25	66
Panama	–0.26	67
Vietnam	–0.27	68
El Salvador	–0.27	69
Venezuela	–0.27	70
Bahrain	–0.37	71
Russian Federation	–0.37	72
Mongolia	–0.44	73
Argentina	–0.44	74
Azerbaijan	–0.46	75
Latvia	–0.48	76
Cyprus	–0.49	77
Dominican Republic	–0.49	78
Benin	–0.51	79
Trinidad and Tobago	–0.51	80
Armenia	–0.51	81
Serbia and Montenegro	–0.55	82
Madagascar	–0.55	83
Gambia	–0.59	84
Algeria	–0.59	85
Nigeria	–0.60	86
Kyrgyz Republic	–0.60	87
Morocco	–0.64	88
Peru	–0.65	89
Uruguay	–0.65	90
Sri Lanka	–0.66	91
Kenya	–0.70	92
Tajikistan	–0.71	93
Cambodia	–0.73	94
Cameroon	–0.74	95
Kuwait	–0.76	96
Mozambique	–0.77	97
Honduras	–0.84	98
Moldova	–0.86	99
Namibia	–0.87	100
Macedonia, FYR	–0.88	101
Bosnia and Herzegovina	–0.92	102
Nicaragua	–0.93	103
Bangladesh	–0.93	104
Costa Rica	–1.02	105
Guatemala	–1.05	106
Guyana	–1.10	107
Ethiopia	–1.16	108
Albania	–1.21	109
Georgia	–1.22	110
Bolivia	–1.24	111
Zimbabwe	–1.36	112
Chad	–1.51	113
Ecuador	–1.53	114
Paraguay	–1.69	115

Source: INSEAD.

(cont'd.)

Government Readiness

Government Readiness measures the degree to which governments are in a position to employ ICT. It is reflected in the policy-making 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 in laws that encourage ICT deployment and use. It is also reflected in the government's own use of ICT, and the extent to which it equips its people to do the same. Singapore leads on Government Readiness, followed by the United States and Denmark. Korea and the United Kingdom, ranked 4th and 5th, respectively. Note also the positions of Malaysia (12th) and Chile (16th).

Usage

The Usage component aims to measure the degree of ICT usage by the principal stakeholders of the NRI framework, namely, individuals, businesses, and governments. In the absence of reliable data about the specific impact of ICT on the key stakeholders, the Usage component provides an indication of the potential gains in efficiency and productivity associated with the adoption of ICT.

Denmark, Singapore, and Sweden are the top three performers with regards to overall usage, as was seen in Table 5. One can observe variations in country performance over the three sub-indexes, reflecting uneven impact across the three principal stakeholders. For example, Singapore ranks high for Government Usage (1st) but relatively low for Individual Usage (14th) and Business Usage (10th). Another notable example is Estonia, with higher Government Usage (3rd) as compared to Individual (27th) and Business Usage (26th).

Tables 12, 13, and 14 give the detailed results and scores for each of the three sub-indexes used for measuring Usage.

Individual Usage

Individual Usage indicates the level of adoption and usage of ICT technologies by a nation's citizens. This is done by assessing the deployment of connectivity-enhancing technologies, such as telephones and Internet connections, levels of Internet usage, and money spent online. The Individual Usage rankings differ significantly from those of Individual Readiness. The top performers here are Sweden, Denmark, Switzerland, Netherlands, and Korea.

Business Usage

Business Usage measures the level of deployment and use of ICT across 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, levels of online

Table 12: Individual Usage

Country	Score	Rank
Sweden	2.34	1
Denmark	2.32	2
Switzerland	2.14	3
Netherlands	2.06	4
Korea, Rep.	2.03	5
Hong Kong SAR	1.93	6
Iceland	1.84	7
Canada	1.80	8
Taiwan	1.80	9
Norway	1.74	10
United Kingdom	1.69	11
United States	1.67	12
Luxembourg	1.66	13
Singapore	1.62	14
Finland	1.47	15
Belgium	1.44	16
Austria	1.43	17
Germany	1.34	18
Japan	1.30	19
Australia	1.22	20
France	1.17	21
Israel	1.10	22
Malta	1.00	23
Italy	0.98	24
Ireland	0.97	25
New Zealand	0.92	26
Estonia	0.89	27
Cyprus	0.77	28
Slovenia	0.75	29
Portugal	0.75	30
Spain	0.67	31
Czech Republic	0.61	32
Greece	0.49	33
Hungary	0.37	34
Croatia	0.29	35
Slovak Republic	0.24	36
United Arab Emirates	0.20	37
Latvia	0.19	38
Bahrain	0.16	39
Chile	0.15	40
Lithuania	0.14	41
Kuwait	0.14	42
Poland	0.12	43
Malaysia	0.10	44
Qatar	0.03	45
Jamaica	–0.01	46
Trinidad and Tobago	–0.14	47
Mauritius	–0.14	48
Bulgaria	–0.15	49
Turkey	–0.15	50
Mexico	–0.18	51
Brazil	–0.19	52
Russian Federation	–0.19	53
Romania	–0.20	54
Serbia and Montenegro	–0.20	55
Costa Rica	–0.24	56
Uruguay	–0.28	57
Bosnia and Herzegovina	–0.29	58
Thailand	–0.32	59
Macedonia, FYR	–0.33	60
South Africa	–0.34	61
Ukraine	–0.34	62
China	–0.46	63
Argentina	–0.47	64
Venezuela	–0.47	65
Panama	–0.53	66
Colombia	–0.54	67
Jordan	–0.55	68
Albania	–0.56	69
Dominican Republic	–0.57	70
Ecuador	–0.57	71
Tunisia	–0.58	72
Moldova	–0.58	73
Morocco	–0.62	74
Egypt	–0.63	75
El Salvador	–0.63	76
Kazakhstan	–0.64	77
Georgia	–0.64	78
Armenia	–0.64	79
Philippines	–0.66	80
Peru	–0.71	81
Indonesia	–0.72	82
Azerbaijan	–0.74	83
Algeria	–0.75	84
Guyana	–0.78	85
Paraguay	–0.78	86
Bolivia	–0.80	87
Botswana	–0.80	88
Guatemala	–0.81	89
Namibia	–0.82	90
Vietnam	–0.83	91
Mongolia	–0.86	92
Kyrgyz Republic	–0.86	93
Honduras	–0.90	94
Nicaragua	–0.92	95
Sri Lanka	–0.96	96
Zimbabwe	–0.97	97
Tajikistan	–0.97	98
Cambodia	–1.03	99
Ghana	–1.03	100
Gambia	–1.04	101
Cameroon	–1.06	102
Bangladesh	–1.08	103
Kenya	–1.08	104
Benin	–1.09	105
Uganda	–1.09	106
Tanzania	–1.11	107
Mali	–1.12	108
Pakistan	–1.12	109
Mozambique	–1.14	110
Madagascar	–1.14	111
Chad	–1.17	112
Ethiopia	–1.17	113
India	–1.19	114
Nigeria	–1.37	115

(cont'd.)

Source: INSEAD.

Table 13: Business Usage

Country	Score	Rank
United States	1.90	1
Japan	1.86	2
Israel	1.70	3
Germany	1.68	4
Denmark	1.66	5
Finland	1.64	6
Iceland	1.57	7
Sweden	1.56	8
Taiwan	1.52	9
Singapore	1.51	10
United Kingdom	1.50	11
Switzerland	1.47	12
Austria	1.34	13
Korea, Rep.	1.34	14
Netherlands	1.33	15
Canada	1.32	16
France	1.30	17
Hong Kong SAR	1.27	18
Norway	1.26	19
Belgium	1.16	20
New Zealand	1.16	21
Australia	1.15	22
Ireland	0.99	23
Malaysia	0.98	24
Czech Republic	0.97	25
Estonia	0.91	26
India	0.86	27
Portugal	0.79	28
Chile	0.75	29
Luxembourg	0.74	30
Spain	0.71	31
United Arab Emirates	0.68	32
Hungary	0.67	33
Slovenia	0.61	34
Brazil	0.60	35
South Africa	0.60	36
Thailand	0.50	37
Slovak Republic	0.49	38
Turkey	0.46	39
Lithuania	0.38	40
Cyprus	0.32	41
Jordan	0.32	42
El Salvador	0.30	43
Tunisia	0.30	44
Philippines	0.25	45
Italy	0.24	46
Kuwait	0.21	47
Mauritius	0.20	48
Malta	0.18	49
Latvia	0.13	50
Greece	0.12	51
Bahrain	0.08	52
Panama	0.06	53
Jamaica	0.02	54
Argentina	0.02	55
Egypt	0.00	56
Poland	–0.02	57
Mexico	–0.04	58
China	–0.04	59
Croatia	–0.08	60
Dominican Republic	–0.09	61
Qatar	–0.11	62
Peru	–0.13	63
Pakistan	–0.18	64
Venezuela	–0.18	65
Colombia	–0.20	66
Indonesia	–0.23	67
Uruguay	–0.25	68
Morocco	–0.29	69
Azerbaijan	–0.29	70
Namibia	–0.30	71
Kazakhstan	–0.37	72
Sri Lanka	–0.37	73
Vietnam	–0.39	74
Romania	–0.39	75
Guatemala	–0.47	76
Ghana	–0.49	77
Russian Federation	–0.49	78
Kenya	–0.55	79
Botswana	–0.57	80
Bulgaria	–0.64	81
Georgia	–0.67	82
Tanzania	–0.70	83
Uganda	–0.70	84
Trinidad and Tobago	–0.74	85
Ukraine	–0.78	86
Nigeria	–0.86	87
Mozambique	–0.88	88
Macedonia, FYR	–0.94	89
Mongolia	–0.99	90
Moldova	–0.99	91
Gambia	–1.02	92
Costa Rica	–1.03	93
Madagascar	–1.04	94
Mali	–1.05	95
Ecuador	–1.09	96
Algeria	–1.11	97
Serbia and Montenegro	–1.12	98
Honduras	–1.12	99
Bolivia	–1.14	100
Nicaragua	–1.14	101
Bangladesh	–1.16	102
Bosnia and Herzegovina	–1.16	103
Cambodia	–1.21	104
Cameroon	–1.26	105
Tajikistan	–1.30	106
Zimbabwe	–1.33	107
Paraguay	–1.47	108
Armenia	–1.48	109
Albania	–1.49	110
Benin	–1.76	111
Guyana	–1.76	112
Kyrgyz Republic	–1.78	113
Chad	–2.04	114
Ethiopia	–2.17	115

Source: INSEAD.

(cont'd.)

Table 14: Government Usage

Country	Score	Rank
Singapore	2.54	1
Denmark	1.96	2
Estonia	1.93	3
Taiwan	1.90	4
Iceland	1.86	5
Korea, Rep.	1.82	6
Malaysia	1.78	7
Finland	1.73	8
United States	1.65	9
Hong Kong SAR	1.59	10
United Arab Emirates	1.57	11
Malta	1.52	12
Ireland	1.44	13
Sweden	1.41	14
Canada	1.24	15
Chile	1.22	16
Australia	1.16	17
Israel	1.12	18
France	1.09	19
Norway	1.06	20
Tunisia	1.03	21
Austria	1.00	22
Portugal	0.99	23
Thailand	0.96	24
Qatar	0.90	25
United Kingdom	0.85	26
New Zealand	0.85	27
Netherlands	0.85	28
Switzerland	0.82	29
China	0.69	30
Japan	0.67	31
India	0.61	32
Brazil	0.58	33
Mali	0.53	34
Pakistan	0.52	35
South Africa	0.49	36
Germany	0.44	37
Spain	0.32	38
Jordan	0.32	39
Mauritius	0.32	40
Jamaica	0.22	41
Belgium	0.21	42
Kazakhstan	0.15	43
Turkey	0.12	44
Romania	0.11	45
Slovenia	0.08	46
Vietnam	0.06	47
Hungary	0.04	48
Slovak Republic	0.04	49
Lithuania	0.04	50
Mexico	0.03	51
Uganda	0.01	52
Azerbaijan	0.00	53
Ghana	–0.03	54
Egypt	–0.04	55
El Salvador	–0.05	56
Botswana	–0.07	57
Gambia	–0.08	58
Cyprus	–0.09	59
Czech Republic	–0.10	60
Morocco	–0.13	61
Bahrain	–0.13	62
Tanzania	–0.14	63
Benin	–0.14	64
Bulgaria	–0.18	65
Italy	–0.20	66
Madagascar	–0.25	67
Philippines	–0.26	68
Greece	–0.34	69
Latvia	–0.36	70
Moldova	–0.36	71
Tajikistan	–0.39	72
Luxembourg	–0.42	73
Algeria	–0.42	74
Mozambique	–0.44	75
Uruguay	–0.46	76
Kuwait	–0.48	77
Panama	–0.57	78
Cameroon	–0.57	79
Colombia	–0.59	80
Mongolia	–0.60	81
Costa Rica	–0.61	82
Croatia	–0.61	83
Nigeria	–0.67	84
Argentina	–0.78	85
Indonesia	–0.79	86
Kenya	–0.79	87
Serbia and Montenegro	–0.80	88
Armenia	–0.84	89
Poland	–0.84	90
Russian Federation	–0.89	91
Namibia	–0.90	92
Peru	–0.97	93
Sri Lanka	–0.97	94
Ukraine	–1.00	95
Macedonia, FYR	–1.07	96
Ethiopia	–1.08	97
Guatemala	–1.09	98
Honduras	–1.16	99
Georgia	–1.20	100
Cambodia	–1.21	101
Dominican Republic	–1.22	102
Kyrgyz Republic	–1.24	103
Trinidad and Tobago	–1.26	104
Nicaragua	–1.29	105
Bosnia and Herzegovina	–1.29	106
Bolivia	–1.33	107
Chad	–1.36	108
Venezuela	–1.38	109
Albania	–1.44	110
Bangladesh	–1.47	111
Guyana	–1.54	112
Ecuador	–1.63	113
Zimbabwe	–1.74	114
Paraguay	–2.09	115

Source: INSEAD.

(cont'd.)

transactions, and the availability and usage of new telephone lines and mobile phones by businesses. The top five performers are the United States, Japan, Israel, Germany and Denmark.

Government Usage

This sub-index measures the level of use of ICT by the government of a given country in its efforts to streamline services for its citizens and improve its overall functioning. Factors used to measure this include the government's level of success in promoting ICT, and the availability and usage of online government services. The top ranking countries on this measure are Singapore, Denmark, Estonia, Taiwan, and Iceland. Of particular note are Malaysia (7th) and the United Arab Emirates (11th), reflecting the efforts these governments are taking to actively promote ICT usage in their own functions.

Global trends in the diffusion of ICT

Internet users exceed the number of PCs in the year 2003

In tracing key trends in the evolution of the diffusion of ICT, we examined three key indicators: the number of Internet users in a region or a country, the number of personal computers, and the number of main telephone lines.

As seen in Table 15—consistent with the trends noted by Paua (2004)—the number of Internet users in 2003 exceeds the number of personal computers on a global level, as compared to 1999, when the situation was reversed. Whereas the global number of personal computers grew in the years 1999 to 2003 by 51 percent, the number of persons accessing the Internet grew three times during the same period. In comparison, the number of telephone main lines rose by only 27 percent.

The question that naturally arises is where this growth is coming from. Is it distributed evenly across countries and regions, or uniformly across the three key indicators selected?

Table 15: Increase in global ICT diffusion, 1999–2003*

	1999	2003	1999–2003 increase	
	(millions)	(millions)	(millions)	(percent)
Population, total	5,978	6,274	296	5
Internet users	351	940	589	168
Personal computers	413	625	212	51
Telephone mainlines	907	1,148	242	27
	Percent of total population		Ratio to population	
	1999	2003	1999	2003
Internet users	6	15	1 in 17	1 in 7
Personal computers	7	10	1 in 14	1 in 10
Telephone mainlines	15	18	1 in 7	1 in 5

* or latest available data

Source: Authors' calculations based on data from the World Development Indicators database of the World Bank, accessed October 2005.

ICT Diffusion and national income

Explosive global growth of the Internet and personal computers

Table 16 shows the evolution of the number of Internet users, personal computers, and telephone mainlines across countries with different levels of national income.[3] As expected, growth in the number of telephone mainlines is very low in the upper-middle-income to high-income countries, which are characterized by very high penetration rates, and in which mobile telephone use is quickly overtaking traditional telephony. In fact, in high-income countries, the growth of telephone mainline penetration stagnated. In contrast, low-income and lower-middle-income countries have benefited from a strong increase in the number of telephone mainlines (98 percent for lower-middle-income and 87 percent for low-income). Given that the percentage of the population accessing telephone mainlines for these groups is between one third and one half of that of the higher income groups, the growth in the number of telephone mainlines in these countries is evidence of convergence across nations in the use of traditional telephony.

With respect to personal computer penetration, we see that, as with telephones, there is a large gap in the percentage of total populations with access to PCs. Although the growth rates in the lower income countries are higher than those in the richer countries—increasing their penetration of PCs from 5 percent in 1999 to 9 percent in 2003, an increase of 68 percent—it will take several years to narrow the divide.

Finally, with respect to the number of Internet users, trends similar to those found with personal computers are observed. However, the level of Internet growth is now much higher in comparison to the already high growth rates for personal computers. In the low-income countries, for instance, the growth of Internet users over the 1999–2003 period has been 1,043 percent.

As shown in Figures 2 and 3, taken together, the analysis reveals that significant convergence is occurring among the wealthy and lower-income nations, with respect to the number of telephone mainlines, with substantially less convergence for personal computers. Finally, and perhaps due to a policy focussed on enhancing connectivity, the level of Internet usage in the less wealthy nations has shot up. However, significant progress still remains to be made, since the usage rates of less affluent countries remains about one third those of the high income countries.

Table 16: The divide in ICT diffusion according to income level, 1999–2003*

Internet users	1999	2003	1999–2003 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2003
High-income	177	365	187	106	28	52
Upper-middle-income	23	120	96	417	12	68
Lower-middle-income	23	150	127	556	4	20
Low-income	3	37	34	1,043	2	21
World	227	671	445	196	14	37

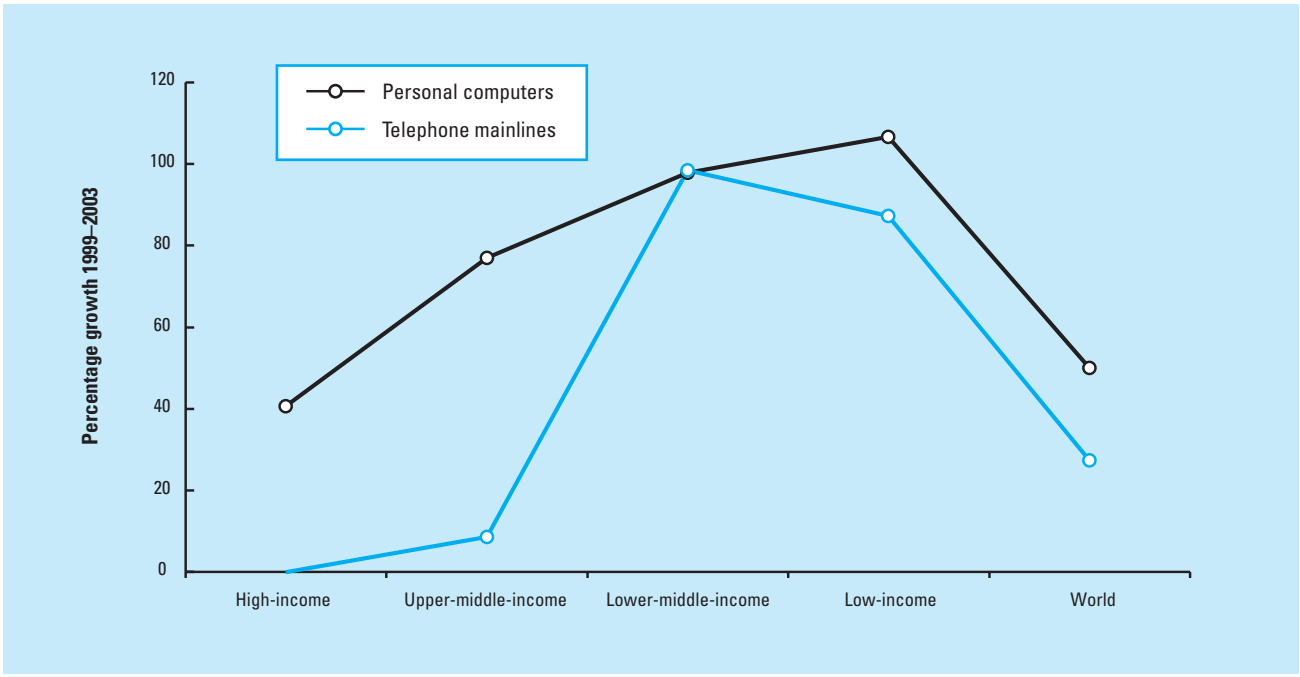
Personal computers	1999	2003	1999–2003 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2003
High-income	325	457	132	41	51	65
Upper-middle-income	28	50	22	77	15	28
Lower-middle-income	38	75	37	98	6	10
Low-income	8	16	8	107	5	9
World	399	598	199	50	25	33

Telephone mainlines	1999	2003	1999–2003 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2003
High-income	548	547	–1	0	86	78
Upper-middle-income	111	121	9	8	60	68
Lower-middle-income	208	412	204	98	35	54
Low-income	40	74	35	87	27	41
World	906	1,154	248	27	58	63

* or latest available data

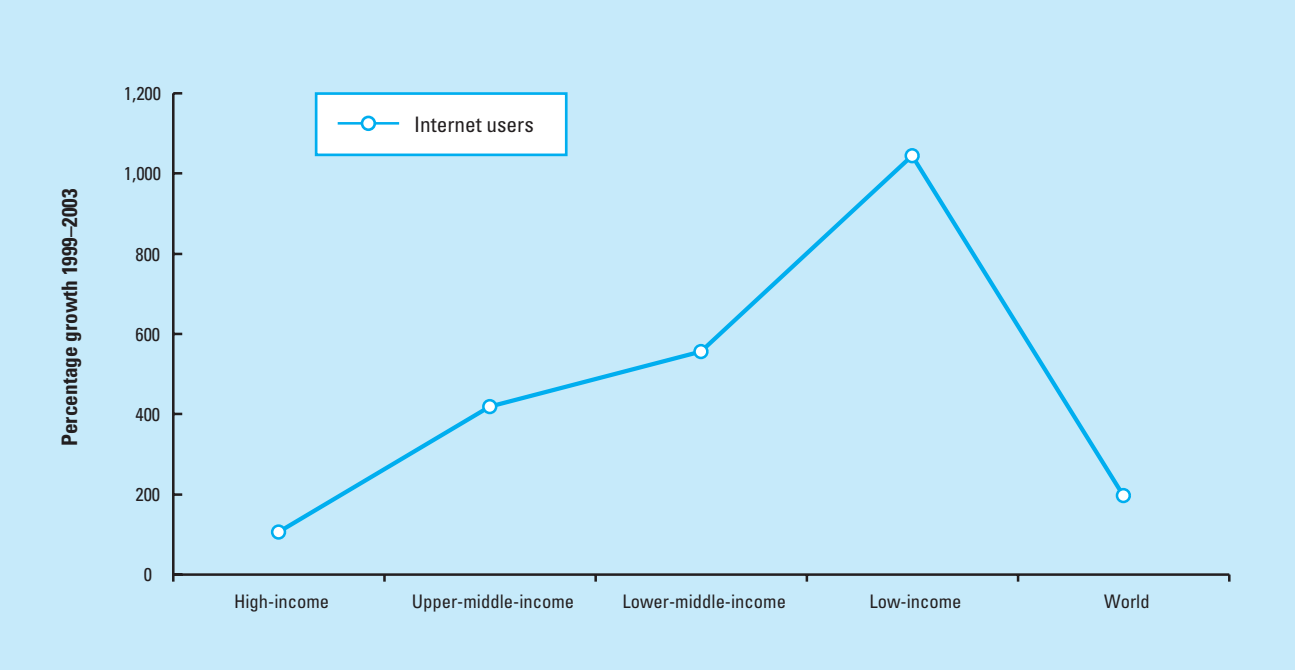
Source: Authors' calculations, based on data from World Bank, 2005, accessed October, 2005.

Figure 2: Growth in personal computers and telephone mainlines across countries with differing national incomes



Source: Authors' calculations, based on data from World Bank, 2005. Accessed October, 2005.

Figure 3: Growth in Internet users across countries with differing national incomes



Source: Authors' calculations, based on data from World Bank, 2005, accessed October, 2005.

Penetration rates in populous countries

Sharp increases in the rates of Internet penetration, but more modest increases in hardware

Table 17 presents data on the evolution of the telephone, PC and Internet penetration among the seven most populous countries, all of which, with the exception of the United States, fall in the category of relatively less affluent nations. The most dramatic improvements have taken place in China, where growth of telephone mainlines has been substantial, representing an increase of 162 million, servicing of 12.6 percent of the population, as compared to India, which has achieved an increase of only 23 million, servicing 2.1 percent of the population. This disparity is also reflected in the Infrastructure Environment index, on which China is ranked 68th, as compared to the 98th rank for India. The United States has also made important progress in enhancing penetration along these indicators, most notably in PC penetration. In comparison with other countries in the sample, notable improvements in penetration rates have been achieved in India and Brazil.

It is interesting to note that in the period 1999 to 2003, China witnessed an increase of 73 million Internet users, as compared to the United States, with its increase of 57 million. This represents a net difference of 16 million Internet users, despite the fact that the United States experienced an increase of 48 million personal computers, as compared with China's increase of 20 million, over the same period. Similar inferences can be drawn for other countries.

Evidence from Table 17 again points to a reduction in the digital divide. However, progress is uneven. Whereas in China, India, and Brazil, the reduction in the divide is significant, in other countries such as Pakistan and Russia, progress is relatively slow.

Table 17: Increase in ICT diffusion in the seven most populous countries, 1999–2003* (millions)

		Increases, 1999-2003*		
2003 population	Country	Internet users	Personal computers	Telephone mainlines
1,288	China	73	20	162
1,064	India	16	4	23
291	United States	57	48	–4
215	Indonesia	7	1	2
177	Brazil	11	7	14
148	Pakistan	1	0	1
143	Russian Federation	1	7	4

* or latest available data.

Source: Authors' calculations, based on data from World Bank, 2005, accessed October, 2005.

Table 18: Evolution of regional networked readiness scores* from 2001 to 2005

Year	Sub-Saharan Africa	Asia and the Pacific	South Asia	West Europe	Central Europe and Asia	Latin America	Middle East	North America	Global
2001	–1.51	–0.73	–0.82	0.94	–0.64	–0.47	–0.70	1.93	–0.41
2002	–1.08	–0.26	–0.27	1.00	–0.71	–0.29	–0.67	1.76	–0.10
2003	–0.90	–0.40	–0.48	0.88	–0.67	–0.49	–0.59	2.03	–0.20
2004	–0.80	0.03	–0.16	0.80	–0.58	–0.60	–0.35	1.61	0.00
2005	–0.52	0.07	0.07	0.97	–0.22	–0.28	–0.14	1.97	–0.31

* For this table, weighted average networked readiness was computed on a regional basis.

Source: INSEAD.

Table 19: Evolution of country networked readiness (standardized) from 2001 to 2005, summed over global regions

NRI Score evolution of a country from 2001 to 2005*	Sub-Saharan Africa	Asia and the Pacific	South Asia	West Europe	Central Europe and Asia	Latin America	Middle East	North America	Total
Increase	3	11	2	5	7	5	2	1	36
Decrease	1	2	1	12	6	15	1	1	39
Total number of countries	**4**	**13**	**3**	**17**	**13**	**20**	**3**	**2**	**75**

*The evolution of a country's score is termed an increase, if the country's 2005 NRI score is greater than its 2001 NRI score. Similarly, a country's score is termed a decrease, if its 2005 NRI score is lower than its 2001 NRI score. Thus for Latin America, five countries have increased their NRI scores over the 2001–2005 period, whereas 15 countries have a decrease in their standardized NRI score. The category "Total" is the number of countries considered in the analysis on a regional basis.

Source: INSEAD.

Regional Trends

Since the NRI covers a five-year period, it deals with the evolution of regions over time and answers such key questions as a) which regions are performing well, b) which regions are underperforming, and c) whether there is digital convergence or divergence over time.

In order to conduct this analysis, the data of the previous four NRI computations, and the current fifth index are used.[4] Table 18 presents a first glimpse at the evolution of regions taking the data for the period 2001 to 2005 and making comparisons across different geographic areas. The table considers only the 75 countries that are common to each of the index computations from 2001 to 2005.

Countries were divided into different regions based on the World Bank's classification.[5] Weighted average NRI scores[6] are presented for each region from 2001 to 2005, giving an indication of the trends in the degree of networked readiness among the regions. It can be seen that there is a broad trend for the average NRI scores to increase in Africa, Asia and the Pacific, South Asia, Central Europe and Asia, and the Middle East. NRI scores for North America and Western Europe are fairly stable, whereas those for Latin America show a mixed trend of alternating increase (in years 2002 and 2005) and decline (in years 2003 and 2004).

The trend of the Latin American score is particularly worrisome, given that many Latin American countries are not wealthy, and the penetration rates of key technologies have been decreasing. Thus what is happening in Latin American is confounding expectations, and indicates a decrease in ICT competitiveness relative to other regions.

For each of the 75 countries, it was determined whether the standardized NRI score decreased or increased in 2005, as compared to the score of 2001. On this basis, countries in each region were divided into one of two categories (Table 19).

The trends observed as a result of this analysis are similar to those for the regional evolution of NRI scores. In sub-Saharan Africa, three out of four countries demonstrate an increase in the NRI score. In Asia and the Pacific, 11 of 13 countries evolve positively. Similar observations may be made for South Asia and the Middle East. For Central Europe and Asia, and North America, which were previously identified to have a neutral evolution of the NRI score over the five reports, the countries that increase and decrease their NRI score are evenly divided, as was expected. Finally, for Western Europe and Latin America, the number of countries that show a decrease in their NRI score is substantially larger than the number of countries that show an improved score. These results indicate the robustness of the previous results on regional trends.

Table 20: Geographic perspective of divide in ICT diffusion, 1999–2003*

Internet users	1999	2003	1999–2003 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2003
Asia and the Pacific	25	126	101	403	1	7
North America	114	175	61	54	37	55
Europe and Central Asia	11	76	65	567	2	16
West Europe	53	116	63	120	17	38
Latin America	13	57	44	349	3	11
Middle East	3	13	10	350	1	5
South Asia	4	14	10	257	0	1
Sub-Saharan Africa	3	14	11	338	1	2
World	**226**	**592**	**366**	**162**	**4**	**10**

Personal computers	1999	2002	1999–2002 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2002
Asia and the Pacific	23	48	25	106	1	3
North America	153	205	52	34	49	64
Europe and Central Asia	18	34	16	86	4	7
West Europe	69	97	28	41	23	32
Latin America	20	35	16	79	4	7
Middle East	6	9	3	44	2	3
South Asia	4	10	6	146	0	1
Sub-Saharan Africa	6	8	2	43	1	1
World	**299**	**447**	**148**	**49**	**5**	**8**

Telephone mainlines	1999	2003	1999–2003 increase		Percent of total population	
	(millions)	(millions)	(millions)	(percent)	1999	2003
Asia and the Pacific	129	299	170	132	7	16
North America	205	200	–4	–2	66	63
Europe and Central Asia	102	107	6	6	21	23
West Europe	159	167	8	5	52	54
Latin America	66	91	25	38	13	17
Middle East	22	39	17	76	8	13
South Asia	31	56	25	82	2	4
Sub-Saharan Africa	9	8	–1	–14	1	1
World	**721**	**966**	**245**	**34**	**13**	**16**

* or latest available data.

Source: Authors' calculations, based on data from World Bank, 2005, accessed October, 2005.

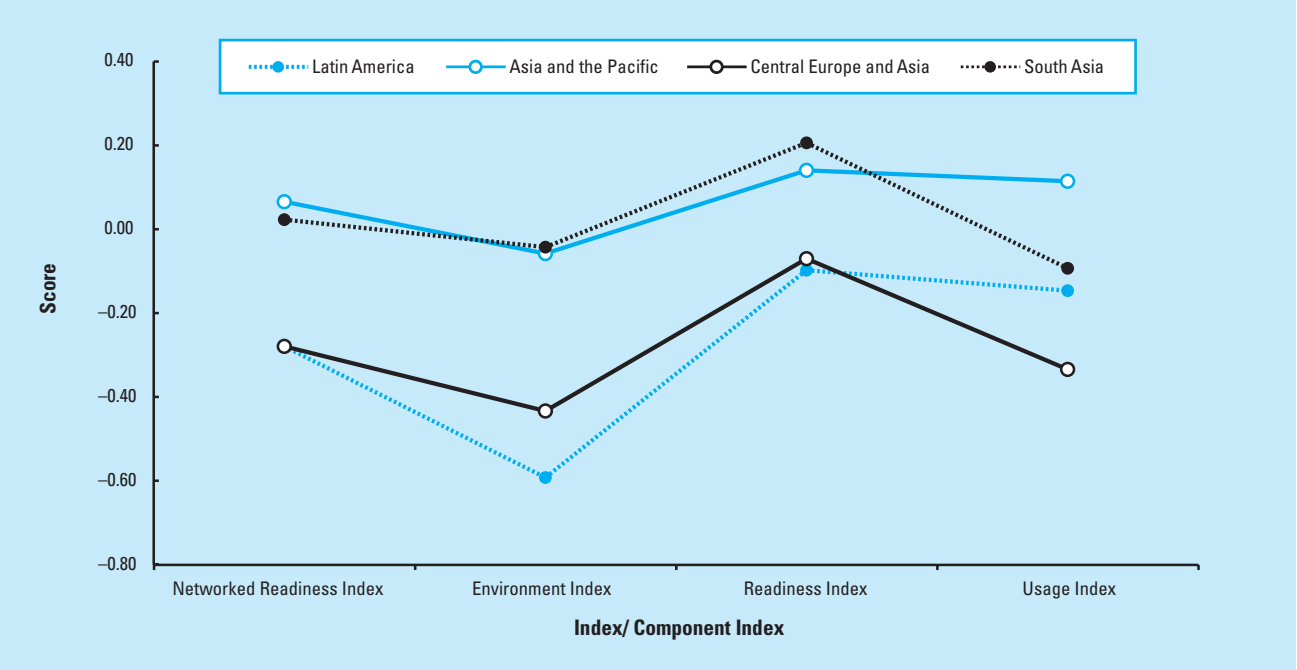
Additional regional trends

Convergence due to immense efforts in the development of ICT infrastructure

Table 20 presents a snapshot of the evolution of the global situation, disaggregated into the eight principle regions of the world across three key indicators: Internet Users, Personal Computers, and Telephone Mainlines. Of all the regions, North America has the highest penetration of telephone mainlines in 2003 (63 percent), closely followed by Western Europe (54 percent). All the other global regions have less than one third of the mainline penetration rates of North America, further evidence of a significant divide. However, this divide is being bridged on a regional basis, as, with the exception of sub-Saharan Africa and Central Europe and some parts of Asia, the less developed regions have increased their penetration of telephone mainlines substantially. For instance, the growth ranges from 132 percent in Asia and the Pacific to 38 percent in Latin America. All in all, on a global basis, penetration of mainlines increased by 34 percent on a five year basis. Moreover, it is of interest to note that whereas the number of telephone mainlines in North America was 205 million in 1999—1.6 times that of Asia and the Pacific—by the end of the five year period, Asia and the Pacific exceeded North America in the number of mainlines by 100 million!

Whereas there is rapid convergence with regard to infrastructure, the level of penetration of personal computers shows much lower convergence. It is true that regions with lower penetration of personal computers have shown higher growth rates relative to North America and West Europe (a growth rate of 106 percent for Asia and the Pacific as compared with 146 percent for South Asia). Thus, the former still remain the main markets for vendors of personal computers, representing over 75 percent of the

Figure 4: Regional Networked Readiness



Source: INSEAD.

global hardware market. However, it is interesting to note that there is higher convergence in the number of Internet users, with North America and Western Europe representing 74 percent of Internet users in 1999, as compared with only 49 percent in 2003, a result in agreement with the findings of the previous sections.

Benchmarking nations using networked readiness

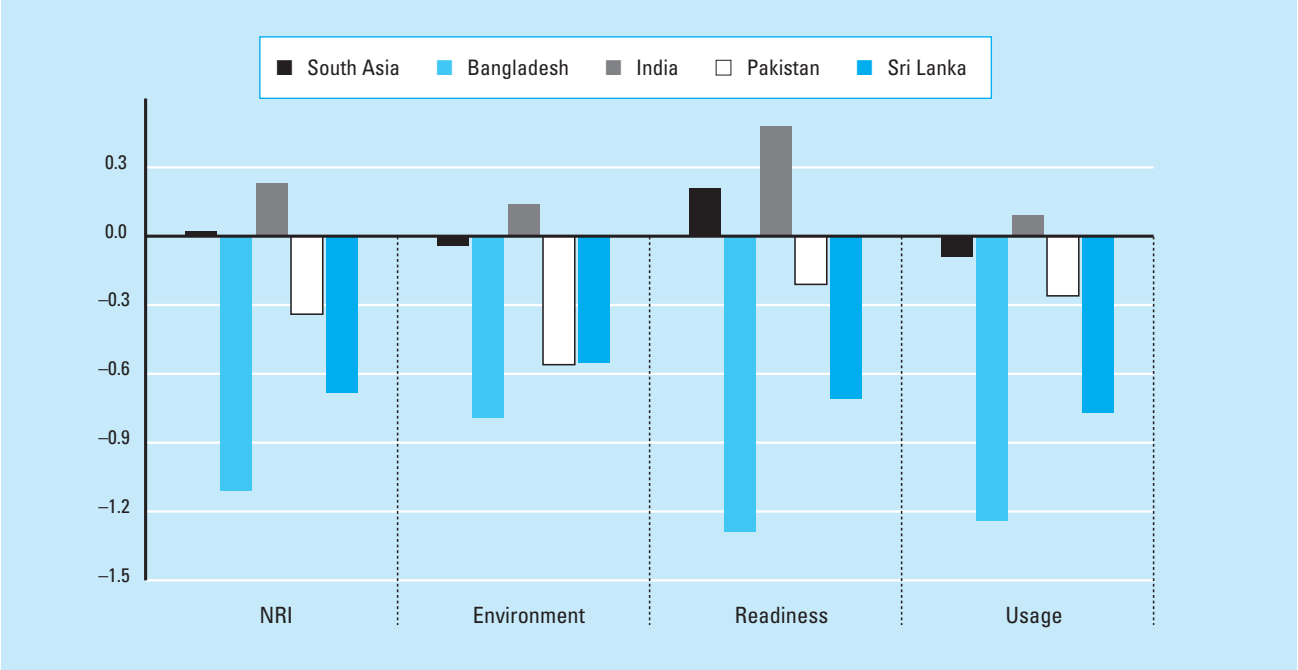
Countries and regions can be compared with respect to their raw data and the computed NRI scores. Figure 4 presents a plot of four of the eight global regions: Latin America, Asia Pacific, Central Europe, and South Asia, on the basis of their scores on the NRI and the three component indexes. One observes that, of the four regions, Latin America, Central Europe, and Asia have the lowest scores, and that Asia Pacific and South Asia perform better. These results are consistent across all four indicators plotted. The Technical Appendix presents the complete set of data for use in benchmarking: networked readiness indexes and sub-indexes, as well as the 66 variables used in the index computation.

South Asia turns out to be the region with the best performance among the four under consideration in Figure 4, with respect to the level of ICT development. This would indicate that further analysis may be required in order to understand the factors underlying the regional performance scores. Figure 5 shows the first step in how this was undertaken, and plots the NRI scores of the four countries in the South Asia region. The weighted average regional NRI score is 0.02, and the component index scores are –0.04 for the environment, 0.21 for readiness, and –0.09 for usage, scores hovering around the global mean scores of zero. It is observed that of the four countries present in the region, India consistently outperforms not only the region but also the global means scores. India has positive scores across all four indexes. In contrast, Bangladesh has the lowest NRI scores of all south Asian countries, and lies more than one standard deviation below the mean. The scores of Bangladesh and Sri Lanka bring down the regional average, whereas those of India and Pakistan raise it.

Given the high performance of India on all the four dimensions of networked readiness, it is of interest to compare it to other countries following similar paths of development. In order to do this, the NRI and component sub-index scores for the Brazil, Russia, India, and China were plotted, as shown in Figure 6. All four of these countries have large populations and are undergoing rapid economic development. It is clear that these four countries have significantly different performances across the four indicators. Once again, India performs well in this group, and has networked readiness scores which, on most dimensions, outstrip those of the other countries.

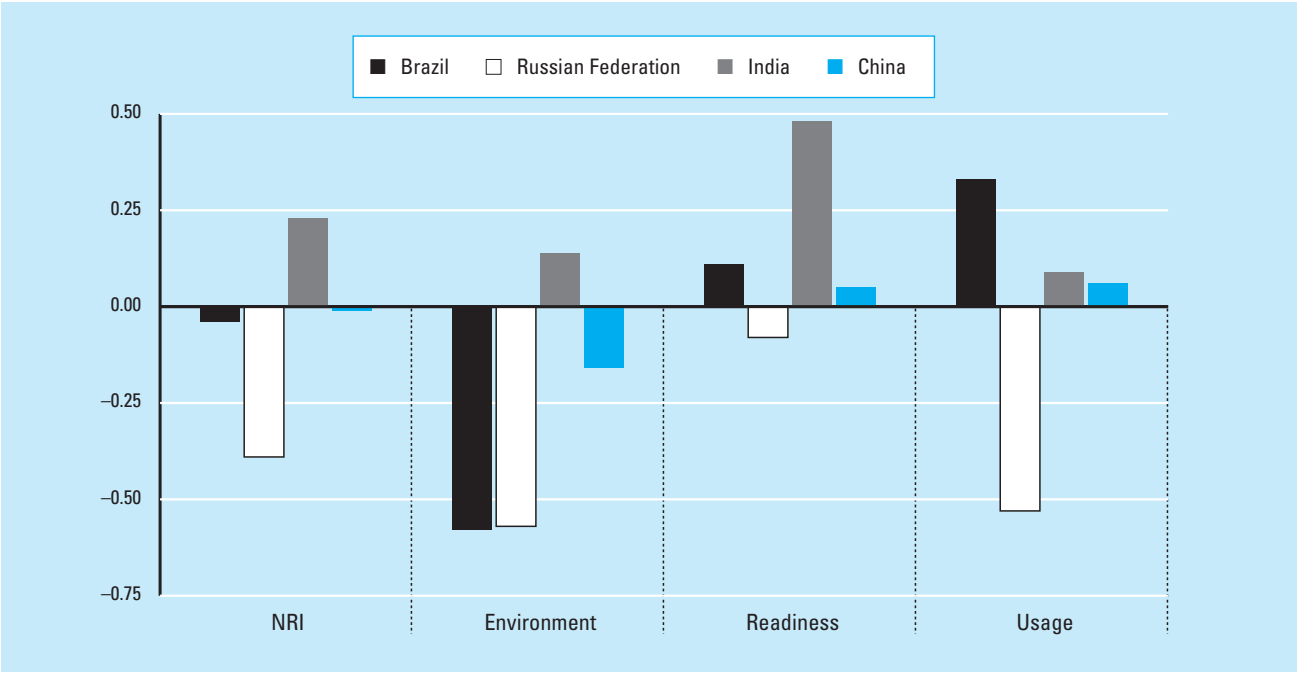
It is also of interest to note that Brazil does very well on the readiness and usage dimensions, as compared to

Figure 5: Benchmarking Networked Readiness in South Asia



Source: INSEAD.

Figure 6: Benchmarking Networked Readiness in four countries: Brazil, Russia, India, and China



Source: INSEAD.

other countries in the group. What holds Brazil back is its performance in the environment dimension, suggesting that while the national stakeholders are actively using the technology, other factors such as the market, the political and regulatory environment, and the quality of the infrastructure act as constraints. Further analysis of these implications would be of interest.

Finally, similar benchmarking analysis can be done at the level of variables or indicators, in order to delve deeper into the basis of a nations' networked readiness. For instance, Brazil could be compared with another country, such as India, which has a higher performance on the Environment sub-index.

Research challenges: Finding the facts

Even the most cleverly-conceived framework will be inadequate, if accurate and reliable data are missing. The goal of our research and analysis has been to provide a scientific and credible interpretation of reality. Thus, an important step in our research has been to collect a complete and high quality set of data relating to ICT.

As mentioned earlier, two types of data were used in this research: subjective survey data, gathered through the World Economic Forum's Survey, and hard data, derived from statistics collected by international multilateral agencies, such as the World Bank and the International Telecommunications Union (ITU). Both these sets of data play a crucial role in the overall analysis. The Survey data is critical in determining the opinions of the decision makers and business leaders, who are intimately familiar with a nation's economy and ICT usage. On the other hand, the hard data captures fundamental elements related to the development of infrastructure, human capital and ICT.

However, with key ICT areas such as mobile telephony and the Internet still undergoing rapid development, it is inevitable that accurate and up-to-date usage metrics will continue to be difficult to obtain. For example, data on the cost of access, penetration and usage of mobile phones, the Internet and other ICT indicators is typically available from international agencies with a lag of 18 to 36 months. Consequently, the current analysis relies on data from as far back as 2002.[7] Thus, as shown in Table 21, while 41 (62.1 percent) of the variables considered in the study are from 2005 when the research was conducted, nine variables (13.6 percent) date from 2004 and twelve variables (18.2 percent) from 2003.

Despite our best efforts to collect data from all major international sources, it was necessary for us to use statistical procedures, such as regression and clustering techniques, to compensate for missing data. Control procedures and checks have been devised to ensure that estimations were reasonable, and not biased in their representation of the countries in question.[8]

Table 21: Age of data variables used

Year	Number of variables	Percent
2001	1	1.5
2002	3	4.5
2003	12	18.2
2004	9	13.6
2005	41	62.1

Source: INSEAD.

Conclusions

Networked readiness is a complex phenomenon and the sum of diverse and interrelated forces. Measuring a country's networked readiness remains a significant challenge, and any framework or model designed to represent it is, of necessity, a simplification. Moreover, limitations in the availability of reliable and current data restrict the measurement of the phenomenon to a subset of countries.

Nevertheless, as has been seen in this chapter, the Networked Readiness Framework and Index can be useful tools for a country's policy and decision makers to understand and benchmark the use of ICT. 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 NRI is a summary measure of a nation's ability to participate in and benefit from ICT developments, and provides guidance to business leaders and public policymakers for enhancing the impact of ICT on important stakeholders: individuals, businesses and governments.

Governments and policymakers can have significant influence on the adoption and usage of ICT. For example, our research (see the *Global Information Technology Report 2004–2005*) has demonstrated that promoting competition and deregulation in the ICT sector leads to decreasing service costs, and that lowered costs result in an increase in the consumption of ICT-based services.

The NRI allows a nation to benchmark its ICT performance, and to 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, by highlighting areas of excellent or poor performance.

Typically, countries that are performing well have put ICT on the national agenda, and have striven to make it an area of excellence, whereas those nations which are underperforming have not done so. The former set of countries have succeeded in going beyond individual measures of national income, or national ICT spending, in an effort to provide an optimal environment for ICT development, thus promoting high levels of readiness and usage within all three key stakeholders. Singapore, Korea

and Estonia are some examples of such leaders, and can serve as role models for other nations in their quest for ICT excellence.

Notes

1 The first *Global Information Technology Report 2001–2002* (GITR) was edited by Kirkman et al. at the Center for International Development at Harvard University, in association with the World Economic Forum. The Reports for 2002–2003 and 2003–2004 were the result of a joint effort between INSEAD, Infodev at the World Bank, and the World Economic Forum. The 2004–2005 edition was produced jointly by INSEAD and the World Economic Forum.

2 For more information on the development of the Networked Readiness framework and other efforts in the domain, refer to Dutta and Jain, 2005.

3 The four national income brackets (high-income, upper-middle-income, lower- middle-income, and low-income) were taken from the classification of the World Bank (World Bank, 2005).

4 The first three NRI indexes were computed on a scale of 1 to 7, with the higher score indicating higher performance. In order to make these scores compatible with the current and previous year (2004–2005), the NRI scores were standardized, so that the mean score for the year was zero and the standard deviation was one. These standardized scores were then used for the analysis.

5 The division of nations into eight distinct regions was based on the classification of countries in the World Development Indicators database of the World Bank (2005). This database divides countries into eight regions: Asia and the Pacific, United States and Canada (North America), Central Europe and Asia, Western Europe, Latin America and the Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa.

6 The weighted average networked readiness score of a region is computed by taking the standardized networked readiness score of each nation in the region and multiplying it by the population figure of the nation. This cross-product is then summed over all the nations in the region. This sum of the cross-products is then divided by the sum of the populations of the countries of the region under consideration.

7 Only one variable, the number of scientific and technical journal articles, was taken from the year 2001. A number of data variables are not computed on an annual or bi-annual basis by international agencies, and the latest available data for this particular variable was for the year 2001. Because it is not subject to significant annual shifts, it was decided to retain it in the study.

8 For more information on the computation of the Networked Readiness Index, and the methodology used in data analysis, the interested reader is referred to a note entitled "Data analysis and index computation: Methodology," available from the authors upon request.

References

Dutta, S., and A. Jain. 2005. "An Analysis of the Diffusion and Usage of Information and Communication Technologies of Nations." *Global Information Technology Report 2004–2005: Efficiency in an Increasing Connected World*. Dutta, S. and A. Lopez-Claros, eds. New York: Palgrave MacMillan. 3–28.

Dutta, S., and A. Lopez-Claros, eds. 2005. *The Global Information Technology Report 2004–2005: Efficiency in an Increasingly Connected World*. New York: Palgrave Macmillan.

Dutta, S., F. Paua, and B. Lanvin, eds. 2004. *The Global Information Technology Report 2003–2004: Towards an Equitable Information Society*. New York: Oxford University Press.

Dutta, S., F. Paua, and B. Lanvin, eds. 2003. *The Global Information Technology Report 2002–2003: Readiness for the Networked World*. New York: Oxford University Press.

International Telecommunication Union (ITU). 2004. *World Telecommunication Indicators*. Available at: http://www.itu.int/home/index.html.

INSEAD. Fountainbleau, France. Available at: http://www.insead.edu/discover%5FINSEAD/publications/index.htm.

Kirkman, G., P. Cornelius, J. Sachs, and K. Schwab, eds. 2002. *The Global Information Technology Report 2001–2002: Readiness for the Networked World*. New York: Oxford University Press.

Paua, F. 2004. "Global Diffusion of ICT: A Progress Report." *The Global Information Technology Report 2003–2004*. Dutta, S., F. Paua, and B. Lanvin, eds., New York: Oxford University Press.

World Bank. 2005. World Development Indicators Database. Washington, DC: World Bank.

Technical Appendix: The operationalization of the Networked Readiness Index

The Networked Readiness Index 2005–2006 separates environmental factors from ICT readiness and usage, and is composed of three component indexes. Each component index is further divided into three sub-indexes. We then distributed the set of over 84 ICT-related variables among the nine sub-indexes, eliminating variables on the basis of the number of countries for which data was available, and using analytical procedures such as factors analysis and Cronbach's alpha. Our final index computation is based on a set of 66 variables.

The Networked Readiness Index is defined as follows:

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

Section I: The Environment Component index is defined as follows:

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

Market Environment is defined by the following variables:

1.01 Availability of scientists and engineers, 2005
1.02 Venture capital availability, 2005
1.03 Financial market sophistication, 2005
1.04 Technological readiness, 2005
1.05 State of cluster development, 2004
1.06 Quality of scientific research institutions, 2005
1.07 US utility patents, 2004
1.08 Tertiary enrollment, 2003
1.09 Burden of government regulation, 2005
1.10 Extent and effect of taxation, 2005
1.11 Time required to start a business, 2005
1.12 Number of procedures required to start a business, 2005
1.13 Intensity of local competition, 2005

Political and Regulatory Environment is defined by the following variables:

2.01 Effectiveness of law-making bodies, 2005
2.02 Laws relating to ICT, 2005
2.03 Judicial independence, 2005
2.04 Intellectual property protection, 2005
2.05 Effeciency of legal framework, 2005
2.06 Property rights, 2005
2.07 Quality of competition in the ISP sector, 2005

Infrastructure Environment is defined by the following variables:

3.01 Telephone lines, 2003
3.02 Secure Internet servers, 2004
3.03 Internet hosts, 2003
3.04 Electricity production, 2002

Section II: The Readiness Component index is defined as follows:

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

Individual Readiness is defined by the following variables:

4.01 Quality of math and science education, 2005
4.02 Quality of the educational system, 2005
4.03 Quality of public schools, 2005
4.04 Internet access in schools, 2005
4.05 Buyer sophistication, 2005
4.06 Buyer dynamism, 2004
4.07 Residential telephone connection charge, 2003
4.08 Residential monthly telephone subscription, 2003

Business Readiness is defined by the following variables:

5.01 Extent of staff training, 2005
5.02 Local availability of specialized research and training services, 2005
5.03 Quality of management schools, 2005
5.04 Company spending on research and development, 2005
5.05 Business monthly telephone subscription, 2003
5.06 Local supplier quality, 2005
5.07 University/industry research collaboration, 2005
5.08 Scientific and technical journal articles, 2001

Government Readiness is defined by the following variables:

6.01 Government prioritization of ICT, 2005
6.02 Government procurement of advanced technology products, 2005
6.03 Importance of ICT to government's vision of the future, 2005
6.04 Government R&D subsidies, 2004
6.05 E-participation index, 2004
6.06 E-government readiness index, 2004

(cont'd.)

Technical Appendix: The operationalization of the Networked Readiness Index *(cont'd.)*

Section III: The Usage Component index is defined as follows:

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

Individual Usage is defined by the following variables:

7.01 Cellular telephones, 2003
7.02 Telephone subscribers, 2003
7.03 Personal computers, 2003
7.04 Telephone lines, 2003
7.05 Television sets, 2002
7.06 DSL Internet subscribers, 2003
7.07 Cable modem Internet subscribers, 2003
7.08 Internet users, 2003
7.09 PC households online, 2005
7.10 Internet bandwidth, 2002

Business Usage is defined by the following variables:

8.01 Prevalence of foreign technology licensing, 2005
8.02 Firm-level technology absorption, 2005
8.03 Capacity for innovation, 2005
8.04 Availability of new telephone lines, 2005
8.05 Availability of cellular phones, 2005
8.06 Extent of business Internet use, 2005

Government Usage is defined by the following variables:

9.01 Government success in ICT promotion, 2005
9.02 Availability of online services, 2005
9.03 ICT productivity, 2005
9.04 ICT pervasiveness, 2005

CHAPTER 1.2

The Infrastructure Challenge in Telecommunications: A Role for Regulation*

SCOTT BEARDSLEY and **LUIS ENRIQUEZ,** McKinsey & Company Inc., Belgium

MEHMET GUVENDI, McKinsey & Company Inc., Turkey

MIGUEL LUCAS, McKinsey & Company Inc., Portugal

ANDREAS MARSCHNER, McKinsey & Company Inc., Germany

Introduction

The frequent sight of teenagers talking live on computers with webcams to friends on MSN, Yahoo, Google or many other websites—for free—is enough to convince one that voice is no longer the same as when we grew up. This phenomenon has led one major international magazine to predict the end of voice as we know it.[1]

Technologies based on Internet protocol (IP), enabled by broadband infrastructure and combined with wireless and other non-traditional telephone devices are changing the way that telecommunications services are provided. They allow new entrants to launch innovative service models, which no longer bill for voice on a metered basis—a radical departure in an industry that traditionally earned its revenues by keeping access prices low and charging voice minutes at a higher rate. The new technologies do not charge for access (indeed, they seldom offer it), and they charge much lower prices for large bundles of minutes. This can drastically reduce the margins earned on a voice minute.

Some of these new entrants have made spectacular news: consider Skype's recent multi-billion-dollar sale to eBay, and Vonage's memorable advertisements in the United States advertizing unlimited calls in the United States and Canada for a flat monthly fee of around $20—slightly higher including Europe. But these operators are still relatively small, so their economic impact has been manageable, felt mostly by fixed networks. Efforts are under way to bring similar technologies to the mobile mass market. However, as these entrants' market share grows and the overall price level for voice declines, the revenue model of the entire industry will require revision.

The challenge to the industry lies in the business model that the new entrants have developed. Although they have succeeded in bringing new technologies to some parts of the network, most of their investment has been in deploying software and new transmission technologies, a relatively cheap component of the overall infrastructure. Regulation (and in some respects its absence) has encouraged this entry, and has supported innovative business models and new investments in competitive transmission infrastructure or IP-telephony-based software and customer premise equipment.

However, across the global industry as a whole, the bulk of assets and investment lies not in transmission but in that part of the network infrastructure that provides individual access to each telecommunications consumer. It is this part of the network that will drive most of the infrastructure need in the coming years. In most of the developed world, the need will focus either on how to improve the bandwidth capacity of the access infrastructure, or on how to eventually close the digital divide between wealthier households, which can afford the new services and upgrades and poorer ones, which cannot. The situation

* The authors would like to thank Sergio Sandoval for his assistance in researching several aspects of this article.

is further complicated by the fact that it is not clear what services should be offered through this new infrastructure, or even what type of infrastructure upgrades are actually needed.

In addition, particularly in emerging markets, many countries still lack proper access infrastructure, particularly to support data applications. While the explosive growth of mobile networks in those countries has vastly increased access by the general population to telecommunications services, these networks are less well suited to providing data applications than fixed networks, and do not come close to matching the ubiquity and capability of the next generation networks, which will be deployed in the developed world. With the exception of mobile networks, regulation has been much less effective at promoting competitive entry and encouraging infrastructure investment in access networks. And for mobile networks, regulators have essentially created a small number of competitors, left them largely unregulated, and then controlled new entry through licensing. While this approach was often justified by the need to encourage investment in mobile networks, this has been quite a different model from traditional regulatory approaches in the industry.

The telecom industry faces multiple challenges in balancing the need for new infrastructure that will earn satisfactory returns against the need to encourage competition and open up the use of that infrastructure to all industry players. In addition, uncertainty over the type of upgrades needed further complicates this trade off. This is because administrative solutions through regulation are less effective than market forces for determining the speed of upgrades, the new services to be offered, or even the technologies to be used. And any major investments made by the industry year after year cannot be sustained without adequate economic returns.

So far, because the new attackers have been relatively small and industry profitability has been relatively high, the economic impact on infrastructure has been modest. Returns are attractive across the industry as a whole, but only because operators have earned relatively generous margins from selling voice services, usually by the minute or the unit. These profits have allowed the sector and its regulators to avoid restructuring the pricing model, with all the political and market risks this might involve. As substitution and new competitive models have emerged in the selling of voice traffic, however, these profits have started to fall, particularly for fixed operators who are seeing both revenue and traffic declines in most countries.

We believe that the telecom industry, policymakers, and regulators will face a complex trade-off between continuing to encourage competition in the new IP technologies and ensuring that operators have sufficient economic incentives to build the next generation of access infrastructures. The problem is particularly acute in fixed networks, but will also apply to mobile and new wireless networks, as regulatory obligations and rules are extended in that direction. The implications are profound. Unless policymakers recognize and shape the complex interactions between current policies, the desired infrastructure may be delayed or foregone altogether. Infrastructure providers must recognize the benefits of new technologies and new entrants, understand that they will transform the whole sector, and adjust their strategies and behavior accordingly.

Infrastructure is central

Despite the emergence of new entrants that focus on specific technologies or operate in specific parts of the value chain, the main driver of market performance in the telecom industry is still the control and deployment of infrastructure. This applies not only to infrastructure-owning incumbents in the fixed-line business, but also to infrastructure-owning mobile operators and even to new entrants, which run large infrastructure operations.

In fixed telephony, those who own the access infrastructure still dominate the industry in most countries. Cable companies in North America and Europe, and pockets of Asia, where infrastructure has been upgraded, have turned out to be formidable competitors, particularly in broadband. Alternative operators may have managed to carve out profitable operations of their own, but their scale, even among the largest entrants such as Cable & Wireless, Energis, FastWeb, Colt, and Mannesmann, which tend to run extensive infrastructure operations on a global scale, is smaller than the larger incumbents.

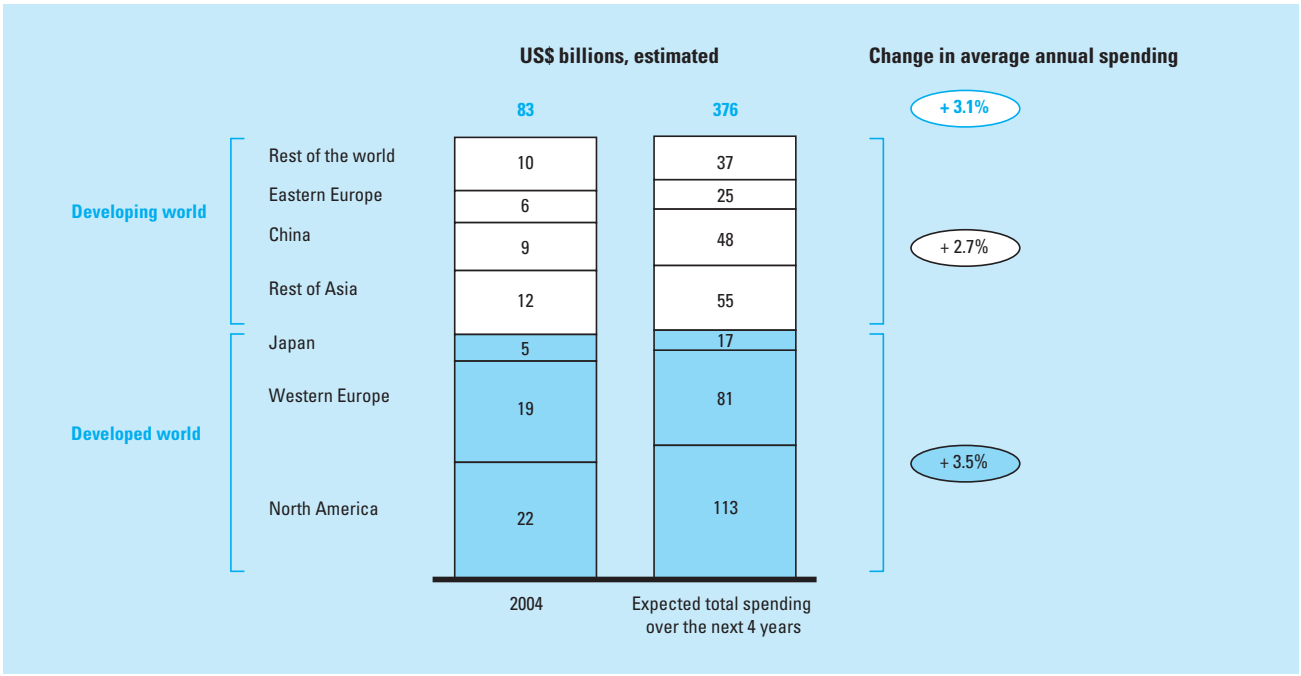
In the mobile world, things look much the same. The infrastructure-based operators command formidable market shares. The alternative operator model—the mobile virtual network operator (MVNO) that uses access infrastructure provided by others—has yet to come close. Because these infrastructure-owning players continue to dominate the telecommunications industry, it is their performance that largely determines that of the industry as a whole.

Substantial but slowing investments

Investment spending in the telecom industry is expected to level off in the next five years. We estimate that the developed world—the United States, Europe, and Japan—will have been responsible for almost half of all investment during 2004. Figure 1 shows that emerging and developed economies will be more or less equally responsible for most of the growth on global investment during the next four years.

In developed economies, which already enjoy very high telecommunications penetration levels, the vast majority of the investments will consist of upgrades to or

Figure 1: Investment by telecom operators



Sources: Gartner, Inc., 2005; McKinsey analysis.

replacements of existing infrastructure, rather than expansion of networks. In the emerging economies, on the other hand, the growth in investments will come largely from the expansion of networks to reach new customers. If global infrastructure spending follows the steep downward adjustment in the United States after 2001, as shown in Figure 2, it is likely to level off once penetration reaches saturation levels, even though absolute spending levels will remain significant. Although some of this decreased spending will be made up by increases in enterprise spending as shown in Figure 3, most of it will be in private networks, rather than public ones.

The impact on the industry and its suppliers

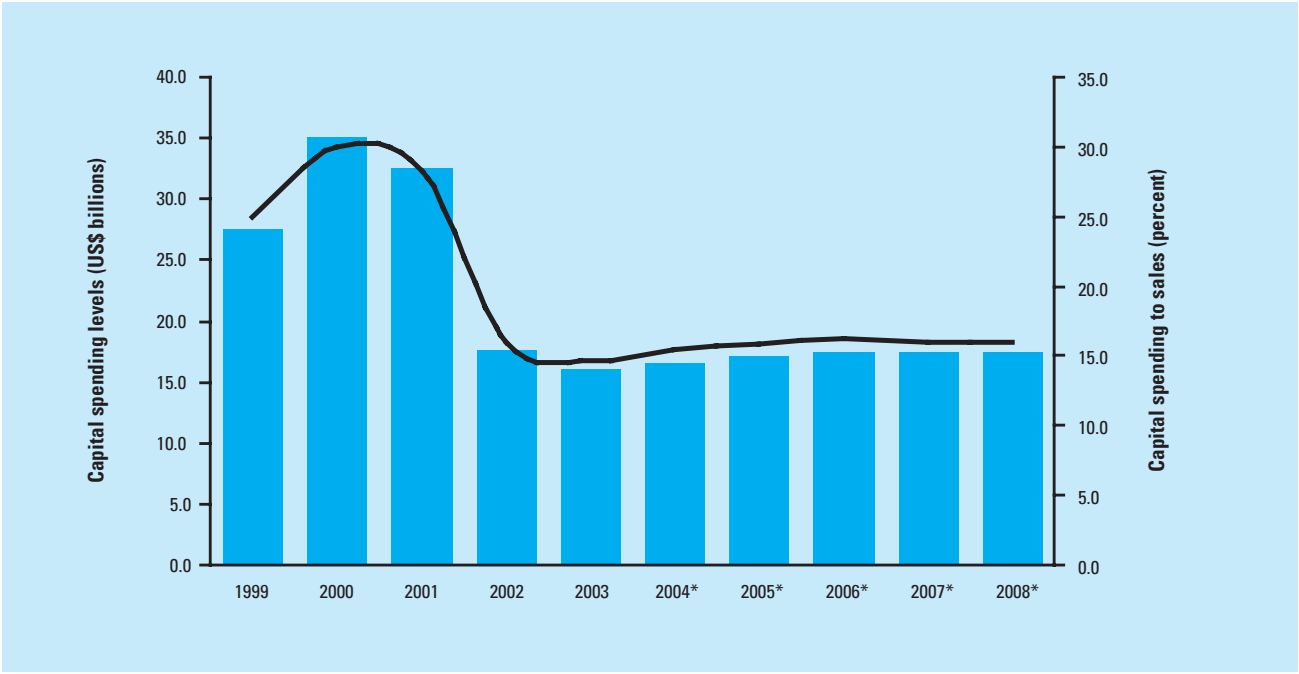
Up to now, the main objective of the telecom regulators has been to level the playing field between incumbents and new entrants, in order to foster competitive markets. It is hardly surprising, then, that the incentives for incumbents to keep investing in infrastructure have dwindled. Much of the revenues recoverable from access infrastructure are now under regulatory control, and often direct price control. Regulators frequently require the major infrastructure owners to sell their competitors access to their infrastructure at a "fair" cost. Often prices chargeable to competitors are limited by pre-defined rules which allow only a "long-term" recovery from the residual value of the capital that was once invested in infrastructure. In the absence of real short-term prospects, incumbents are now finding long-term infrastructure investments far less attractive than in the past, many preferring to concentrate on maintaining existing assets.

This lack of incentive to extend the infrastructure has implications not only for the telecom sector and its immediate equipment supply industry, but for society as a whole.

Especially in fixed telephony, but increasingly in mobile as well, the sector is becoming more dependent on revenues linked to infrastructure (e.g., access including broadband), rather than service provision. However, infrastructure-related revenues are stagnating because unit prices are fixed or declining; volumes are stagnating because of substitution and the lack of incentive to expand infrastructure. So the infrastructure-owning operators that dominate the sector find it hard to expand their overall revenues, given that service revenues offer the only potential for growth. To make matters worse, these poor growth prospects are likely to raise the cost of capital for the entire industry and curb its growth still further.

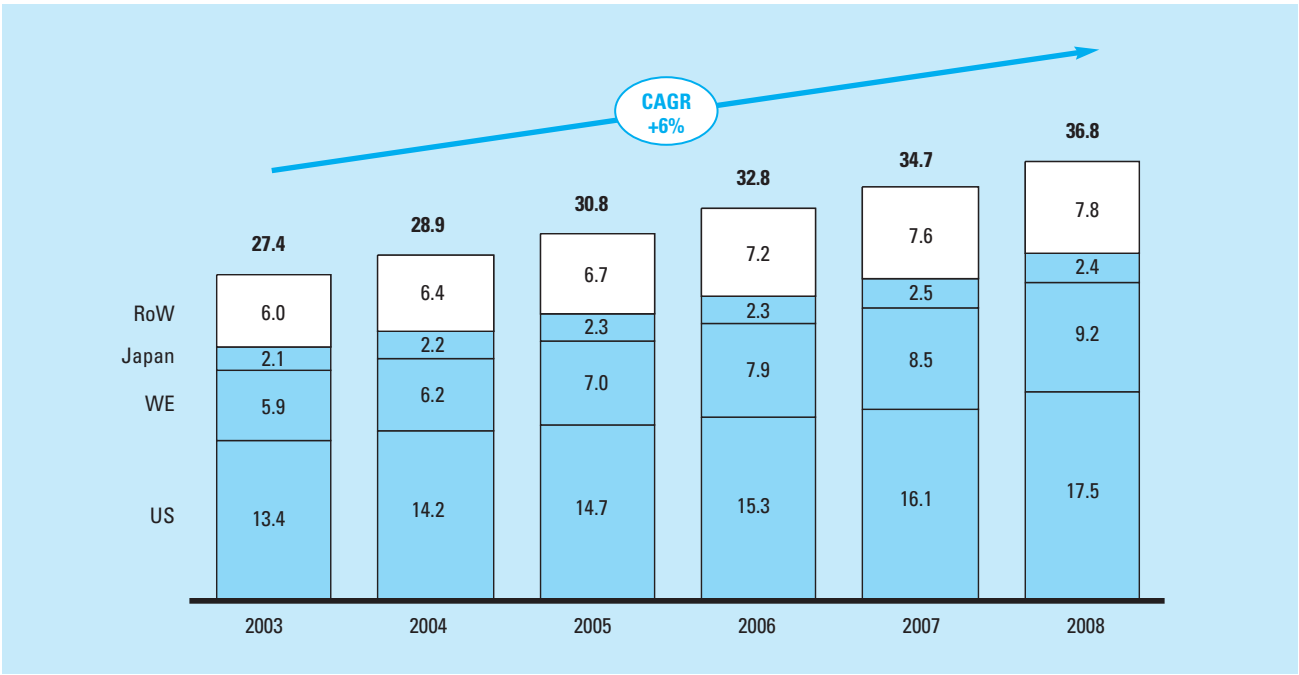
Infrastructure spending is also vital to the health of a huge sector of equipment suppliers. The telecom industry is expected to make a huge infrastructure investment of between US$300 and US$400 billion in the next three to four years. However, if infrastructure spending declines as predicted, the equipment suppliers will be forced to make deep cuts in their output. The eventual impact will extend well beyond these two sectors, because telecommunications make an important contribution to national economies

Figure 2: United States wireline capital spending



* Estimated
Source: Sanford C. Bernstein and Telcordia Technologies, 2004.

Figure 3: Enterprise spending in network equipment* (US$ billions)



* Includes WLAN, WAN, Softswitch, Router, OCC, MSPP, Metro WDM, LH DWDM, ISDN, IP telephone, IP PBX, Hubs, DSLAM, DSL modem, Cable Modem, CMTE, and CDN

Sources: IDC, 2004; McKinsey analysis.

and provide the communication infrastructure that allows all other sectors to grow.

New infrastructure challenges

Despite the arrival of new entrants and the erosion of prices, the industry remains profitable, and continues to earn more than its cost of capital. However, much of this profitability derives from a revenue model that still relies heavily on selling voice minutes, even though a large share of costs is actually fixed.

This discrepancy between the industry's revenue model and its underlying costs creates opportunities for arbitrage. Some entrants—the service-based rather than infrastructure-based competitors—are increasingly exploiting these opportunities. They are aided in large part by regulation and by technological changes that have made Internet standards and IP networks ubiquitous, with their relatively low cost for carrying voice (and data) traffic. This in turn is changing the nature of demand, as consumers and businesses look for simpler, cheaper solutions based on a single piece of easy-to-use equipment, and a simpler, cheaper pricing scheme, usually flat-rate plans or very low-cost calling. Though these changes have been under way for some time, they seem finally to be gathering steam as the forces of technology, regulation, and demand converge.

Both mobile and fixed networks are being affected, but the erosion is far more marked in fixed telephony, simply because the process of regulatory opening has been more thorough and onerous, and has had longer to run its course. How profoundly these trends will shake the industry will vary from country to country. Their net effect, if not addressed, could be to reduce both average and marginal rates of return on infrastructure, with unknown consequences for future investments.

Table 1: Return on capital employed by top telecom operators, 2004 (US$ billion)

Operator	Revenues	Weighted average cost of capital (WASS)	Return on capital employed (ROCE)
Deutsche Telekom*	71.9	7.69	9.11
Verizon*	71.3	8.50	11.76
Vodafone	62.9	8.94	–4.66
France Telecom*	58.6	7.64	8.53
NTT	45.1	6.01	15.01
SBC*	40.8	8.53	9.70
Telecom Italia	38.8	7.80	7.22
Telefonica*	37.7	7.72	10.53
BT*	34.3	8.66	17.15
AT&T*	30.5	8.69	24.61
Sprint	27.4	8.72	0.76
KDDI*	27.2	6.08	10.36
China Mobile HK*	23.2	8.46	16.70
MCI*	20.7	9.06	26.63
China Telecom*	19.5	9.32	11.11
KPN*	14.6	7.73	11.71
Telmex*	13.1	10.12	11.23
MM02	12.3	8.98	3.19
America Movil*	11.9	10.32	17.34
TeliaSonera*	11.2	7.74	9.92
Telenor*	9.0	8.17	11.34
Sofbank	7.8	6.40	0.34
Portugal Telecom*	7.5	7.81	10.10
TDC*	7.3	7.79	17.24
Tele2	5.9	7.77	5.49
Cable&Wireless	5.6	N/A	9.57
NTL	3.8	9.09	–4.43
Telewest	1.3	8.81	2.66

* Operators earning in excess of their cost of capital (ROCE – WACC > 0)

Sources: Datastream; Bloomberg; McKinsey analysis.

The calm before the storm?

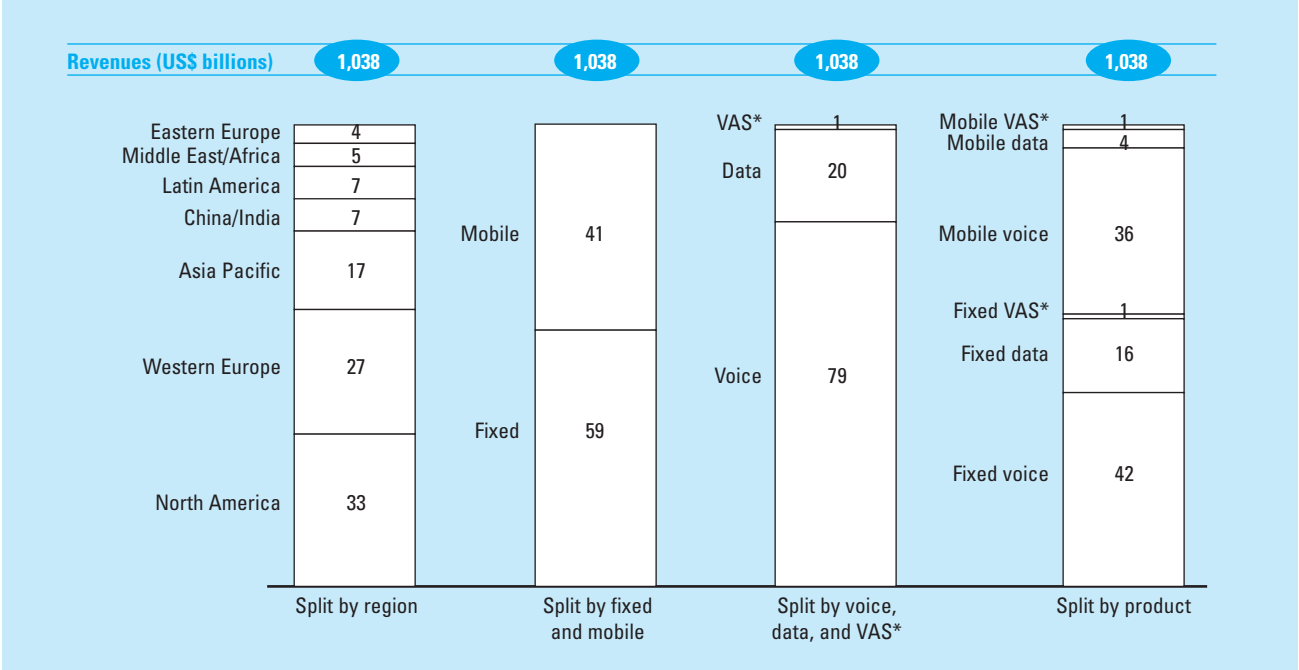
The state of the industry is relatively healthy today. After a sharp dip in profitability at the beginning of the decade, most large infrastructure operators made a rapid recovery and are thriving, as a glance at a few major players reveals (Table 1).

Most large integrated incumbents across the globe—even those, such as NTT that have lost share to alternative providers—are earning above their cost of capital. Similarly, most new entrants have rallied and consolidated, and seem to be still winning share from infrastructure-based players. Some, including Tele2, Cable & Wireless, and even Softbank, are beginning to earn positive profits as they build scale and extend their customer base.

But all is not as it seems. This profitability rests on an unstable revenue model. Paradoxically, the economics of today's infrastructure providers rely on relatively high per-minute voice revenues, even though most infrastructure costs lie in building, enhancing, and maintaining their access networks. This, despite the fact that, because of the substantial market growth of the past decade, mobile operators have spent more resources in capturing and retaining customers than in expanding their networks.

Although the industry is massive and still growing—it generated over US$1 trillion in revenues in 2003—nearly 80 percent of the industry's global revenues derive from voice-related services (see Figure 4), including both the sale of minutes and the sale of access, usually through a monthly fee. These access or recurring fees make up between 20 and 40 percent of incumbents' total fixed voice revenues. Mobile revenues are more dependent on voice minutes, but many voice-minute bundles offered by mobile operators effectively behave as recurring monthly revenues, but are not comparable to fixed monthly fees.

Figure 4: Shares of worldwide telecom revenues, 2003 (percent)



* Value-added services
Sources: Gartner Inc., 2003; Ovum Ltd., 2004d; Jupiter Research, 2003; McKinsey analysis.

This is due to the proliferation of pricing models in mobile telephony, stemming, in part, from less regulatory oversight, which has given mobile companies substantial flexibility in pricing. In fixed telephony, the proportion of revenues accounted for by monthly access fees is rising, as the price of minutes drops, and infrastructure operators bundle voice with access, charging a monthly fee for the two, much in the same way as mobile does today. As shown in Figure 4, voice continues to dominate the revenues of both segments, although its share in mobile, around 90 percent of total revenues, is higher than fixed, around 70 percent, after pressures have forced prices down in many categories.

Does this matter? Yes, absolutely. Much of the industry's costs lie in providing and maintaining access, yet its revenue streams do not recover these costs from monthly access fees. Margins on selling voice minutes have been relatively high, while margins on the access component of revenues have been much smaller, even negative.

Even though competition has made substantial inroads into the margins on voice, these returns remain attractive in many segments. They have allowed markets to continue to open up while simultaneously supporting new entrants, new technologies such as *voice over Internet protocol* (VoIP), and profitable infrastructure players. However, as the erosion in voice revenues and margins deepens, this state of affairs will come under pressure.

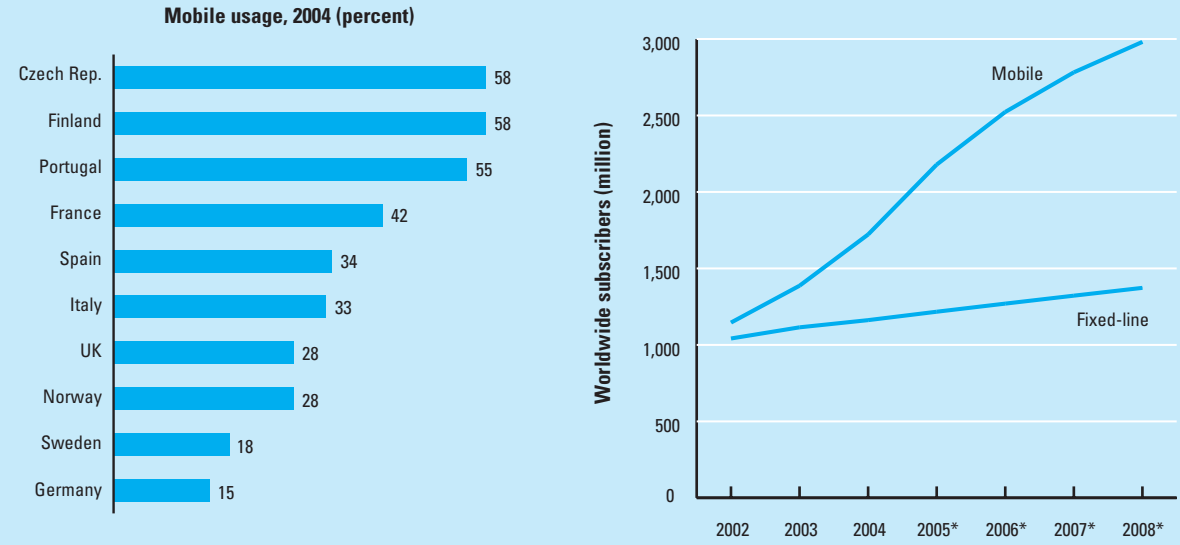
This is not to say that infrastructure players will go bankrupt in the medium term; they are too large and profitable for that. No, the real risk is that they may respond to narrowing margins by slowing or stopping investments well before their financial viability comes under threat. This risk is more acute in fixed telecommunications, where the decline in revenues and traffic seems to be speeding up, and where regulation has pushed competitive arbitrage furthest.

Up to now, regulators have not had to address the cost of infrastructure, since the revenue models of infrastructure players have remained relatively robust, even as competition has brought down prices. Moreover, the impact of erosion in the current fixed-revenue base has yet to be properly understood.

New trends accelerating erosion

Several trends threaten to undermine the industry's traditional pricing model. The pressure is strongest in the large fixed networks, which used to dominate the industry, and which are now the primary means of delivering mass access to data services via dial-up and broadband. These networks have depended on the sale of voice minutes to fund their access infrastructure. Despite the attention given to the rise of VoIP and the growth of new entrants such as Skype and Vonage, their effect on market share has been limited, although it is likely to increase steadily over the next decade. The impact of VoIP has been larger in

Figure 5: Voice traffic shifts to mobile



* Estimate
Sources: Ovum Ltd., 2005a; Ovum Ltd., 2005b; McKinsey analysis.

accelerating the change to flat-fee type business models, and in shifting huge amounts of enterprise and corporate traffic in developed countries onto private IP based networks. Yet, the greatest impact of all has come from the emergence of an alternative vehicle for voice: mobile telephony.

Figure 5 shows the importance of mobile in the evolution of the sector, using European data and projections for the number of subscriptions (SIM cards in mobile, access lines in fixed).

Mobile minutes now account for more than half of all voice traffic in some countries. Worldwide, the number of mobile access lines has exceeded fixed since 2002, and is expected to reach nearly 2.5 times the fixed level by 2008. In emerging markets, mobile access has overtaken fixed access, and in most countries mobile minutes are rapidly catching up with fixed. In many countries, mobile revenues now vastly exceed those from the fixed network, and globally mobile represents 40 to 45 percent of all telecom service revenue.

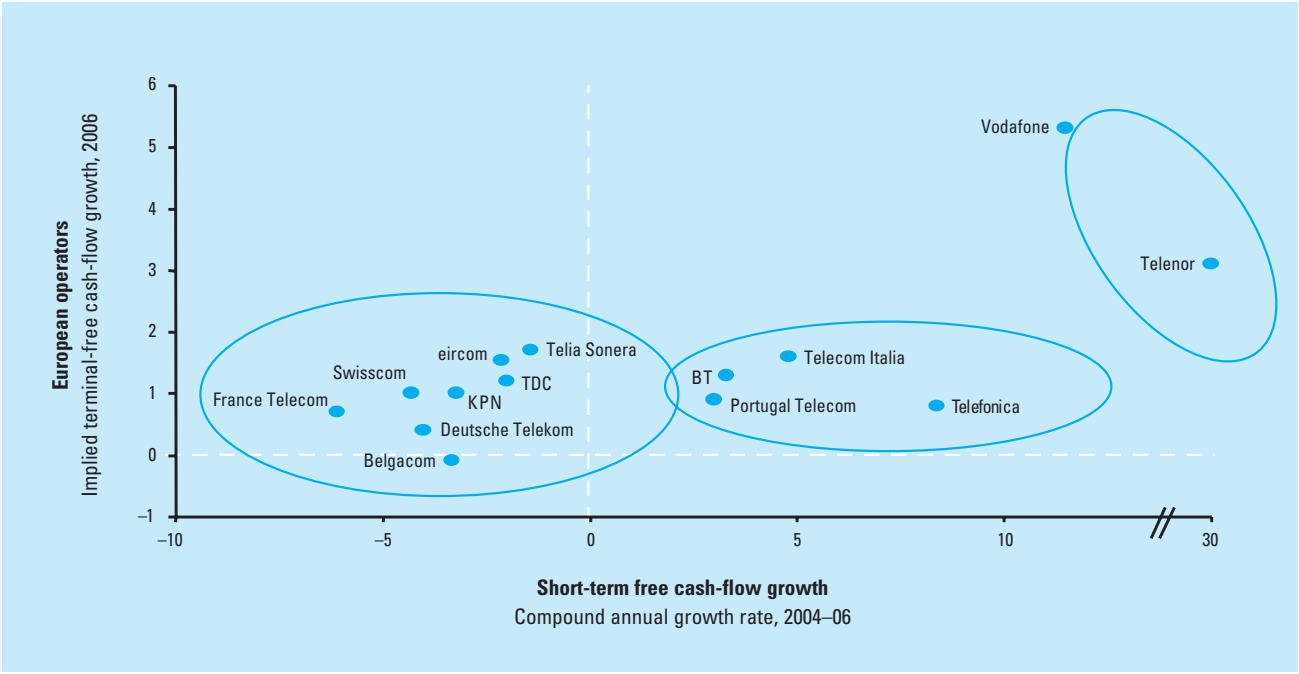
Adding to the pressure from mobile and VoIP, metropolitan fiber networks, alternative long-haul carriers, cable companies, and other alternative operators have made further inroads into traditional players' market shares in both voice and access. Beset by these trends, most incumbents can expect to suffer a decline in revenue in the short to medium term, or else a fall in real revenues in the medium term—along with a growth rate well below that of the overall economy—even when their mobile revenues are taken into account.

A glance at the cash-flow expectations implied in the stock-price valuations of large European operators, as of May 2005, suggests that fixed and integrated operators will see only low growth (Figure 6). Stock markets are expecting many incumbents to suffer declining overall cash flows in the next two or three years, and declining real cash flows in the long term. Even operators that are expected to grow cash flows rapidly in the short term, such as Telefonica and Telecom Italia, have been given this gloomy long-term prognosis, despite the fact that many operate large mobile divisions. Mobile is still expected to grow, as we can see from the implicit growth expectations for Vodafone and Telenor. It is the fixed-line business that will bear the brunt of dwindling revenues and cash flows.

A bias against new infrastructure?

Why should this stagnation matter? After all, in the developed world, almost everyone has access to telecommunications services at attractive prices, either on a mobile network or on a fixed network. But there are three fundamental challenges surrounding infrastructure. First, it is not clear how much infrastructure is actually needed, or for what advanced services. Second, there are fundamental uncertainties about what technologies should be used to deliver those services. Finally, it is not clear how policymakers should address the growing digital divides both

Figure 6: Capital-market projections for cash flow growth (percent)



Sources: Multex; Credit Suisse First Boston; Bloomberg; McKinsey analysis.

among and within countries—e.g., between households that can afford advanced services, and those that cannot. In other industries, market forces would have eventually determined some sort of path for investment, new advanced services, and the appropriate market structure, as is happening in enterprise networks. But in telecommunications, regulation plays a central role in what gets built and when. But whether regulation has the same impact on infrastructure incentives that markets would have is not known, so we do not know if the right investments will be made.

The decline in fixed networks is not, in itself, a bad thing. It partly reflects the phenomenal growth in mobile telephony (and other wireless technologies), which has captured some of the existing and most of the additional minutes that would otherwise have been claimed by fixed networks, due to rising incomes and penetration. In addition, some of the revenue decline is contributing to the development of a dynamic competitive sector, offering better services at lower prices. This is creating new economic value and benefiting consumers. Indeed, it could be argued that a modern economy needs less fixed infrastructure, and it may be that operators are correct to cut back these infrastructure investments.

This could be exactly what will happen. Problems will arise if these trends reduce operators' incentives to invest in needed upgrades to the access network. For these companies, the returns from large chunks of additional investments—as opposed to incremental investments—are highly uncertain. New investment in upgrading fixed-access infrastructure has a long payback period. Moreover, it is difficult to predict what new services these upgrades may enable, and what incremental revenues may flow from them. It seems likely, too, that the prospect of regulation could have an additional impact on these returns. Uncertainty on such a scale can have immediate consequences: projections that operators' revenue base will drop may reduce expected returns on investment, affecting investment in the here and now.

This would not be a problem, per se, if alternative infrastructures using new, primarily wireless technologies are certain to be deployed, such as 3G, WCDMA, HXXXX, WIMAX, and Flarion. Yet these infrastructures, too, require very large scale capital investments and long-term paybacks, if deployed on a broad scale, and regulatory conditions, in addition to rapidly decreasing technology lifecycles are key sources of uncertainty; witness the huge licensing costs and capital investments and slow take-off of 3G in Europe. A further time bomb is uncertainty over conditions that will be applied when existing mobile licenses come up for renewal over the next 10 to 15 years.

On the regulatory side, if public policies deem that upgrades are needed—perhaps to build a high-bandwidth network, increase networked readiness, or to extend broadband availability to all consumers—then regulation

Figure 7: Levers for influencing infrastructure investments

Lever	Impact on infrastructure	Impact on return: Lower return	Impact on return: Higher return
Financial incentives	Encourage investors to deploy infrastructure through subsidies and tax incentives	No subsidies/taxes	Subsidies/no taxes
Direct obligations	Impose obligations on operators (as to coverage, quality of service, social obligations, etc.) that directly affect their financial capacity to invest on infrastructure	Broad obligations	No obligations
Infrastructure access	Defines the access to networks (which often acts as a substitute for building one's own infrastructure)	Open access	Closed access
Licensing	Determines industry structure by limiting or promoting competition, making the industry more or less attractive to investors	Multiple platform licenses*	Monopoly/duopoly
Exclusivity periods	Protect infrastructure investments by establishing an exclusivity period for exploiting the resulting assets	No exclusivity	Long exclusivity
Customer (equal) access	Allows infrastructure-light competitors to reach infrastructure providers' customers and capture part of the revenue stream	Easy access	Difficult access

* Though the evidence on the impact of awarding unlimited licenses for multiple platforms is inconclusive. Limited licensing with coordinated (directive) approach sponsored by government or an industry has frequently accelerated technological change, as with 2G mobile, cable Docsys standards, and mobile data standards in Japan and Korea.

Source: McKinsey analysis.

should be adjusted to support this goal. In practice, such alignment of public policies has yet to materialize.

Regulation plays a central role in the profitability and evolution of access. Because of the expense of reproducing an extensive access infrastructure—and the resulting market-share strength of the companies that own it—the retail prices of access services tend to be controlled through regulatory approvals. In addition, infrastructure providers are increasingly required to open up their access infrastructure (fixed or mobile) to competitors with no infrastructure. The result has been a complex layer of regulation and approvals for infrastructure-related investments and competitive behavior.

Regulators must tread a fine line between the need to ensure parity between competitors using infrastructure on the one hand, and the need to establish market-style incentives to invest in new infrastructure on the other. Since they are more familiar with the former requirement than the latter, there is a risk that regulation may inadvertently discourage investment in access infrastructure. Add to this a degree of political pressure to avoid restructuring access prices for fear of public opposition, and the bias to continue finding ways to push prices down is substantial.

Growing regulatory complexity

Over the long history of the regulation of access infrastructure, regulators and policymakers have developed a number of tools to influence the returns from infrastructure. However, each country follows its own individual approach, and the levers used by different regulators often appear to be pointing in opposite directions. In fact, because the competitive model is based on infrastructure, policymakers do not have a clear approach that will deliver adequate incentives for infrastructure investment—i.e. that will establish market-style incentives.

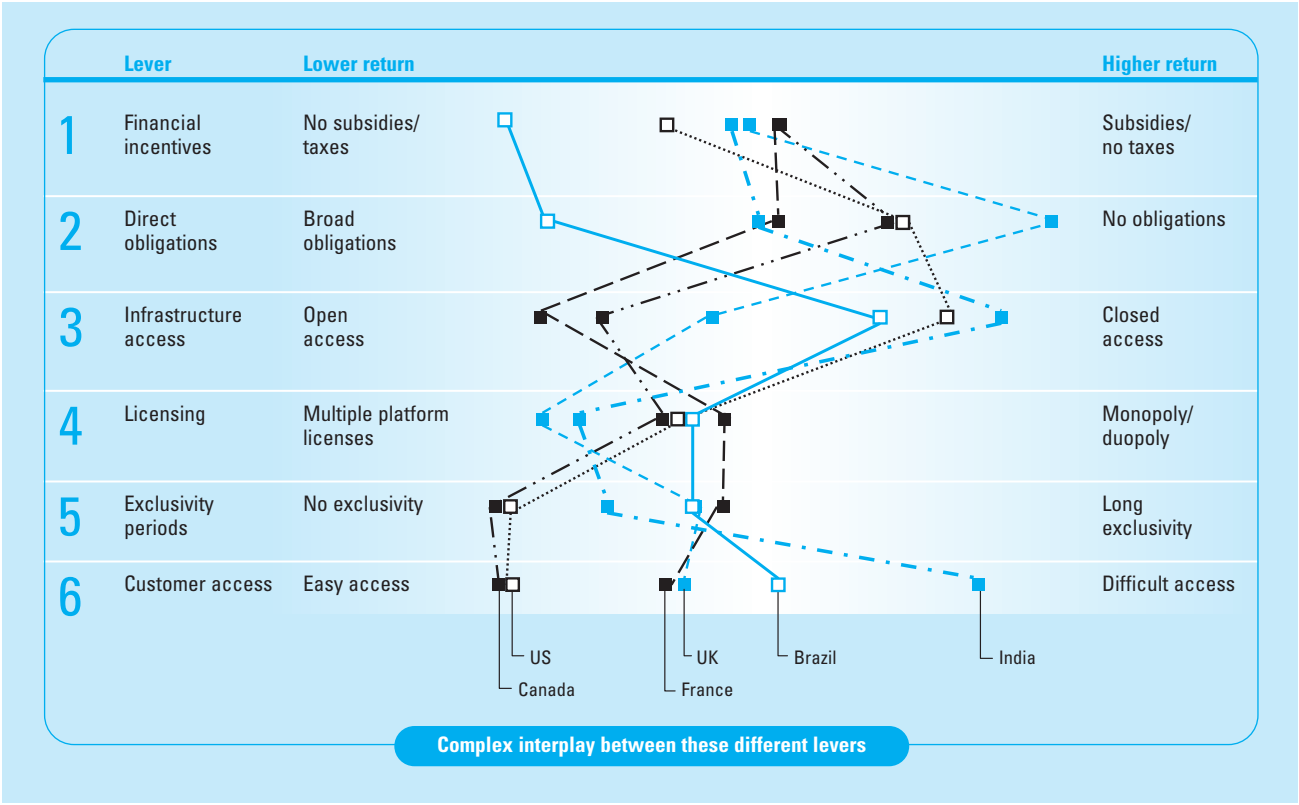
Multiple levers

Public policy has a number of tools at its disposal to influence the economics of infrastructure investments. Figure 7 provides a simplified list of actions that a policymaker or regulator can take to encourage or discourage infrastructure investments. These tools act mostly on the supply side; that is, they affect a company's willingness to invest for a given level of demand. Other tools exist to stimulate the demand side, and can play an important role, as they did in Korea's success in adopting broadband.

The levers in Figure 7 can be categorized according to whether they act to raise or lower the returns on new infrastructure investments, all else being equal:

- Financial incentives
- Direct obligations to build infrastructure
- Infrastructure access
- Licensing
- Exclusivity periods
- Customer (equal) access

Figure 8: Combinations of levers in different countries (simplified)



Source: McKinsey expert interviews.

Multiple approaches

No two countries have adopted the same combination of levers. Figure 8 provides a simplified overview of those chosen by six different countries. Rather than a detailed analysis, it offers a rough illustration, since there are various dimensions within each lever that must be evaluated, before we can fully understand the degree of support it provides for infrastructure returns.

The figure yields several insights. First, there are broad differences in regulatory choices from country to country. How a country's chosen levers interact with its overall market structure will determine its ultimate stance on infrastructure. Second, when we look at some levers—infrastructure access, customer access conditions, and direct obligations—countries appear to be following widely divergent paths. This is especially marked with infrastructure access, which would include the unbundling of network elements. However, the other levers show a degree of convergence. For example, there appears to be a strong neutral stance on using direct payments to drive infrastructure: most countries cluster around the middle of the chart. A similar pattern emerges in licensing and exclusivity periods, which range from neutral to slightly negative.

Adjusting to changing market conditions

It is clear that the telecom industry and policymakers face a major challenge. On the one hand, the introduction of infrastructure-light competition has brought genuine benefits: lower prices, wider choice, better services, and vastly improved performance by infrastructure providers and new entrants. On the other hand, this change was achieved through the creation of a complex regulatory apparatus, focused chiefly on introducing competition that exploits existing infrastructure to drive prices down. Although that was and is a valid objective for regulation to pursue, the system has not been designed to address new infrastructure investments.

So regulators and policymakers must now manage a complex tradeoff. How can they allow these competitive trends to continue while ensuring that providers have sufficient incentives to invest in upgrading their basic infrastructure? Neither the industry nor policymakers have developed clear approaches to this challenge.

The challenge for policymakers and regulators

Policymakers and regulators must take steps to incorporate infrastructure explicitly into the policy debate. In particular, they must understand the combined economic impact

of the policies they undertake, to continue to experiment, and to avoid excessively prescriptive or administrative solutions. Let us look at each of these three imperatives in turn:

1. Understand the combined economic impact of their policies.
Cable, wireless, and fixed operators are often regulated separately—even by regulators in many countries—yet convergence and competition across technologies is a reality. Voice, video, and data travel over multiple networks today. Under the existing regulatory model, each regulatory or policy lever that affects infrastructure is treated separately. These levers are evaluated independently, often by different bodies with different jurisdictions: for example, licensing typically lies with cabinet-level agencies or ministries, whereas customer-access conditions are the preserve of independent regulatory bodies. After this evaluation, the usual compromises of the policymaking process are made, and then decisions on specific levers follow. Nothing in this process is geared to encouraging specific infrastructure goals.

Policymakers must first understand the cumulative economic impact of the multiple initiatives they are pursuing. They must appreciate how any given lever fits into the context of other decisions that have been taken, and how it interacts with the country's market structure. It is not unusual, for instance, for a market to have two or three large infrastructure players competing for access, while at the same time the largest operator is forced to open up its infrastructure extensively. Though this may create short-term gains through lower prices, its impact on the degree of infrastructure competition is uncertain at best, and could well prove detrimental.

To achieve this broader understanding, policymakers would have to move away from the multiple discrete quasi-legal processes we see today, and adopt, instead, a more holistic long-term view of the sector's overall direction. A pragmatic way to bring this about might be to change the mandates of the various agencies that regulate telecommunications, and create the bodies and regulations necessary for the regulation of converged technology infrastructures. The infrastructures of fixed, mobile, and cable companies are direct competitors and substitutes for each other in many service areas, and regulation should now evolve beyond the legacy of so-called "natural" monopoly-premised regulations, which are no longer relevant.

2. Continue to experiment and evaluate options versus objectives.
The tool kit developed to open up the monopolies of the 20th century was highly successful at achieving lower prices, arbitrage opportunities, increased choice, and better and more diverse services. But it is now showing signs of age. The conditions (and regulations) which prevailed in the United States and the United Kingdom in 1984, and in Japan and New Zealand soon after, were quite different from those which prevailed in 1998, when most countries in the European Union opened up their markets, even though the outlines of the model were similar.

The sort of infrastructure-light arbitrage plays that were to emerge in Germany and elsewhere at the end of the last century were not encouraged by the entry rules adopted by the UK and the U.S.; as a result, prices in these two countries did not fall as dramatically as they did in Germany during 1998 and 1999. Even so, the UK now has several large infrastructure players competing against British Telecom, and a number of national infrastructure networks were built in the United States in the 1980s. But these outcomes were an unintended consequence of regulation, since it primarily focused on how to gradually rebalance the pricing structure of telecoms, without bankrupting the infrastructure operators.

A similar dynamic may develop for infrastructure. However, there are several impediments, which will make it difficult to recapture the success of the past two decades:

- There are no obvious milestones to focus attention on potential distortions. (For voice liberalization, the market openings in the U.S. in 1984 and the EU in 1998 served that purpose.)

- Objectives are much less clear than they were when telecom markets were first opened up. The nature of the infrastructure need is uncertain: is it to extend broadband? Provide next-generation networks? Upgrade fiber? Deploy a wireless-data infrastructure?

- It is difficult to determine which levers should be pulled to achieve infrastructure objectives, though it seems evident that a combination of levers will be needed. For example, a given solution may call for exclusive access over long payback periods, some pricing flexibility, and some universal-service funding, along with other measures.

All this suggests that regulators and policymakers must be clear on what objectives they are trying to achieve. They should continue to test and experiment various options for achieving those objectives. Policymakers will also have to consider whether to continue to pursue distinct national policies, or policies across regions. To be sure, from the point of view of investment, success stories do exist: Korea, for instance, deployed multiple regulatory and policy levers in support of broadband, with subsidies, demand stimulation, and a government-backed national sales push. Wireless data in Japan (and Korea) followed a similar pattern.

3. Avoid overly prescriptive and administrative solutions.
Simple market-based solutions are the way forward. Infrastructure gets built not because of administrative fiat, but because it promises to earn an adequate return that reflects the risks assumed. To approach this issue in the standard regulatory fashion can only delay investment. Investment approval is normally treated as an administrative process: a company proposes an investment, and the regulator negotiates how much of it is reasonable, sets a controlled rate of return on part of it, and negotiates over a reasonable economic life. In a situation where investments were incremental and fairly profitable, this process was effective in controlling the costs of regulated services. In a situation where technological change is increasingly uncertain, the same approach risks delaying or even blocking investment. **Less, not more, regulation is likely to be required to allow market forces to flourish.**

The challenge for infrastructure operators

Operators must also respond to changing conditions by recognizing that the market structure has changed, adapting to the new models, and taking an active part in shaping new markets.

1. Evolve corporate strategy to reflect uncertainties.
Two long-term technological trends have been driving major changes in the market structure: the rise of wireless and the growth of Internet Protocols (including even higher bandwidth IP services). These are likely to continue to reshape the industry over the next 10 to 15 years, leaving operators to face several challenging questions: the evolution and speed of more intense competition will vary from country to country; however, the developing social and political consensus seems to support more competition rather than less. Operators will be forced to recognize the changed market structure, and evolve the portfolio of initiatives that, collectively, comprise their corporate strategy for balancing risk across a number of technology and regulatory scenarios over time.

2. Understand and adapt to changing economic and revenue models.
These trends will progressively transform the economics of existing infrastructure operators, certainly in fixed-line, but perhaps in mobile, as well. The precise effects are uncertain, but some broad implications are already discernible. Operators will have to:

- Adopt new revenue models that emphasize flat rates or large minute bundles, and possibly bundle voice with other services such as data. How far prices fall is likely to vary by country, and will depend not only on the intensity of competition, but also on what kind of entrants and other players operate there.
- Manage a larger data revenue stream. Even in countries where broadband has grown rapidly, it accounts for only a small share of total revenues so far—around 5 to 8 percent. However, as enterprises and consumers increasingly invest in private-premise networks, infrastructure providers will have to develop their revenue model beyond basic infrastructure, toward managed services, based on IP data from enterprises to consumers. This will be a step requiring new sales models, value propositions, and marketing strategies.
- Manage the regulatory process, so that infrastructure occupies a central place in the debate about the future of the industry, and so that it does not suffer a "death of a thousand cuts" from multiple regulatory agendas and measures running in parallel.
- Pursue not just efficiency but operational effectiveness. It is clear that the operating cost base will have to reflect the likelihood of lower revenue per subscriber. Less obvious, technological trends will necessitate a shift from a relatively stable product that sells easily (voice-plus-access) to one that faces more competition, centers on a data consumer product, and comes in multiple variants.

3. Actively shape the evolution of markets.
Infrastructure providers, both fixed and mobile, account for the bulk of the investments, revenues, and value of the telecom industry. This gives them the power to shape its evolution in a way that addresses infrastructure needs. They must take an active role in regulatory management, in order to shape industry evolution across borders, as well as responding more decisively to the revenue challenges posed by technological trends. In so doing, they must be able to articulate in more than just economic terms how their approach will influence industry objectives and various stakeholder agendas.

Conclusion

Major trends such as the rise of wireless, mobile, and IP and convergence across technologies will transform the revenue model in telecoms and economics of existing infrastructure operators, not only in fixed telephony, but also in mobile and cable. These changes are taking place at different speeds in different countries, but the impact on expected returns, and hence on investment, may come soon, while they are still under way.

The changes are forcing the telecommunications industry to face a complex tradeoff between continuing to drive more competition and ensuring appropriate levels of infrastructure investment. If industry stakeholders are serious about supporting infrastructure, they will have to

rethink current policy approaches. Policymakers and regulators must recognize the necessity of piloting different approaches, so as to manage the tradeoff between competition and infrastructure, and may have to adjust the missions pursued by many of the relevant agencies. Infrastructure providers must understand the impact of these trends, evaluate changes to their business and revenue models, and actively shape both the regulatory debate and the evolution of the market.

Note

1 *The Economist*, 2005.

References

Bear, Stearns International Limited. 2003. *Wireless Network Economics*. London: Bear, Stearns International Limited. 2 June.

Beardsley, S., I. Beyer von Morgenstern, L. Enriquez and C. Kipping. 2002. "Telecommunications Sector Reform—A Prerequisite for Networked Readiness." G. Kirkman, P. Cornelius, J. Sachs, and K. Schwab, eds., *Global Information Technology Report 2001–2002: Readiness for the Networked World*. New York: Oxford University Press. Available at: http://www.cid.harvard.edu/ cr/pdf/gitrr2002_ch11.pdf

Beardsley, S., I. Beyer von Morgenstern, L. Enriquez, and W. Verbeke. 2004. "Towards a New Regulatory Compact." In S. Dutta, B. Lanvin, and F. Paua, eds., *Global Information Technology Report 2003–2004, Towards an Equitable Information Society*. New York: Oxford University Press.

Bernstein, S. C. and Telcordia Technologies. 2004. "Fiber-to-the-Premises: Revolutionizing the Bell's Telecom Networks." Bernstein Research-Technologies Report. May. Available at: http://www.telcordia.com/products/fttp/bernstein_report.html

Carter, S. 2003. "The Communications Act: Myths and Realities." Speech of 9 October by Stephen Carter, Chief Executive, Office of Communications. Available at: http://www.ofcom.org.uk/media_office/speeches_presentations/carter_20031009

Commission of the European Communities. 2003. *European Electronic Communications Regulation and Markets 2003: Report on the Implementation of the EU Electronic Communications Regulatory Package*. COM (2003) 715 final. Brussels. Available at: http://europa.eu.int/eur-lex/en/com/cnc/2003/com2003_0715en01.pdf

The Economist. 2005. "Telecoms and the Internet, How the Internet Killed the Telephone Business." September 15.

Federal Communications Commission (FCC). 2003. *Report and Order and Order on Remand and Further Notice of Proposed Rulemaking* (FC 03–366). Washington, DC: FCC. Adopted 20 February; released 21 August. Available at: http://www.fcc.gov/Daily_Releases/Daily_Business/2003/db0821/FCC-03-36A1.pdf

Gartner Inc. 2003. Forecast: Fixed Public Network Services. Available at: http://www.gartner.com/

———. 2005. *Forecast: Global Telecommunications Market Take, 1Q05*. March. Available at: http://www.gartner.com/

IDC. 2004. Worldwide Telecommunications Black Book.

International Telecommunication Union (ITU). 2003a. *World Telecommunication Indicators Database*. 7th ed. Geneva: ITU.

———.2003b. Trends in Telecommunication Reform: Promoting Universal Access to ICTs—Practical Tools for Regulators. 5th ed. Geneva: ITU.

Jupiter Research. 2003. European Internet Paid Content Forecast. January.

OECD (Organisation for Economic Co-operation and Development). 2003. *OECD Communications Outlook 2003*. Paris: OECD. Available at: http://www1.oecd.org/ publications/e-book/9303021E.PDF

Ofcom. 2004. *Strategic Review of Telecommunications Phase 1 Consultation*. London: Ofcom. 28 April. Available at: http://www.ofcom.org.uk/consultations/past/telecoms_review1/telecoms_review/?a=87101

Ovum Ltd. 2004a. *Broadband@Ovum advisory service forecasts*. London: Ovum Ltd. May.

———. 2004b. *Mobile@Ovum advisory service forecasts*. London: Ovum Ltd. July.

———. 2004c. *Consumer VoIP: the market opportunity*. London: Ovum Ltd. 11 August.

———. 2004d. Mobile regional forecasts 2003–2008. January.

———. 2005a. Fixed Voice Services, Connection, October.

———. 2005b. Mobile regional forecasts 2004–2009. October.

Sanford C. Bernstein and Telcordia Technologies. 2004. "Fiber-to-the-Premises: Revolutionizing the Bell's Telecom Networks." May.

Standard & Poor's. 2004. *Compustat (North America) Database*. New York: Standard & Poor's.